



EFFECTIVENESS OF FLIPPED CLASSROOM VERSUS TRADITIONAL LECTURES IN MEDICAL TEACHING

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ABSTRACT

Background: In contemporary medical teaching, student-centered active learning is gradually replacing the conventional passive role of the teacher. Traditional lectures are the method that is still widely used in medical colleges, but they do not always give students the opportunity for discussion and interaction, or for application of knowledge. The flipped teaching approach gives learners an opportunity to review lesson content before attending class, while face-to-face time is used for discussion, clarification of difficult points, and problem-solving activities.

Objective: To compare the effectiveness of flipped classroom teaching with traditional lecture-based teaching among medical students.

Methods: This comparative education study was undertaken with 60 medical students of HBS Medical and Dental College, Islamabad, Pakistan. The subjects were divided into 2 groups: the students who learned with the flipped classroom method, 30 students, and the students who learned with the traditional lecture method, 30 students. The same topic and similar learning outcomes were used for both groups. A pre-test was used prior to the teaching session, and then a post-test was administered immediately following the teaching session. A post test after a delay was also performed to determine memory retention. A structured questionnaire was used to evaluate students' engagement and satisfaction. SPSS software was used in the analysis of the data. The statistical significance (p-value) of ≤ 0.05 was considered.

Results: Initial assessment scores were almost the same in both groups. Following the teaching session, students taught through the flipped classroom approach obtained markedly higher post-test

scores than those taught by conventional lectures. The improvement in mean score was also greater among students in the flipped classroom arm. Knowledge retention, classroom involvement, satisfaction, motivation, and confidence were also better in this group. Good academic outcome was recorded in 24 (80.0%) students from the flipped classroom arm, compared with 16 (53.3%) students taught through traditional lectures.

Conclusion: The student-centered flipped teaching approach produced better learning outcomes than conventional lectures, with improvement in academic scores, knowledge retention, participation, and learner satisfaction. This method may be used as an effective teaching strategy in medical education to promote active learning and better understanding of medical concepts.

Keywords: Flipped classroom, traditional lecture, medical education, active learning, student engagement, academic performance, knowledge retention

INTRODUCTION

Medical education must use teaching styles that will not only impart knowledge but also facilitate understanding, application, critical thinking, and retention (1). Traditional education has been the most popular approach adopted in medical colleges for many years. Typically, the teacher communicates to a whole class of students, and students listen, take notes and ask some questions. While useful to get through a lot of material in a short amount of time, traditional lectures are criticized for being teacher-centred and for not affording much opportunity for active student participation (2).

Medical education has shifted to student-centered, competency-based learning in recent years. This shift has fostered the adoption of pedagogical approaches that have students actively engaged in learning (3). The flipped classroom is one way to do this. This model is when the students have a learning material from which to read before the class, for example reading notes, recorded lectures, slides or videos. They learn the basic content independently before coming to the classroom session. Classroom time is used for discussion, problem solving, group activities, clarifying difficult concepts and for knowledge application (4).

The essence of a flipped classroom is that the initial exposure to content takes place outside the classroom environment, as opposed to the traditional classroom lecture. This will enable the classroom session to proceed with depth rather than delivering information. This may be especially valuable in medical education where students are required to master complicated concepts and apply them in clinical scenarios. This learner-centered approach can enhance learners' confidence, motivation, communication ability as well as problem-solving ability through advance preparation and active classroom involvement.(5).

There are multiple studies which reported that flipped teaching approach teaching improves learning performance and student engagement within health professions teaching (6). Students who are educated by the flipping classroom method have achieved better satisfaction in previous studies and higher post-test scores than those who are educated by the conventional classroom method. The approach also fosters self-directed learning, a key skill for medical students and health care professionals. The efficacy of the flipped classroom, however, may rely upon the planning, quality of the pre-class material, student preparation, and active facilitation of the class (7).

Despite all of this, traditional lectures remain a valuable and important component of medical teaching and learning, as they are easy to organize, familiar to both teachers and students, and effective in delivering focused information to a large audience. However, lectures alone might not be enough to foster higher order learning skills. The students can sit on their hands during lectures and their recall of what they have heard can be reduced over the years. Thus, the traditional teacher-student lecture teaching method is compared with active learning, such as the "flipped classroom" teaching method.

