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Comparison of the learning outcomes between flipped classroom and interactive lectures among medical undergraduates

Simi Kurian[1], Manu Mathews[2], Binoo Divakaran[3]

[1]Associate Professor, Department of Obstetrics and Gynecology, [2]Associate Professor, Department of Medicine, [3]Assistant Professor (Statistics), Department of Community Medicine, Government Medical College, Kannur, Kerala, India

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ABSTRACT

Background: Flipped classroom is a novel teaching-learning method which is more learner-centered. Here there is active involvement by students and more teacher-student interaction. **Aims and Objectives:** The study intends to compare the learning outcome of the flipped classroom method and interactive lectures among medical undergraduates and to determine the students' perception of flipped classroom method. **Materials and Methods:** This was a non-randomized interventional study conducted in the Department of Obstetrics and Gynecology. Thirty-one students were exposed to flipped classrooms and 31 students to interactive lectures. Both the groups were assessed by a multiple choice question-based pre-test and post-test using the same questionnaire. At the end of 1 month after the intervention, another test was conducted to assess their retention of knowledge. The students' perception of the flipped classroom was collected by a preformed validated questionnaire. **Results:** The average post-test score was higher for flipped classroom group compared to interactive lecture group and was statistically significant. The post-test score after 1 month was also significantly higher in flipped classroom group compared to the interactive lecture group. Majority of the students had strongly positive perception regarding flipped classroom and felt satisfied and motivated with flipped classroom. **Conclusion:** Based on our study, flipped classroom method is having better learning outcome than interactive lectures in terms of post-test scores as well as knowledge retention test scores after 1 month. Although flipped classroom was a new experience for the students, majority of the students were satisfied and felt more motivated.

Key words: Flipped classroom; Interactive lectures; Obstetrics and gynecology; Outcome

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INTRODUCTION

After the Vision 2015 of Medical Council of India, medical education has shifted from a traditional objective-based curriculum to competency-based curriculum.[1] The essential skills required for competency-based medical education (CBME) are self-directed and lifelong learning.[2] Flipped classroom is one such innovative teaching-learning method which can develop the habit of self-directed learning among medical students.

A flipped classroom is a pedagogical model in which students are provided with study resource material like teacher-prepared notes, paper hand-outs, power points, and videos as pre-class assignment. This develops a basic understanding of the topic before class. The class time is utilized for learner-centered activities such as case discussions, clearing doubts, problem-solving, and group discussions.[3] There will be active involvement by the students. There will be more student-teacher interaction. The teachers' role is to monitor, guide, and support the learning process of their students.[4]

Address for Correspondence:
Dr. Simi Kurian, Associate Professor, Department of Obstetrics and Gynecology, Government Medical College, Kannur, Kerala, India.
Mobile: 91-8156991384. **E-mail:** drsimikurian@gmail.com

Flipped classroom is becoming a popular teaching-learning method in medical education. Flipped classroom can develop lifelong learning skills such as independent identification, appraisal, analysis, and synthesis of knowledge desirable of modern physicians. Flipped class provides equal opportunity for slow pace learners and fast-paced learners. Furthermore, learning is self-paced rather than teacher-paced. Recently, flipped model education has reached a high level due to ease with technological development.

In a busy clinical department like Obstetrics and Gynecology, especially when there is a staff shortage, by implementing flipped classroom model, the time in the wards can be more effectively utilized for clinical case discussions and activities.

Aims and objectives

- To compare the learning outcomes between students with flipped classroom and interactive lectures.
- To evaluate the student perception of flipped classroom as a teaching-learning method.

MATERIALS AND METHODS

Study setting

Department of Obstetrics and Gynecology, Government Medical College, Kannur.

Study design

Design was non-randomized interventional study. Study was conducted among final-year medical students posted in the Department of Obstetrics and Gynecology. The objectives were to compare the learning outcomes between students with flipped classroom and interactive lectures and to evaluate the student perception of flipped classroom as a teaching-learning method.

