Effectiveness of Flipped Class Room as A Teaching Tool: A Pilot Study

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Abstract: Background & Objective: In flipped class, active teaching learning occurs outside while conventional classroom is used for problem solving. We aimed to develop, implement, and evaluate a pilot flipped class to improve competence of undergraduate medical students in physiology. Methods: A guided-inquiry learning activity was developed and conducted to complement recorded, previously viewed didactic lecture. The activity was constructed to focus on critical thinking and application of basic principles of physiology of taste and smell. A combination of independent work and active discussion with the facilitators and guided student response provided student-facilitator interaction. Student learning was evaluated by comparing Test 1 (comprehension and knowledge) and Test 2(clinical application) assessment results. Students' perception was obtained using a mixed closed and open ended questionnaire. Results: Thirty-nine out of forty participated in the study, 38/39 (97%) scored above 50% in the test for comprehension and knowledge. 26/39 (66%) of the students scored between 50-75% in the test for clinical application. 7/13 have consistent performance in both test 1 and 2, while the remaining 6 students deteriorated in test 2. Most students gave a positive feed-back regarding inclusion of flipped class Interpretation and Conclusion: The flipped class model included active-learning and formative assessments that provided students spaced and repetitive curricular engagement. The intervention transformed the classroom interactions and contributed to improved student understanding of the topic.[Roopashree NJIRM 2017; 8(4):78-84]

Key Words: Flipped class, Test for comprehension and knowledge, test for clinical application, Physiology

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Introduction: Medical knowledge is increasing exponentially and poses a challenge to educators in imparting the required skills to students. Traditional methods of teaching using lectures have been questioned; especially when a number of studies have shown active learning methods with student participation has a positive effect on long term retention of knowledge[1, 2]. Students who are actively engaged in constructing their own learning had higher learning gains when compared to those who were taught using traditional lectures[3, 4].

After an initial good span of attention, there is a decline steadily and substantially[5, 6] which recovers again towards the end with an average of 15-20 minutes at the beginning and about 10 to 15 minutes at the end of the class [7, 8]. It is said that only 20% of the material presented is remembered by the students. Students have reported that passively listening to hour long lectures is boring and takes away the pleasure of learning[9]. The teacher plays a crucial role in stimulating critical thinking and problem solving skills by applying the knowledge acquired by students on their own[10]. Comprehension of students improves significantly when they are actively engaged in the learning process[11, 13].

Active learning has shown to stimulate higher-order thinking, problem solving, and critical analysis while providing feedback to both the student and facilitator[14, 15].One such method wherein the students are engaged actively in their learning introduced by J.Wesley Baker in 2000[16]is the "flipped classroom"[, 5, 17].Learning based on a "flipped classroom" approach occurs when students are engaged in significant pre-class preparation, such as watching pre-recorded lectures, while traditional class time is utilized for discussion, clarifying the doubts and/or problem solving of the relevant topics[13].

In the flipped classroom teachers prerecord lectures and post them online for students to watch so that class time can be dedicated to student-centered learning activities, such as problem-based learning and inquiry oriented strategies[3, 5,17,1]. This approach helps the facilitator to address different learning styles and introduce active learning strategies that encourage problem solving during dedicated class time[19]. The flipped classroom model is student-centered. Acquisition of basic knowledge is a pre-requisite before attending the class. Knowledge acquisition then is self-paced and self-guided, enabling students to control when and how much content they learn. The rich open discussions in the classroom

provide students with a good base to further their knowledge.

Studies among Asian students evaluating the efficiency of flipped class are far and few[9, 20]. Majority of these studies have shown a positive response from the students. International Medical School Bangalore is an off shore campus of Management and Science university (MSU), Shah Alam and is accredited by the Malaysian Medical Council. The Malaysian nationals are admitted to the school after a rigorous entrance test and interview conducted in Malaysia.

