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Perception of MBBS students to "flipped class room" approach in neuroanatomy module

Raveendranath Veeramani[1], Venkatesh S. Madhugiri[2], Parkash Chand[1]
Departments of [1]Anatomy and [2]Neurosurgery, Jawaharlal Institute of Postgraduate Medical Education and Research [JIPMER], Dhanvantri Nagar, Pondicherry, India

Abstract: A flipped classroom is a learner centered approach in which the learner is responsible to attend the class with basic understanding of the subject to fully participate and engage in discussions. The aim of this study was to evaluate students' perception of flipped classroom approach for neuroanatomy module and assess the impact on their performance and attitudes. The subject chosen to evaluate the flipped classroom model for first year medical students was clinical neuroanatomy. One hundred and thirty first year medical students participated in the study module. Students were divided into five groups and five case scenarios pertaining to various clinically relevant regions of the neuraxis, with varying anatomical complexity were generated. The pre- and post-tests were designed to specifically test the declared learning objectives of the session. The perception of the students regarding this model of teaching and learning was also evaluated. Eighty-six percent of students felt that the flipped classroom approach was better at fulfilling the stated learning objectives than the conventional didactic teaching, 92% felt that the work-sheet with questions provided prior to the class enabled a better understanding of the subject and 87% were of the opinion that the web sources with references kindled a greater interest to read as compared with didactic lectures. The paired t test showed highly significant differences between the pre and post-test scores. Student response to the flipped classroom structure was largely positive, indicating it to be an approach worth pursuing in future years.

Key words: Flipped class room, Inverted classroom, Neuroanatomy

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Introduction

Didactic teaching sessions occupy a large proportion of the available teaching-learning time in medical courses. This form of teaching usually takes the form of a lecture delivered by an expert to a group of students. The size of the student group differs in various milieus and decides the aids used in teaching; these may include a chalk and board, computer aided slide projection systems and audiovisual aids. The students' role is reduced to listening, recording or making notes, with opportunities for questioning and interaction usually being relegated to the concluding minutes of such a session. The teacher is obviously unable to meet the varying demands of each student during such a session.

Attempts to put the available teaching-learning time to better use and address the needs of students by increasing active involvement in the teaching-learning process led to the evolution of the "flipped classroom" or "inverted classroom" approach [1]. In this model, the activities carried out during traditional class time and self-study time are reversed or 'flipped.' Although such an approach could be implemented in many ways, it usually involves students preparing for class by watching a pre-recorded lecture or undertaking assigned reading activities. The class time is used for interactive discussion or problem-solving. Thus, the role of the teacher shifts

Corresponding author:
Raveendranath Veeramani
Department of Anatomy, Jawaharlal Institute of Postgraduate Medical Education and Research [JIPMER], Dhanvantri Nagar, Pondicherry 605006, India
Tel: +09043997352, E-mail: dr_raveendra@rediffmail.com

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from being the 'sage on the stage' to the 'guide by the side' [2]. There is evidence that demonstrates that students taught via this approach are more aware of their own learning process. This awareness would allow for adjustments pertaining to their activity and focus in order to perform optimally in the course [3].

Several of the world's leading universities have implemented this model and the performance and perception of the flipped classroom model has been studied in several student cohorts [4]. Undergraduate students in the first year of a medical course have little background knowledge of the material they are taught; this could be construed as being one barrier to using the flipped classroom approach for this group of students. There have been no studies that evaluate the feasibility or the response of first year medical students to the flipped classroom learning model. We conducted a study to assess the perception of first year medical students to an interactive session on neuroanatomy teaching using the flipped classroom approach.

Materials and Methods

The subject chosen to evaluate the flipped classroom model for first year medical students was clinical neuroanatomy from Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Pondicherry, India. One hundred and thirty first year medical students comprising of 60 males and 70 females with age range between 20–26 years participated in the study module. The session was planned and conducted jointly by the Departments of Neurosurgery and Human Anatomy. Students were divided into five groups (with 26 students per group) two weeks prior to the planned session. Five case scenarios pertaining to various clinically relevant regions of the neuraxis, with varying anatomical complexity were generated. Three questions were appended to each case scenario. The first question dealt with the anatomy relevant to understanding the case scenario. The second question required a fusion of anatomy with physiology to explain the pathophysiology of the disease condition. The third question dealt with the application of anatomy and pathophysiology information to devise a suitable management strategy. All the groups received all the case handouts a week prior to the session. An example of one such case scenario is as follows:

A 45 year old lady presents with complaints of pain in her upper back radiating around the left side of her chest at the level of the nipple. She also complains of weakness of her left lower limb, beginning 6 months previously. She initially noted difficulty in gripping footwear with her toes. She then noticed that her entire lower limb felt rigid and stiff and she had difficulty getting up from a squatting position. She also noted parasthesiae of her right lower limb, progressing to sensory loss, beginning over the sole of her foot and ascending to involve the entire foot. She now complains of stiffness of her right lower limb as well as parasthesiae over her left lower limb. ***On examination****, HR, BP, RR were all normal. CVS, RS and abdomen are normal. CNS – Higher mental functions were normal, Cranial nerves were all normal. She had normal bulk in all muscle groups, Tone – was normal in upper limbs, grossly increased in both lower limbs, L>R.Power – normal in upper limbs, paraparesis, grade 3/5 on the left side, 4/5 on the right side.She had sensory loss to touch and pressure on the right side. Deep tendon jerks – upper limbs were normal, lower limbs (knee and ankle) grossly exaggerated. Babinski was positive bilaterally*

Questions

1. *How do you explain her symptoms and the examination findings using a knowledge of anatomy (and physiology)? List the structures involved.*
2. *Using your knowledge of anatomy - Where is the lesion?*
3. *How will you confirm/arrive at a definitive diagnosis?*

The general lesson plan and learning objectives were declared *a priori*. The module consisted of two parts, the first, offloading content and the second, creating a learner centered classroom. For the first part, which involved individual learning as well as group discussion, study aids in the form of web sources related to neuroanatomy and neuropathology modules were provided, as were relevant clinical neuroanatomy textbooks. The second part, or the full course "learner centered classroom" was planned over two hours.

The session commenced with the administration of an objective type written pre-test pertaining to the topics of discussion. Subsequently, each case scenario was projected and a member of the group randomly chosen by the facilitator to provide the prepared answer to each question. This answer was discussed with the rest of the class. Supplemental information was provided by a neurosurgeon to facilitate understanding of the anatomy and its clinical relevance. A pre-prepared slide presentation with anatomic illustrations and surgical videos was used to provide this supplementary information and to clarify anatomical and physiological

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concepts. All the case scenarios were addressed in a similar manner. At the conclusion of the session, a post-test was administered. The pre- and post-tests were designed to specifically test the declared learning objectives of the session.

The perception of the students regarding this model of teaching and learning was evaluated by two short questionnaires, with responders maintaining their anonymity. The first questionnaire was a closed set that had ten items, graded using the Likert five-point scale. A 5-pt Likert scale with a score of 1=poor, 2=satisfactory, 3=good, 4=very good, and 5=excellent was used to find out the rating from the students. The number and percentage of students responding to each item was noted. The mean rating for each item was calculated (Table 1). Student's suggestions and remarks were also elicited. The second questionnaire contained open ended questions so as to elicit freewheeling comments from the students as a qualitative dimension assessment. The students' performance was also evaluated via a scheduled summative neuroanatomy exam comprising short note and essay-type questions; this was administered a week after the flipped classroom session. The students' performance on this summative exam was compared with their performance on the post-test. The students were also asked if were likely to consider a career in the neurosciences. This question was addressed to them both before and after the session, so as to check if the flipped classroom approach was able to arouse their interest in the subject.

The pre- and post-test score obtained by each student was calculated and a paired t test applied to test for statistical significance of the difference, if any. The correlation between scores obtained on the post-test and in the summative neuroanatomy exam was calculated using Spearman's correlation coefficient. Besides this, scores obtained by the present batch of students on the summative exam (after the flipped classroom session) was compared with scores obtained by the previous batch that only had traditional didactic teaching. The previous batch of students had the same course content but the instructors are different set of experts in traditional teaching method. The $P \leq 0.05$ was considered statistically significant for all statistical tests.