Intervention

Sixty-two students were enrolled in the study after getting informed consent. The 62 students were divided into two groups – Group A and Group B, of 31 students each, based on their registered roll numbers assigned in alphabetical order. Group A of 31 students was exposed to flipped classrooms on topics 1, 2, and 3. The same topics were taught to Group B with interactive lecture with the same teacher. After 3 topics, there was a crossover so that topics 4, 5, and 6 were taken by interactive lecture method for Group A and flipped classroom method for Group B, as shown in Figure 1.

The students of flipped classroom were provided with study resource materials like power points with voice over, teacher prepared notes, and videos one day before the class. The in-class time was utilized for case discussions, doubt clearing and problem based learning. The students of the other group were exposed to interactive lectures using PowerPoint presentations. Both the groups were assessed by a pre-test before the class. At the end of each topic, both the groups were assessed by a post-test. At the end of 1 month after the intervention, another test was conducted to assess their retention of knowledge which consisted of questions equally from the topics taken by both methods.

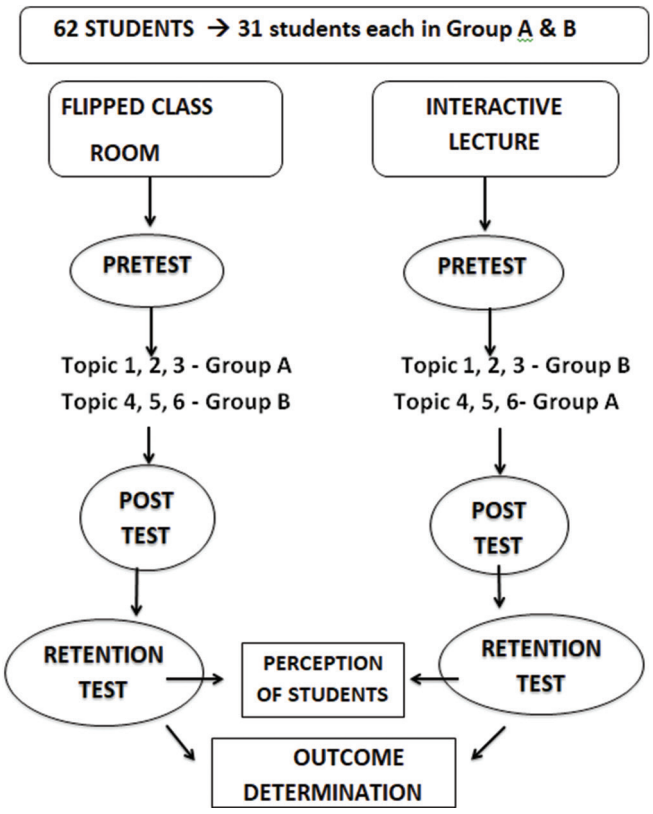

Figure 1: Methodology flowchart

The students' perception on flipped classrooms was collected by a preformed validated questionnaire based on five-point Likert scale ranging from "strongly disagree" to "strongly agree." The total perception scores could range from 10 to 50. This range can be divided into five groups as follows: 10–18 representing strongly negative perception, 19–26 representing negative perception, 27–34 representing neutral perception, 35–42 representing positive perception, and 43–50 representing strongly positive perception.

A higher score in perception denotes a more positive perception. For the purpose of getting total perception scores, question numbers 8, 9, and 10 which were negatively phrased were reverse scored, and the sum of the scores of all the questions calculated.

Tools

1. A validated multiple choice question-based test was used to assess the knowledge before the class as pre-

test and a post-test after the class to assess the learning outcome after each topic
2. Problem-based questions used for the assessment at the end of 1 month of the intervention
3. A pre-validated questionnaire using Likert scale was used to assess student's perception on flipped classroom.