The undergraduate course is delivered as a five year curriculum consisting of year 1 and Year 2 of pre-clinical subjects and year 3, 4 and5 as clinical subjects. The year 1 and year 2 pre-clinical curriculum is modular system based. In these two years, pre and para clinical subjects are taught based on body systems such as cardiovascular, respiratory, endocrinology etc. In year 1, anatomy, physiology and biochemistry are learnt using eleven such modules in an integrated manner. Teaching learning strategies include minimal traditional didactic lectures and interactive student centered methods such as seminars, tutorials small group discussions and self-directed learning sessions (SDL). The tutorials are conducted as directed self-learning sessions (DSL) that are supervised by facilitators but students decide the method of learning. Students use e-textbooks and online materials during both DSL and SDL sessions. Seminars are presented by students and are complementary to the basic lectures. Some of the small group, active teaching learning methods used in our department include jigsaw method, fish bowl and case based discussions. Incentive to use interactive student centered method prompted us to try the flipped class method as a pilot study.

The objective of our study was to explore the impact of flipped class on student learning and assess its role in comprehension and clinical application of the study material.

Methods: The study was done as part of regular active learning methods with permission from the Head of the institution. Hence, Institutional Review Board permission was not considered necessary. The topic, taste and smell was selected for this pilot study. Forty first MBBS students were given the prerecorded lecture of which thirty nine students were present on the day of the flipped class. A Voice-over power point presentation of the prerecorded lecture was given to the students in a pen drive a week before the scheduled class. The presentation was 20 minutes long and covered the basic information. The students were required to view the lecture at leisure.

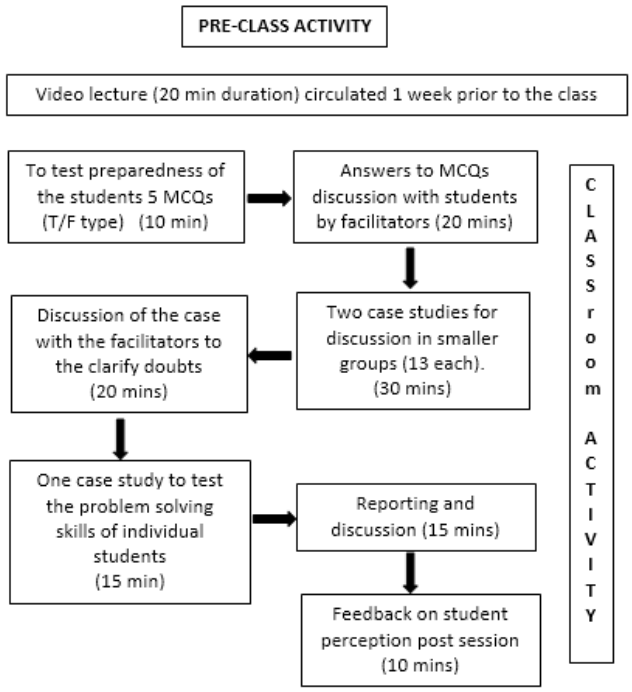
The class activities included two tests and group discussions guided by the facilitators. The first test to assess basic knowledge and comprehension of the subject was administered at the beginning of the class. The test comprised of five multiple true/false type questions each with five options which effectively addressed the learning objectives of the topic. The maximum score for test 1 was twenty five marks. The next activity was discussion of two case vignettes that tested the application of knowledge and critical thinking in small groups of 10. Discussions were supervised by facilitators. The second test, with a maximum score of 10 marks was in the form of a Short Essay Question (SEQ) with a case vignette that tested their ability to apply the knowledge acquired. SEQ format was chosen as this is one of the formats used for their summative assessment along with MCQs and Modified Essay Questions (MEQs) in their curriculum. Questions in these tests were created on level 3 and 4 of Bloom's taxonomy.

A mixed-methods quantitative and qualitative questionnaire to evaluate the perception of the students on flipped classroom session was prepared and administered to the students at the end of the session. The questionnaire included a 17 fixed-response (quantitative) component with statements directed to evaluate specific aspects of the flipped class format. These questions had a five point Likert like scale, with "one" indicating strongly disagrees to "five" indicating strongly agree. These 17 statements were categorized into three categories, namely

- Attitudes of students towards flipped class (5 statements)
- Perception of students on e-learning(6 statements)
- Role of flipped class on acquisition of knowledge (6 statements)

The second component of the questionnaire consisted of five open-ended (qualitative) questions aimed at exploring participant perspectives in more in-depth manner.