Results

All 130 students responded to the questionnaires. The mean age of the students were 24 years and majority were females (n=70). The responses to each statement are summarized in Table 1. The category with the highest number of responses for each statement has been highlighted. From Table 1, it is evident that a large majority of the students preferred the flipped classroom approach to the traditional lecture method of teaching. Eighty-six percent of students felt that the flipped classroom approach was better at fulfilling the stated learning objectives than the conventional didactic teaching, 92% felt that the work-sheet with questions

Table 1. The questionnaire distributed to the students with their responses to the flipped classroom approach

Sample No.	Content and structure	Response					Mean rating	Total
		1	2	3	4	5		
1	At the beginning of the each session, all educational objectives were clearly defined	79 (61)	33 (25)	18 (14)	0	0	1.5	130
2	The worksheet given prior to the session was very useful to understand the topic	92 (71)	28 (21)	10 (8)	0	0	1.3	130
3	The sources given in the worksheet such as- references and web sources kindled interest to read	98 (76)	27 (21)	3 (2)	2 (1)	0	1.3	130
4	This method was more engaging and interesting in comparison to traditional class	101 (78)	26 (20)	3 (2)	0	0	1.2	130
5	This module provided sufficient knowledge of anatomical basis of neurosurgical disease localization and approaches [Deeper understanding]	92 (71)	27 (21)	8 (6)	3 (2)	0	1.3	130
6	More such modules should be organized in the future	110 (85)	11 (8)	9 (7)	0	0	1.2	130
7	Time allotted for the cases were adequate	89 (68)	11 (9)	10 (8)	12 (9)	8 (6)	1.7	130
8	This method made me participate actively with the subject	75 (58)	26 (20)	9 (7)	12 (9)	8 (6)	1.8	130
9	Enjoyable way of learning	95 (73)	26 (20)	9 (7)	0	0	1.3	130
10	The team based activity enabled me to go through the topic prior to the module	91 (70)	26 (20)	11 (9)	2 (1)	0	1.4	130

Values are presented as number of responses to each statement (%). Response: 1, strongly agree; 2, agree; 3, neutral; 4, disagree; 5, strongly disagree.

provided prior to the class enabled a better understanding of the subject and 87% were of the opinion that the web sources with references kindled a greater interest to read as compared with didactic lectures. Seventy-eight percent of the students also felt strongly that this method provided them with an incentive to actively engage with the subject before the class. Ninety-three percent of students opined that more such flipped classroom sessions should be organized in the future. The mean ratings for each category ranged between 1.2 and 1.8, proving the fact that the students appreciated flipped classroom approach.

The mean±SD of pre- and post-test scores were 3.35±1.5 and 8.12±1.6, respectively. The paired t test showed highly significant differences between the pre- and post-test scores (P<0.05). A positive correlation (0.5) was noted between the mean post-test scores and the summative neuroanatomy exam scores. The mean and SD of the summative neuroanatomy scores of present batch with the previous batch was 89±12% and 70±14%, respectively. There was also a significant difference (P<0.05) between the neuroanatomy examination scores of present batch after the flipped classroom session than those of the previous batch that had only traditional teaching. The percentage of students who opined that they would be interested in considering the neurosciences as a career option was as high as 70% at the end of the session and majority of them were males.

The answers to the following open-ended questions were also collected: (1) In what way did the flipped classroom model support your learning?, (2) Were the handouts and web resources useful?, (3) Which aspect of the session did they enjoy most?, (4) Which aspect of the session was least enjoyable or least useful?, and (5) Any other comments? Most students responded to all these questions. Some of the opinions expressed by students from this flipped classroom approach during the activities carried out in the research process are given below:

"I liked this type of class very much. The scenarios were enjoyable. The scenarios made us to like the topics of neuroanatomy. Group works were good as well. I believe that I will be more successful with the help of these type of teaching."

"It is interesting; I understand better; I was able to listen to class as I solved the cases; I was able to interact with the facilitator better as I had read the basics prior to class; It created a group activity enabling us to share what we understood."

"I concentrated in the class for a long time as it was interactive and it added to what I learnt at home. Made my concepts clear. More such sessions to be organized; It gives a different orientation to the topic and certainly to be incorporated into Medical sciences."