Ethical considerations

The study protocol was approved by the Institution Ethics Committee, Government Medical College, Kannur (IEC No: 55/2023/GMCK). Written informed consent was taken from all the students before the study. Confidentiality of the data and anonymity of the study participants were well maintained.

Statistical analysis

MS Excel spreadsheet was used to create the database. The scores obtained in the multiple choice question-based pre-test and post-test for both groups were summarized using mean, median, and standard deviation. Independent t-test was used to compare the scores between the two groups. A $P<0.05$ was considered as statistically significant.

The student perception questionnaire was used to evaluate the flipped classroom method using Likert scale. Frequency and percentage were reported for students' response on flipped classroom.

RESULTS

On comparing the pre-test scores of flipped classroom and interactive lecture group, as shown in Table 1, there was no statistically significant difference between the groups on all the topics, except the 6th topic where the flipped classroom group had a significantly higher pre-test score compared to the interactive lecture group (using Mann–Whitney U test).

Comparison between post-test scores in each group

A significant difference in post-test scores between the two teaching methods was seen in the topics 2, 4, 5, and 6 as shown in Table 2. Flipped classroom group had significantly higher post-test scores in topics 2, 5, and 6 as well as post-test average scores, but interactive lecture group had significantly higher post-test score in topic 4 (using Mann–Whitney U test).

Comparison between pre-test and post-test scores in each group

There was a significant difference between the pre-test and post-test scores for all the six topics in both the teaching methods (using Wilcoxon signed rank test, $P<0.001$), with the post-test scores being higher than the pre-test scores.

The average post-test score was also significantly higher than the average pre-test score in both teaching methods (using paired t-test, $P<0.001$).

Comparison between the post-test scores after 1 month between the two groups

It was seen that the post-test score after 1 month was significantly higher in flipped classroom group compared to the interactive lecture group by Mann–Whitney U test ($P<0.001$).

Repeated measures analysis of scores in each group:

A non-parametric Friedman test was conducted within each teaching method group, to compare the scores obtained at three-time points, namely, average pre-test score, average post-test score, and post-test score at month. The results showed a significant difference in both groups ($P<0.001$) as shown in Figure 2.

Students' perception of flipped classroom

The total perception scores in our study ranged from 39 to 49. The mean perception score was 43.7 (Standard

Table 1: The pre-test scores of each topic compared between the two groups

Topics	Teaching method	Mean	Standard deviation	Median	Inter-quartile range	P-value
Topic 1 fibroid	Flipped classroom group	5.3	1.4	5.0	3.0	0.066‡
	Interactive lecture group	4.6	2.1	4.0	4.0	
Topic 2 abnormal uterine bleeding	Flipped classroom group	5.3	1.9	5.0	3.0	0.725‡
	Interactive lecture group	5.2	1.1	5.0	2.0	
Topic 3 postmenopausal bleeding	Flipped classroom group	4.8	1.6	5.0	2.0	0.483†
	Interactive lecture group	5.1	2.0	6.0	2.0	
Topic 4 endometriosis	Flipped classroom group	4.7	1.0	5.0	1.0	0.338‡
	Interactive lecture group	5.3	2.1	5.0	4.0	
Topic 5 genital prolapse	Flipped classroom group	5.1	1.9	5.0	3.0	0.531†
	Interactive lecture group	4.8	1.7	5.0	3.0	
Topic 6 adenomyosis	Flipped classroom group	5.0	1.1	5.0	2.0	0.002‡
	Interactive lecture group	4.0	1.1	4.0	2.0	
Average pre-test score	Flipped classroom group	5.0	0.5	5.0	0.8	0.411†
	Interactive lecture group	4.9	1.0	4.7	1.8	