Flow chart depicting the methodology



Result: As flipped classroom was introduced as a part of routine active student centered learning method a convenience sampling involving the whole class consisting of 39 students was considered as study group[21].

The data was analyzed using SPSS Statistics for Windows, version 18.0 (SPSS Inc., Chicago, IL., USA). Wilcox on signed rank test was used to analyze the descriptive statistics since the data of Test 2 was not normally distributed. In Test 1 (Knowledge and comprehension), the 39 students had a mean score of 68.51 (SD±11.43). In Test 2 (clinical application), the mean score was 49.68 (SD ± 29.86). The range of score for Test 1 was between 28 and 92, for Test 2 it was between 0 and 100(Table 1).

Table 1: Descriptive statistics of the students' score

	N	Mean	SD	Min score	Max score
Test 1 (in %)	39	68.51	11.43	28	92
Test 2 (in %)	39	49.68	29.86	0	100

Test 1: Knowledge and comprehension, Test 2-Clinical application, N- number of students, SD- standard deviation

Table 2: represents the scores of the students in both the tests. The Scores secured by the students in Test 1 and Test 2 were divided into quartiles of 0-24, 25–49, 50–75 and >75

Table: 2: Performance and scores of the 39 students in the Test 1 and Test 2 respectively

		Range of Scores (in %)				
		0-24	25-49	50-74	>75	Total
Test 1	No of students	0	1	26	12	39
Test 2	No of students	7	11	7	14	39

Comparison of scores obtained in Test 1 and Test 2 assessments were tested by a relationship table (Table 3). This helped in assessing the individual ability of the students not only to comprehend but also to observe if the students were able to apply the knowledge acquired to solve the clinical vignette

Table3: Comparison of scores between Test 1 and Test 2

	Range of scores in Test 2(in %)				
Range of scores in Test 1(in %)		0-24	25-49	50-74	>75
25 – 49 (1 student)	No. of students	1	0	0	0
50-74 (26 students)	No. of students	4	9	5	8
>75 (12 students)	No. of students	2	2	2	6

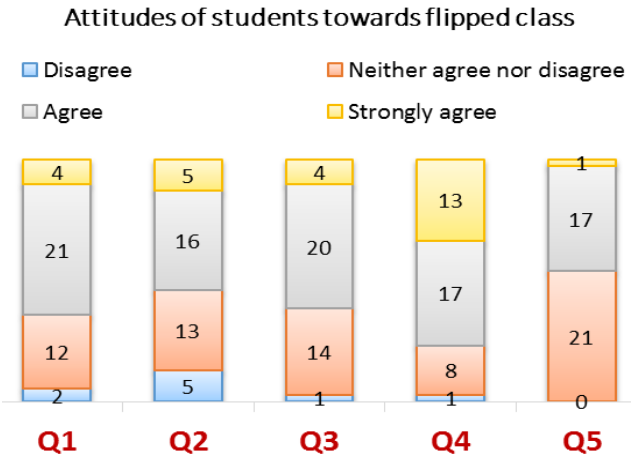
There was a single student who secured < 50% (28 marks) in the Test 1, the Test 2 score of the same student was < 24% (13 marks). Of the 26 students, who have scored between 50 – 70% in the Test 1, 13 students (50%) have either maintained or improved in their performance in the Test 2. The remaining 13 students in this group have deteriorated in their performance.

There were 12 students who have scored >75% in the Test 1. Among them, six students have been consistent in their Test 2 performance with scores >75%. In the Test 2, seven students have secured scores between 0-24%. 11 students have scored between 25-49%. Seven students have scored between 50-74% and 14 students have scores >75%.

The responses to perception questionnaire are depicted in the form of proportional bar diagrams.