These were the qualitative findings obtained from the open ended questions through flipped classroom approach. Therefore, the students opined that the flipped classroom model did indeed help them learn and understand better because they actively engaged with the subject as well as the teaching process. Students also felt strongly that this active learning process and the discussion made them more attentive in the class than during the traditional lectures. However, some students averred that this method should not be used for all classes and felt that traditional teaching methods were required for certain topics that were difficult to understand. A few students (2%) commented that they were unable to correlate the surgical knowledge provided (including the videos) with the knowledge of basic sciences that they were expected to learn and retain.

Discussion

The term "flipped classroom" was coined by Jonathan Bergmann and Aaron Sams, two high school chemistry teachers from Colorado, USA, in 2012. They had begun flipping the teaching and learning scenarios in 2007. The flipped classroom model (also called an inverted classroom) has since spread to many other branches and milieus of learning and education around the world. Although the perceptions of students towards the flipped classroom approach have been evaluated in several disciplines and at varying levels of learning, such data is not available for medical students. More specifically, data on the efficacy of this model in the teaching of human anatomy (which is a first year subject) in lacking in literature.

The feedback obtained after the flipped teaching session in this instance mirrors data from other study [5]. The noteworthy comments are that it helped them to understand better, to actively engage with and thus learn the subject and the availability of ample time and opportunity to discuss and clarify their doubts with the facilitator. This was possible as much of the key material was learnt prior to class. Students agreed that active student engagement was consistently encouraged by the instructor and they also realized that good preparation for the class was necessary for an optimal

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utilization of time.

The key to the success of this approach is that students take responsibility for their own learning. This could be perceived as both an advantage and a disadvantage. Advantages of this approach include an increase in opportunities for interaction between students and teachers, a shift in the responsibility for learning onto the students, the freedom to prepare for the class at a time that suits them, the opportunity to revise the material and as many times as required, the ability to readily archive learning resources, collaborative working between students, an increase in student engagement and a shift from passive listening to active learning. Possible disadvantages include the need to invest time and resources to develop such courses, the possible need for technological investment and time for both teachers and students to acquire and adapt to the new skills required for this more active and self-directed approach to learning.

Research has shown that the average attention span of a medical student is 15 to 20 minutes and the optimum length of a lecture may be 30 minutes rather than 60 minutes [6]. Thus, it is possible than the results of hour-long lectures may be less than optimal. Students can read and learn information on their own, but they need instructors to act as coaches and mentors to stimulate and challenge their thinking, guide them in solving problems, and encourage their learning and application of the material [1]. Evidence also indicates that engaging students in active learning enhances their learning outcomes higher-order thinking, problem solving, and critical analysis and improves their motivation and attitudes [7]. A study conducted on nursing students to determine the effect of flipped classroom concluded that blending new teaching technologies with interactive classroom activities can result in improved learning but not necessarily improved student satisfaction [8]. It is almost certain that instructional videos, interactive simulations and other online tools will continue to proliferate. However, how effectively these tools fulfill their potential remains to be seen [9-12]. It is also stated based on a team teaching subject in a medical school that the professors should reach a consensus on an item difficulty and should consider their teaching methods so that students would develop understanding and interest in gross anatomy [13].

Flipping the traditional classroom is both a feasible and necessary move to educate students to reinvent their classrooms 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 [4]. Finally, it is important to plan and consider the academic time taken to deliver a course using a flipped classroom approach.

Although every precaution was taken to carefully prepare and conduct the flipped classroom module, there are certain limitations attendant to this study. The entire neuroanatomy module was not taught using the flipped approach; only the clinical neuroanatomy section. The other issue is that first year medical students who enter a medical course after 12 years of school education, without prior undergraduate education (as happens in several countries including India) may be ill equipped to read and understand complex medical subjects on their own. If they do get overwhelmed by the set material for self-study, the flipped model will do little to remedy this. In order to generate a robust comparison, the students would need to be randomly assigned to one of 2 groups—one of which would be taught an entire module (say neuroanatomy) by conventional techniques and the other, only through flipped sessions. However, such an experiment would raise several issues. Until such robust data becomes available, a hybrid of didactic teaching sessions interspersed with flipped sessions may be ideal.

Students felt that the flipped classroom approaches promoted active learning and enhanced their capacity to perform better in their exams compared with traditional lectures. Student response to the flipped classroom structure was largely positive, indicating it to be an approach worth pursuing in future years.

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