†Independent samples t test, ‡Mann–Whitney U test

Table 2: The post-test scores of each topic compared between the two groups

Topics	Teaching method	Mean	Standard deviation	Median	Inter-quartile range	P-value
Topic 1 fibroid	Flipped classroom group	9.2	1.1	9.0	1.0	0.406‡
	Interactive lecture group	8.4	2.0	9.0	4.0	
Topic 2-abnormal uterine bleeding	Flipped classroom group	9.5	0.9	10.0	1.0	0.001‡
	Interactive lecture group	8.7	1.0	9.0	2.0	
Topic 3 postmenopausal bleeding	Flipped classroom group	9.9	0.5	10.0	0.0	0.623‡
	Interactive lecture group	9.7	0.9	10.0	0.0	
Topic 4 Endometriosis	Flipped classroom group	9.5	0.9	10.0	1.0	0.029‡
	Interactive lecture group	9.8	0.9	10.0	1.0	
Topic 5 genital prolapse	Flipped classroom group	9.6	0.6	10.0	1.0	0.018‡
	Interactive lecture group	9.2	0.7	9.0	1.0	
Topic 6 adenomyosis	Flipped classroom group	9.5	0.9	10.0	1.0	<0.001‡
	Interactive lecture group	7.2	1.3	7.0	2.0	
Average post-test score	Flipped classroom group	9.5	0.4	9.5	0.7	<0.001†
	Interactive lecture group	8.8	0.6	9.0	0.8	

†Independent samples t test, ‡Mann–Whitney U test

Table 3: Students' perception of flipped classroom method

Questions	Strongly disagree (%)	Disagree (%)	Neither or N/A (%)	Agree (%)	Strongly agree (%)
1. The provided study material for FCR was very useful	0.0	0.0	0.0	35.5	64.5
2. FCR improved my learning motivation	0.0	0.0	3.2	45.2	51.6
3. FCR stimulated me to acquire in depth knowledge	0.0	0.0	0.0	67.7	32.3
4. FCR gave me opportunity to communicate with the teacher	0.0	0.0	3.2	54.8	41.9
5. Satisfied with the course content covered by FCR	0.0	0.0	0.0	29.0	71.0
6. FCR improved my reasoning skills	0.0	0.0	6.5	54.8	38.7
7. I would like FCR to be applied in future classes	0.0	0.0	0.0	51.6	48.4
8. Flipped class was time-consuming	12.9	74.2	12.9	0.0	0.0
9. FCR gave me too much burden and pressure	45.2	45.2	9.7	0.0	0.0
10. Prefer traditional teaching over the FCR	19.4	61.3	16.1	0.0	3.2

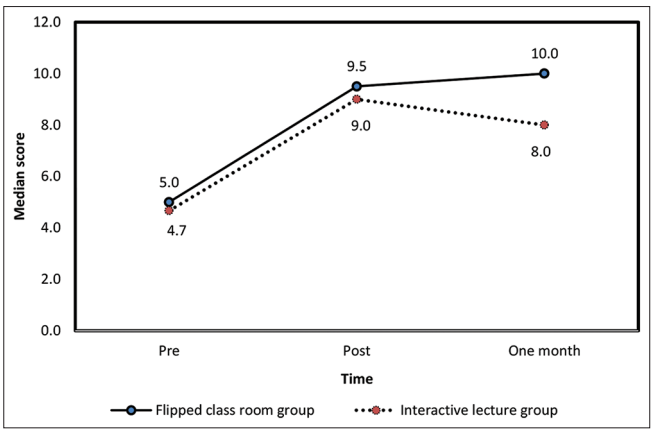

Figure 2: Diagram showing median scores at the different time points

deviation 2.9), median 44 (inter-quartile range 4). The student's perception of flipped classroom using Likert scale is shown in Table 3.

Hence, the total perception regarding flipped classroom teaching can be summarized as:

Majority of the students (64.5%) had a strongly positive perception regarding flipped classroom and 35.5% had a positive perception.

DISCUSSION

The current study compared the learning outcomes based on the assessment scores in six different topics of Obstetrics and Gynecology among the final year MBBS students between the flipped classroom and interactive lecture method. In addition to the score assessment, the attitude of the students towards flipped classroom was also assessed.