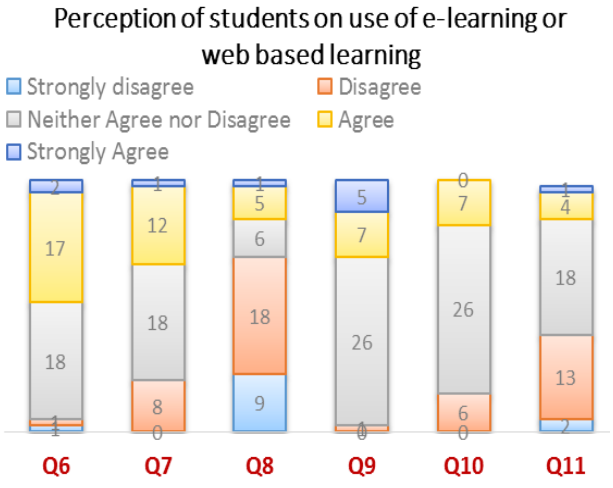
Each bar depicts a particular question; the different colours along with the number on each of the bar correspond to the number of students of the total who have responded.

Graph 1



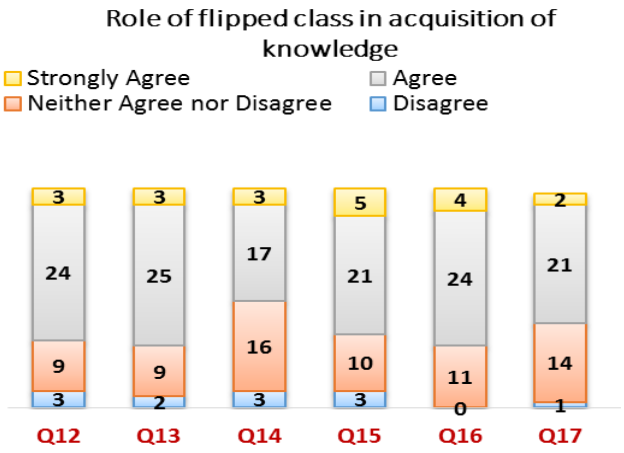
Q1: This class is more engaging than the traditional class
Q2: I recommend flipped class to my friends
Q3: I have more time to communicate with friends
Q4: I like watching the lessons on the video
Q5:I find it easy to pace myself

Graph 2



Q6: I prefer entire class moving at the same pace
Q7:I spend less learning time using tradtional methods
Q8:Social media is not an important part in my learning
Q9: I prefer a tradtional teacher led lesson than a video
Q10: I dislike self pacing
Q11:This method has not improved my learning

Graph 3



Q12: I watch the video assignment regularly
Q13: It helped me solve the MCQ easily
Q14: It helped me to participate fully in the discussion
Q15: This method has improved my understanding
Q16: It gives me more time to study the topic
Q17: This method gives me better motivation

About seventeen questions were administered as part of the feedback. Many students found flipped class more engaging. Watching a video lesson helped the students in self learning (graph 1). More than 50% of the students feel social media has a major role in their learning and understanding of the subject (graph 2). Flipped class improves motivation, helps in the solving MCQs which were part of test 1 and participation in the discussion of case vignettes (graph 3).

The students were also given an opportunity to express their individual opinions with five general open ended questions. As answering these questions were not mandatory, only about 15% of the students responded. Respondents were asked to elaborate on their general experience in relation to the overall experience with the flipped classroom. Responses to these open ended questions are useful to corroborate answers to closed questions, offering support that the questionnaire is valid[22]. Formal content analysis was undertaken rigorously[23,24]. where the steps mentioned below were followed by two researchers independently to increase the reliability[25].

1. Read a sub-set of the comments.
2. Devised a coding frame to describe the thematic content of the comments.
3. Assigned the codes to all the comments.
4. The codes were then categorised in appropriate categories.

5. These categories were then reviewed by rereading the previously read comments to check the suitability of the categories developed[25].
6. Inter-rater reliability of identified categories and comments assigned to categories, were calculated using Miles and Huberman's formula[26] as follows: Reliability = number of agreements/total number of agreements and disagreements. The reviewers resolved all differences in coding through discussion and came to an agreement.

