

Original research article

Implementation of Flipped Classroom Model in teaching Biochemistry to Phase-I MBBS Students.

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Abstract

Background: With the implementation of the new competency based curriculum in the Indian medical education system in 2019 there has been adoption of innovative tools to make teaching and learning student-centric. The education system is changing from teaching facts to empowering students to learn how to look for relevant information and organise it for better learning. Flipped classroom is one such model where the learner is assigned didactic lecture material before the class and the class room is used for face to face interaction to inculcate a higher level of thinking amongst the students. At this juncture this study has been conducted to see the effectiveness and feasibility of implementing flipped classroom in teaching biochemistry to Phase I MBBS students.

Aim & Objectives: The aim of the study is to examine the effectiveness and feasibility of flipped classroom model in teaching biochemistry to Phase I MBBS students through analysis of perception of students and faculty at Government Institute of Medical Sciences (GIMS), Greater Noida.

Methodology: Flipped classroom model was implemented in the subject of biochemistry among 95 Phase I MBBS students. The pre class reading material was shared four days prior to each classroom session. During the classroom session there was focused discussion promoting higher level of learning. Thereafter, feedback was taken from the students and the concerned faculty in a pre- validated structured questionnaire (with both closed and open ended questions) about the effectiveness and feasibility of such flipped classes.

Findings: The study observed high satisfaction score regarding teaching and learning through flipped class on a five point Likert scale. The Satisfaction index (SI) calculated as per a prescribed formula was found to be 94.1, where students agreed that flipped class inspired them to pursue further learning for the module. Around 98% of students with SI of 93.61 agreed that flipped classroom session improved their understanding of the key concepts. SI was 94.73 where students found flipped class to be engaging, SI of 95.91 indicated that students were satisfied with the clarifications on difficult concept by the faculty during the flipped class. All faculty strongly agreed that flipped class is a more interesting teaching learning methodology compared to the traditional method. There was better faculty- student interaction and that it helped promote higher order thinking in the students. Positive responses were seen in the open ended questions regarding this methodology.

Conclusion: The present study concludes that flipped classroom is an effective and motivating method to engage students. Both students and faculty agreed that flipped class is more engaging and has led to increased interaction among the students as well as with faculty. In view of the strongly positive perceptions observed among the respondents of the study, flipped classroom methodology is an approach worth pursuing in future and implementing on a wider scale.

Introduction

In recent times, India's medical education system has moved to competency based medical education (CBME). With the stated goal of undergraduate medical training to produce "physicians of first contact", there is a need to implement learner – centred models. A critical skill requirement for students is to develop the ability of self-directed learning and be a lifelong learner. ^[1]The education system is changing from teaching facts to empowering students to learn how to look for relevant information and organise it for better learning. In medical education a major portion of the course is covered by didactic lectures. The traditional teaching methods are basic ways of imparting knowledge. To promote higher student engagement involving active learning strategies, curriculum innovation projects are being encouraged. It is an important challenge for the educators in any discipline to design effective modules that facilitate the students to become active learners.

Flipped classroom is one such model where the learner is assigned didactic lecture material before the class time and the class room is used for higher order face to face discussion to inculcate a higher level of thinking amongst the students. In traditional teacher- centric model, the teacher is the primary source of knowledge; in flipped classroom model, instruction shifts to a learner-centric approach. This model helps students to develop higher levels of learning i.e. applying, analysing, evaluating and creating during the classroom time.^[2] The teachers become facilitators who decide what they need to teach and what the students need to explore on their own. As facilitators, their job becomes more demanding than in the traditional set up. During class time, they provide feedback to students relevant in the moment and assess their academic work including their depth of knowledge. ^[3] Flipped classroom is a model of learning that developed under the blended learning model where student will not listen to the lectures in classroom but at home. The traditional classroom lecture will be moved to video which allows students to watch and repeat it as and when needed. ^[4] Research supports that the students enjoy being able to learn at their own pace and that students who learned through a flipped classroom approach considered themselves more engaged than students attending traditional courses. ^[5]

The current generation of students are more engaged with various technologies. The new technologies can be used in medical education as a source to facilitate the teaching and learning. A successful implementation of this innovative and effective flipped classroom method requires proper planning in a stepwise manner, starting with priming of the students and delivery of educational content as pre-class material. The second step in class activity involves peer learning and problem solving. The last step should include application of knowledge and feedback.^[6] To establish a successful teaching learning with technology - based learning, interaction is important, be it student-content, student- teacher, or student-student.^[7] As we move towards enhancing student learning, we as teachers need to contribute to the insights we gain by adopting new teaching and learning methods.

AIM & OBJECTIVES

Aim: The aim of the study is to examine the effectiveness and feasibility of flipped classroom model in teaching biochemistry to Phase I MBBS students through analysis of perception of students and faculty at Government Institute of Medical Sciences (GIMS), Greater Noida.

Specific objectives:

1. To evaluate the effectiveness of flipped classroom model for engaging students in active learning process.
2. To analyze the perception of students and faculty about flipped classroom module.
3. To assess the feasibility of using flipped classroom model as a regular teaching learning method.

METHODOLOGY:

The study was conducted to evaluate the effectiveness of flipped classroom in teaching biochemistry to Phase I students. The study was conducted in the Department of Biochemistry, Government Institute of Medical Sciences, UP. All 99 students of 2020 Batch enrolled for the study of which 04 did not complete the study. Ethical clearance was obtained from the Institutional Ethics Committee of GIMS vide their Letter No: GIMS/IEC/ HR/2021/07. The students were included in the study after obtaining informed consent from each one of them. The faculty members in the department were sensitized about the flipped class model where their role as facilitators was explained. Subsequently they identified the topics to be covered in the flipped class module. The topics chosen for this study were heme metabolism and liver function tests from two competencies of Biochemistry. A lesson plan and Specific learning objectives were finalized. Before the module was implemented the students were also sensitized about the flipped class.