Conventional lectures are still the primary instructional methods used by many medical institutions in the local context. There were few data about the effectiveness of flip classroom teaching of medical students compared with traditional classroom teaching. It is essential to evaluate the effect

of the flipped classroom method on learning outcomes, memory retention, engagement in the classroom and satisfaction of students in the medical field.

Therefore, this research was planned to evaluate whether the flipped teaching strategy provides better learning outcomes than the conventional lecture approach in medical students. The study assessed changes in baseline and post-intervention test scores, knowledge retention, classroom participation, satisfaction, and overall academic achievement across the two instructional methods.

Methodology

This comparative educational study was designed to assess how effective the flipped teaching approach was in comparison with conventional lectures within medical teaching. The study was carried out at HBS Medical and Dental College, Islamabad, Pakistan over a period of six months from December 2024 to May 2025. The purpose of the study was to compare learning outcomes, knowledge retention, student engagement, and satisfaction between students taught through a flipped classroom approach and those taught through the conventional lecture-based method.

The study enrolled 60 medical students in total. The participants were randomly divided into two groups: 15 students to the Flipped Teaching Group and 15 students to the Traditional Lecture Group. The final analysis excluded those who failed to participate in the pre-test, teaching intervention, post-test, and/or delayed assessment. The participants were selected using non-probability consecutive sampling method until the required number of participants is obtained.

All the participants were briefed on the purpose and the procedure of the study before the onset of the teaching intervention. Data was kept confidential and student identities not revealed. Approval for the study was obtained from the institutional ethics review board before starting data collection. All participants gave written informed consent. Students volunteered to participate; they could drop out of the study at any time without harming themselves in any academic way.

The students were divided into two groups. The subjects in Groups A and B used the same content and subject matter, but differed in teaching method: Group A was taught by the flipped classroom method, and Group B was taught by the traditional lecture method. The same topic was chosen for both groups to ensure that the same content is being taught. The duration, the content of learning, the questions in the assessment and the learning objectives remained the same for the two groups. To minimise teacher variation, a single instructor facilitated the instructional session.

For the flipped classroom group, students were given learning material prior to the classroom session. This was comprised of notes from the reading, slides for presentation, and a list of learning resources available on the topic. Students were asked to study the material prior to class. In the classroom, the teacher emphasized discussion and clarification of concepts, problem solving activities and interactive learning. Students were encouraged to be active, ask questions and discuss the topic with other students and facilitator.

Traditional lecture group: students had the same topic taught via a traditional lecture format. The instructor delivered that topic in a classroom using teaching slides and oral explanation. The students were listening to the lecture and they were given an opportunity to ask questions at the end of the lecture. This group received no specific background information or in-class exercise before learning.

To check the baseline knowledge of the students of both groups, a pre-test was administered prior to the teaching session. Questions related to the selected topic were used in the baseline assessment. After completion of the teaching session, an immediate follow-up test was administered using comparable questions to measure short-term learning gain. A post-test was performed after a specified time to check on knowledge retention for students. All students were marked using the same criteria.

Student engagement was checked through class participation, asking questions, engaging in discussion and completion of learning material. A structured questionnaire was used to gauge the students' satisfaction and perception of the teaching method. Items investigated in the questionnaire were the understanding of the topic, the motivation to learn, the confidence, the interaction between teacher and pupil, and the preference for the teaching method. Responses were noted and compared

between the two groups.

The difference between post-test scores of the flipped class group and the traditional lecture group was the main outcome variable. Secondary outcome variables were: score improvement, score gain after instruction, follow-up assessment score, knowledge retention, student involvement, satisfaction with teaching method and overall academic performance. Good academic performance was based on post-test score as per the pre-designed cut-off value of the study.

SPSS data entry and analysis software were used. Age, baseline test marks, immediate assessment marks, score improvement, and engagement score were reported as a mean and SD for quantitative variables. Qualitative variables like gender, satisfaction, class participation, preferred teaching method and academic performance category were displayed in frequency and percentage. The mean values of both groups were analyzed with an independent sample t-test, while categorical data were assessed using the chi-square test. Statistical significance was set at a p-value of ≤ 0.05 . The design of the study was planned in such a way that the same educational content was given to both groups, with the only difference being the method of teaching. This enabled a valid comparison of the student learning, retention, engagement, and satisfaction of flipped classroom teaching with that of traditional lecture based teaching.