The pre-test scores for both groups were comparable and hence no statistically significant differences were observed. This shows even though they have studied those particular topics in previous years, still their knowledge at the time of the study was comparable.

There was a significant difference in post-test scores between two teaching methods. Flipped classroom method had significantly higher post-test scores except for a single topic. The average post-test score was also more for flipped classroom. This result is similar to the meta-analysis by Kuhl et al.,[5] which documented that flipped classroom approach was more effective than the traditional classroom in increasing student learning

outcome. One explanation for this greater effect of flipped classroom is that having unrestricted access to pre-recorded video lectures before class enables students to learn anywhere and at any time, at their own pace. Students can also watch the videos multiple times to better understand a particular topic.

Kuhl et al., also stressed on the importance of the study material.[5] If the students are provided with high-quality study materials which is simple and easy to understand, there is a high probability that they will read the material before the class. The findings of our study also show that flipped classroom has the potential to promote self-directed learning which is an important part of CBME. The availability of more in-class active learning time also helps the students to understand the subject material.

In our study, the test score after 1 month to assess the retention capacity was also significantly higher in flipped classroom group compared to interactive lecture group. This implies that students remember flipped classroom teachings for a longer period compared to interactive lectures. The flipped classroom approach enhances memory retention because pre-class activities stimulate initial exposure to the study material. The self-directed learning before the class and in-class interactions reinforces and deepens the understanding of the subject. The active learning environment in the classroom encourages the students to apply and practice concepts, contributing to better retention compared to passive listening in lecture classes.

Although flipped classroom has an effective impact on students learning performance and motivation as in our study, some studies have shown the negative impact of flipped classroom.[6] Kim et al., concluded that the students' grade was not affected by flipped classroom when it was used as a learning approach.[7] Sun and Wu's study also shows no impact on interaction and learning satisfaction between students and teachers when flipped classroom was used.[8]

Students' perceptions towards flipped classroom approach

In our study, the students generally "strongly agreed" and "agreed" for using the flipped classroom approach. Majority of the students were satisfied with flipped classroom because they had participated in class activities, felt more motivated, and had good interaction with the teacher. None of the participants "strongly disagreed" or "disagreed" about the use of flipped classrooms. This result agrees with Morgan et al., as most of their study subjects consider flipped classroom as an effective learning tool and are satisfied using it.[9] However, Zhao and Ho, reported that about half of the participants preferred to use flipped class room, while another half did not.[10] Similar results were also reported by studies of Gubbiyappa et al., and Veeramani et al.[11,12]

Limitations of the study

- The sample size was limited
- We could not assess whether the students had fully utilized the pre-class study materials forwarded to them
- We have only assessed post-1-month retention test, which is not adequate to assess the long-term learning outcome
- Faculty feedback was not included.

CONCLUSION

Flipped classroom method is having better learning outcome than interactive lectures in terms of post-test scores as well as knowledge retention test scores after 1 month. Students are satisfied and felt more motivated with flipped classroom. Majority of the students' performance are improved with flipped classroom. As a novel way of teaching, the flipped classroom could potentially help the students develop lifelong learning skills by promoting application of medical knowledge and stimulating critical thinking. Due to these reasons, flipped learning is certainly worth attempting in the current medical curriculum.

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MM- Concept and design of the study, data acquisition and analysis, drafting of manuscript, and final approval of manuscript; **SK-** Planning of study design, critically reviewing the article, and preparation of manuscript; and; **BD-** Statistical analysis and interpretation of results.

Work attributed to:
Government Medical College Kannur, Pariyaram - 670503, Kerala, India.

Orcid ID:
Simi Kurian - https://orcid.org/0000-0002-6202-9285
Manu Mathews - https://orcid.org/0000-0001-8417-7361
Binoo Divakaran - https://orcid.org/0000-0003-2423-9377

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