For the question one, "what do you consider as the advantages of a flipped classroom?" The four categories of responses identified were: This made them come prepared for the class, they could clarify their doubts, the lecture video could be watched repeatedly and at their convenience and it was fun. To the second question as to what they considered as disadvantage of flipped classroom, only three students responded. They found the information in the video inadequate, one respondent preferred face to face interaction rather than watching the lecture on video and one respondent felt that flipped classroom preparation time was encroaching on his other academic activities. The third question was if they considered flipped classroom suitable for all topics. The response was that, it may be suitable only for simpler topics. They also suggested that using different teaching learning methods depending on the complexity of the topic would be beneficial. The fourth question invited their suggestions to improve the flipped classroom. The responses were varied and quite contrary to one another .For example a few of them suggested that the facilitator should again explain the topic during the class, where as some felt that this was not needed and the class time should be spent more in discussing case vignettes which will help them develop critical thinking and problem solving. The fifth question "any other comments" generated only appreciative responses.

Discussion: Flipped class as a model teaching tool was received favorably by most of the student community. This has been brought out in various studies conducted so far[6, 7, 27]. The teacher is given a flexibility to dwell into the depth of the subject and provide an opportunity to the students in applied learning[8]. Our study has re-emphasized the fact that the flipped classroom was welcomed by the students as a novel teaching tool.

The flipped classroom is a relatively new education model in Asia. Opinions vary on the specifics of what comprises a flipped classroom model, but it is fairly clear that its primary tenet is the focus on active, pre-class preparation, thus allowing classroom time to focus on problems or discussions, again involving more active learning.

Among the studies conducted, the students as well as teachers have shown a favorable response for this method[9]. The flipped class allows the student to take responsibility for his/her learning. This is one of the most important aspects of adult learning. There is growing evidence that e-learning in medical education has become an important adjunct to learning by traditional teaching[14]. Medical educators are evaluating the methods which are most appropriate in delivering the vast body of knowledge to medical students[28].

The students at International Medical School, Bangalore represent the current generation of students who incorporate unique style of learning with the help of online study material in addition to traditional methods.

In our institute students' assessment is based on Bloom's taxonomy with a majority of the questions stimulating the analytical and problem solving skills, so essential in a practicing physician[29, 30].This was the reason for using both MCQs and SEQs for testing their acquisition and application of knowledge.

Our study demonstrates that the students preferred a flipped class approach compared to the traditional teaching of the designated topic. This also supports the current evidence where there have been favorable responses to flipped class teaching across different fraternities[8, 10]. The results of the Test 1 clearly indicate that the video sufficed in helping the students grasp the basics of the subject. Rose et al demonstrated that pediatric residents scored better in post- test when flipped class was introduced for teaching pediatric emergencies[31]. In their study, Tainter et al could assess the knowledge and comprehension among surgical residents posted to ICU following their exposure to flipped class. The group showed a significant improvement in the post intervention assessment[32]. Munson et al in their study concluded that a combination of video lectures,

discussion and problem solving contributed in improved examination scores[33].

Only a few students could perform reasonably well in analyzing the clinical problem in test 2 (table III). The knowledge of the subject did help these students to critically analyze and solve the case. This could be because first year students do not have any clinical exposure. Almost all the students were positive about the online learning of basics through video lecture and were satisfied with this newer teaching method (graph I). One of the key advantages of the flipped classroom is that it allows students to move through content and learn at their own individual pace[34]. In our study, this proved to be of significant value as seen from the Test 1 scores (Table3). Flipped class is similar to a traditional lecture class where in concepts are introduced for the basic understanding of the subject. In general, flipped classroom is a well-received method by the students which will help them in self-directed learning. The present study was conducted as a pilot to evaluate the effectiveness offlipped class as student centered T/L method and to obtain feedback from students in order to implement itin the ensuing academic year.

The limitation of the study was that, there was no definite way in which we could monitor if the students had learnt the basics from the video lecture provided to them. Test 1 was used indirectly as an indicator whether the student had studied from the video lecture as it consisted of MCQs based on the basic facts provided in the lecture. The Test 2 was conducted after discussion in the class and was aimed at assessing the application and critical thinking.

Conclusion: Flipped classroom is appreciated and well received by students and teachers alike. With a well-executed flipped class, the scheduled class time can be used productively for active learning. The flipped class room helps to kindle the minds of pre-clinical students to initiate application of their knowledge of physiology in the forthcoming clinical years.

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