Results

Students were grouped into two groups with 30 students in each group, one group was taught using the flipped classroom method and the other group was taught using the traditional lecture method. The baseline characteristics of both groups were similar, suggesting that there was no difference between the two groups prior to the educational intervention.

Table 1: Pre-Intervention Characteristics of the Participants

Variable	Flipped teaching group n=30	Conventional lecture group n=30	p-value
Age in years	21.3 $\pm$ 1.4	21.6 $\pm$ 1.5	0.426
Male	14 (46.7%)	13 (43.3%)	0.795
Female	16 (53.3%)	17 (56.7%)	0.795
Previous academic score	68.9 $\pm$ 7.8	67.6 $\pm$ 8.2	0.532
Attendance percentage	86.4 $\pm$ 6.5	84.9 $\pm$ 7.1	0.397

The mean pre-test score was nearly the same for both groups prior to the teaching session. This indicates that students' prior knowledge was similar. However, the improvement was greater in the flipped teaching arm. This finding seems that the learners instructed by the flipped classroom had significantly higher mean post-test scores than the students taught by traditional lectures.

Table 2: Assessment Scores Before and After the Teaching Intervention

Test Score	Flipped teaching	Conventional lecture	p-value
Baseline assessment score	44.8 $\pm$ 8.6	43.9 $\pm$ 8.9	0.692
Post-test score	78.5 $\pm$ 7.4	69.2 $\pm$ 8.1	<0.001
Mean score improvement	33.7 $\pm$ 8.2	25.3 $\pm$ 7.9	<0.001

Student's knowledge retention was evaluated by a delayed post-test. The students in the flipped classroom group had a higher score than the traditional lecture group. This result shows that the flipped classroom teaching method was more effective in the retention of knowledge over time.

Table 3: Comparison of Knowledge Retention between Groups

Variable	Flipped teaching	Conventional lecture	p-value
Delayed post-test score	74.6 ± 7.8	63.8 ± 8.7	<0.001
Decline from immediate post-test	3.9 ± 2.5	5.4 ± 3.1	0.044
Students with good retention	23 (76.7%)	14 (46.7%)	0.017

There were also higher levels of student engagement for the flipped classroom group. There are more students in this group who are involved in class discussions, with questions, and complete pre class learning material. The overall engagement score was significantly better in the flipped classroom group than in the traditional lecture group.

Table 4: Student Engagement and Participation

Variable	Flipped teaching	Conventional lecture	p-value
Active class participation	25 (83.3%)	15 (50.0%)	0.006
Asked questions during class	21 (70.0%)	11 (36.7%)	0.010
Completed learning material	26 (86.7%)	18 (60.0%)	0.020
Mean engagement score	8.1 ± 1.2	6.4 ± 1.5	<0.001

Students who were given the flipped classroom method were more satisfied. The students in the flipped classroom group indicated that they had improved understanding, motivation and confidence on the topic. learners taught through conventional lectures, however, reported less satisfaction and preference for the teaching method.

Table 5: Student Satisfaction and Perception

Variable	Flipped Classroom	Traditional Lecture	p-value
Satisfied with teaching method	26 (86.7%)	17 (56.7%)	0.010
Better understanding of topic	25 (83.3%)	16 (53.3%)	0.013
High motivation to learn	24 (80.0%)	15 (50.0%)	0.015
Increased confidence	23 (76.7%)	14 (46.7%)	0.017
Preferred teaching method	25 (83.3%)	13 (43.3%)	0.001

Flipped teaching group showed superior overall academic performance. The achievements of students' learning were good in 24 (80.0%) students from the flipped teaching group, whereas in 16 (53.3%) students of the traditional lecture arm. The observed difference was statistically significant.

Table 6: Association between Teaching Method and Academic Performance

Academic Performance	Flipped Classroom Group n=30	Traditional Lecture Group n=30	p-value
Good academic performance	24 (80.0%)	16 (53.3%)	0.028
Poor academic performance	6 (20.0%)	14 (46.7%)	0.028

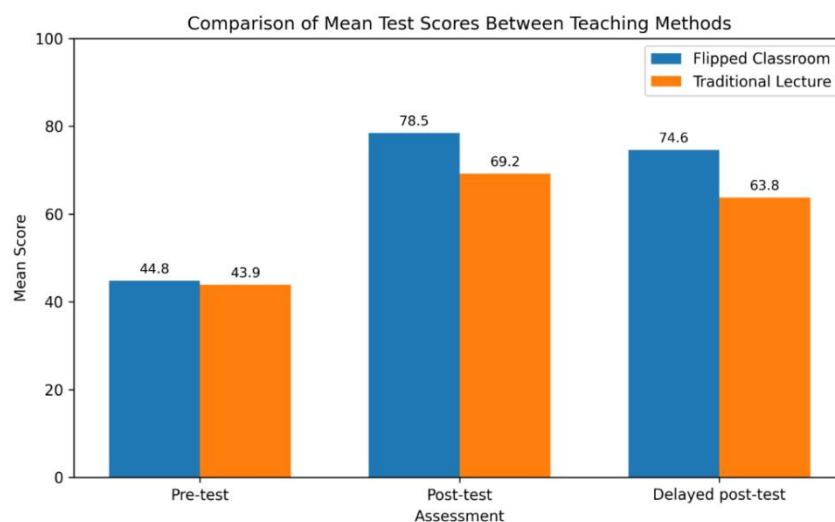


Figure 1: Mean assessment scores across the two teaching approaches.

The graph shows that both groups had similar pre-test scores, while post-test and delayed post-test scores were higher in the flipped classroom group.

Discussion

The present study compared the effectiveness of flipped classroom teaching with traditional lecture-based teaching among 60 medical students. The findings showed that both groups had almost similar baseline knowledge before the intervention, as reflected by comparable pre-test scores. After the instructional session, learners in the flipped teaching group obtained markedly better post-test results than those taught through conventional lectures. The average improvement in scores was also higher in the flipped teaching group. These results indicate that the flipped teaching strategy enhanced immediate academic achievement more effectively than the lecture-based approach.

The student-centered flipped teaching strategy uses an activity-based learning design, which may explain the better performance observed in the flipped teaching group. This teaching approach introduces basic content to students before class and uses classroom time for discussion, clarification, interaction, and application of knowledge. This moves students away from being passive listeners and into the active engagement. Prober and Khan noted that the essence of medical teaching is not a long passive lecture, but rather, classroom time should be allocated to deeper learning, problem solving, and interaction (8). Likewise, O’Flaherty and Phillips found that, with appropriate planning, the flipped classroom model in higher education fosters engagement, learner responsibility and active participation (9).

The results of the present study support the review by Chen et al., which indicated that, in general, flipped classes in medical education resulted in better learner engagement and academic outcomes, albeit the quality and design of studies were found to vary (10). In the current study, students taught through the flipped approach obtained significantly higher follow-up assessment scores, showing that this teaching strategy may improve short-term learning results. Fatima et al. similarly reported that the flipped teaching approach in undergraduate medical education was beneficial and helped learners become active participants (11). This is similar to this study, which observed greater classroom involvement and academic performance.

The improvement of the students' learning in the flipped classroom group is also corroborated by the meta-analysis by Hew and Lo, which found that teaching methods that are more student-centered than the traditional approach in the health professions education field are conducive to the improvement of students' learning (12). In the present study, the average score after instruction was 78.5 ± 7.4 among students taught through the flipped approach and 69.2 ± 8.1 in the traditional lecture group, clearly showing an academic advantage among learners receiving flipped teaching.

This score gap suggests that active learning in the classroom, along with pre-class preparation, may improve understanding and retention of medical concepts compared with a lecture-based approach. The interventional study carried out by Angadi, et al. among undergraduate medical students revealed that the learning experience of students was found to be better and their performance improved in flipped class teaching than in conventional teaching (13). The results are comparable with those of the present study, which indicated that performance gains, engagement and satisfaction were greater for the students of the flipped classroom. This might be attributed to the fact that the students in the flipped classroom group were prepared prior to the class and utilized the class time for discussions and conceptualization.

The student group receiving the flipped teaching approach also demonstrated a better knowledge retention in the present study. The result of the post test of the students taught with the flipped classroom method was higher than the students taught with the traditional lecture method. This is significant because, besides the immediate recall, medical education should also promote understanding and application of knowledge. Matinho et al. investigated the impact of the flipped classroom model on students' knowledge retention in medical education students and found that the flipped classroom model had a positive effect on knowledge retention (14). Likewise, Ji et al. found flipped classroom teaching was effective in enhancing the short-term learning and the long-term academic achievement in subsequent medical subjects (15). These results are consistent with the present one indicating that the flipped classroom teaching might have the effect of positive retention beyond the teaching session.

The flipped classroom group in the current study showed a significantly high student engagement. Students contributed more to class, were more engaged, asked questions and more completed learning material. This is confirmed by the findings of Yang et al. which showed that the employment of flipped classroom in anatomy learning was supported by web-based anatomy learning which enhanced the interest, interaction, and learning experience of students in learning anatomy (16). In another work, Wu and his colleagues found that a flipped classroom model teaching in pharmacology by using micro-video has improved the interest, communication and learning efficiency of students (17). The results are consistent with the current study which found that students exposed to Flipped Classroom teaching were more active in the teaching session.

The current research also revealed that the satisfaction rate of students was higher for the group of FL. For most students in this group they have better understanding, higher motivation, higher confidence, and prefer the teaching method. The results are similar to that of Matinho et al who stated that the flipped classroom teaching is good in medical teaching, and it benefits improving the students' perception of learning (14). In the Flipped classroom, students can be satisfied with the classroom because they can see the learning content before the class begins and self-study at their own speed. This enables students to pinpoint challenges prior to class and ask questions and clarify concepts during class.

The findings are also consistent with those of Ruesseler et al., who summarized the results of their study on the effect of the flipped classroom in health professions education in China, and found that the teaching of the flipped classroom was generally effective in enhancing the learning effect and the enthusiasm of students (18). Current study Flipped teaching group was found to be positively correlated with post test score, delayed post test score, engagement and satisfaction, which are important indicators of teaching effectiveness. In medical education where knowledge understanding, application, and retention is crucial, this indicates that flipped classroom teaching may be applicable.

The value of the flipped teaching approach has also been reported within preclinical medical subjects in recent literature. Ji et al. assessed the flipped classroom with WeChat-platform based team learning for teaching biochemistry and its results confirmed that the blended classroom had positively enhanced the learning outcomes and classroom participation (19). This aligns with the current discovery that involvement and preparation prior to the class can enhance learning outcomes. In the same way, Nichat et al. studied the flipping classroom in the field of medical education and reported that it can support critical thinking, participation and engagement of students (20). The

features are very applicable in medical education as students are required to apply the knowledge in clinical and problem-solving scenarios.

The findings are also confirmed by the 2023 review by Naing et al. A review by them showed that there is evidence that flipped classroom interventions can positively impact academic achievement and student satisfaction for undergraduate health professional students, but further high-quality trials are required (21). This is because there were positive results from the present study, as well, but the sample size was not very large. Based on this, although the results are more in favor of the flipping classroom teaching model, caution should be exercised when interpreting and more multicenter studies should be conducted to confirm the results.

Based on the present findings, it can be concluded that teaching using the flipped classroom approach outperforms traditional lecture-based approach regarding academic performance, retention, engagement, and satisfaction. But it should not be assumed that traditional lecture is totally ineffective. The students in the traditional lecture group also showed improvement following teaching in the present study, albeit to a lesser extent. While the lectures may not be as beneficial in other situations, they can be very helpful in introducing a new topic, providing organized information, and teaching large audiences. Deeper understanding and student participation, however, seem to be an added advantage of the Flipped Classroom when the goal is to engage students in Active Learning.

This study has some limitations. It was conducted on a relatively small sample size of 60 students, with 30 students in each group. The study was conducted in a single setting, so the findings may not be generalizable to all medical institutions. Student preparation before class was assessed mainly through reported completion of learning material, which may be affected by self-reporting bias. In addition, the delayed post-test was used to assess retention, but longer follow-up could provide better evidence of sustained learning. Future studies with larger sample sizes, multiple institutions, longer follow-up, and standardized assessment tools are recommended.

Conclusion

The present study concluded that the flipped teaching approach was superior to conventional lecture delivery among undergraduate medical students. Students taught through the flipped classroom approach achieved higher post-test scores, greater score improvement, better knowledge retention, higher engagement, and greater satisfaction compared with students taught through traditional lectures.

The flipped classroom method promoted active learning, self-directed preparation, classroom interaction, and better understanding of the topic. Although traditional lectures also improved student knowledge, the improvement was greater with flipped classroom teaching. Therefore, flipped classroom teaching may be used as an effective educational strategy in medical teaching, especially for topics that require discussion, application of knowledge, critical thinking, and long-term retention. Larger studies are recommended to further validate these findings in different medical colleges and across different subjects.

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