The module consisted of two parts. The first part was disseminating the content (online activity) and the second part was the learner-centric flipped classroom. A common portal for exchange of information a WhatsApp group was formed, with students and faculty. Four days prior to each class, learning material was provided to the students which included PPTs, Videos and case reports. Instructions were posted in the WhatsApp group to access the material. The students were also suggested to refer to textbooks and were provided links for online material related to the topic. The students went through the study material and discussed with the peers before each classroom session.

The second part of flipped class activity was the contact session of 2 hours in the classroom. The sessions started with a discussion on the basic concepts of the topic which had already been covered by the students as pre class activity. The students were subdivided into groups of 8 each to facilitate interaction. They were given handouts which had case scenarios and laboratory investigation reports. The groups were given 30 minutes to discuss amongst themselves the problems given in the handouts. The problems were discussed and a student from each group presented their answer. The facilitator provided additional relevant information for better understanding of the topic. The session ended with a quiz through MCQs in google form.

Once the competencies were covered and the flipped class module was completed a written feedback was obtained from the students and faculty in the form of questionnaires regarding their perception on flipped class (Copies of Questionnaires attached as Annexures – 1 and 2).

The 5 point Likert scale was used for feedback. The identity of the responders was kept anonymous. The feedback questionnaire was adapted from a validated questionnaire.^[8] The percentages of students and faculty responding to each item were noted. The median and satisfaction index of each item was calculated. The questionnaire also included a few open ended questions so as to elicit general perception comments from students and faculty.

OBSERVATIONS AND RESULTS

The study was intended to evaluate the effectiveness of flipped class in teaching biochemistry to Phase I MBBS students. Out of 99 students, 95 completed the study. The 4 cases of nonparticipation in the classroom session were due to personal reasons or illness. Students who participated in flipped class activity responded to the questionnaire regarding their perception towards flipped class. Six faculty members participated in this flipped class activity.

After completion of the study the students and faculty were asked to provide feedback through a questionnaire which also included some open ended questions about advantages, disadvantages and challenges faced. Feedback was taken using a 5 point Likert scale as shown in Table 1 and 2. The median was 5 (strongly agree) for most of the items and 4 (agree) for a few items. The satisfaction index (SI) of each item was calculated using the following formula^[9]:

$$\frac{[(n_1*1) + (n_2*2) + (n_4*4) + (n_5*5)]*20}{(n_1 + n_2 + n_4 + n_5)}$$

Here n is the total number of students gaining the score mentioned in the subscript for that particular item.

The scores were rated on a 1-100 satisfaction index scale. Satisfaction index was 94.1 where students agreed that flipped class inspired them to pursue further learning for the module. Around 98% of students with satisfaction index of 93.61 agreed that flipped classroom session improved their understanding of the key concepts. SI was 94.73 where students found flipped class to be engaging and SI was 95.91 where students were satisfied with the clarifications on difficult concept by the faculty during the class.

Table 1: RESPONSES OF STUDENT FEEDBACK QUESTIONNAIRE

	Response on Likert Scale					M	SI
	5	4	3	2	1		
1. Pre-reading material was available on e-learning portal before the Flipped Classroom activity.	81 (85.3)	11 (11.6)	1 (1.1)	1 (1.1)	1 (1.1)	5	96.17
2. Adequate time was provided to spend on the pre-reading material before the Flipped Classroom activity.	72 (75.8)	18 (18.9)	1 (1.1)	3 (3.2)	1 (1.1)	5	93.4
3. Pre-reading material was relevant for the Flipped Classroom activity.	75 (78.9)	18 (18.9)	0 (00)	0 (0)	2 (2.1)	5	94.52
4. The classroom arrangements (positioning of the chairs for group activity, audio-visual facilities) were for Flipped classroom.	47 (49.5)	44 (46.3)	3 (3.2)	0 (0)	1 (1.1)	4	89.56 conductive

5. The activities during Flipped Classroom session improved my understanding of the key concepts.	67 (70.5)	26 (27.4)	1 (1.1)	0 (0)	1 (1.1)	5	93.61
6. The Flipped Classroom session inspired me to pursue further learning for the module.	63 (66.3)	26 (27.4)	6 (6.3)	0 (0)	0 (0)	5	94.1
7. More lectures should be conducted in the Flipped Classroom mode	61 (64.2)	22 (23.2)	8 (8.4)	4 (4.2)	0 (0)	5	92.18
8. Instructor was able to engage me in the Flipped Classroom activity.	70 (73.7)	25 (26.3)	0 (0)	0 (0)	0 (0)	5	94.73
9. Instructor was able to provide clarification on difficult concepts during the Flipped Classroom activity.	74 (77.9)	19 (20.0)	2 (2.1)	0 (0)	0(0)	5	95.91
10. Instructor was able to expand on e-lectures and pre-reading material during the Flipped Classroom activity.	68 (71.6)	24 (25.3)	2 (2.1)	1 (1.1)	0(0)	5	94.19

Values are presented as number of responses to each statement (%). Response on Likert scale. 5= Strongly agree, 4=Agree, 3=Uncertain, 2=Disagree, 1= Strongly disagree, M median, SI satisfaction index

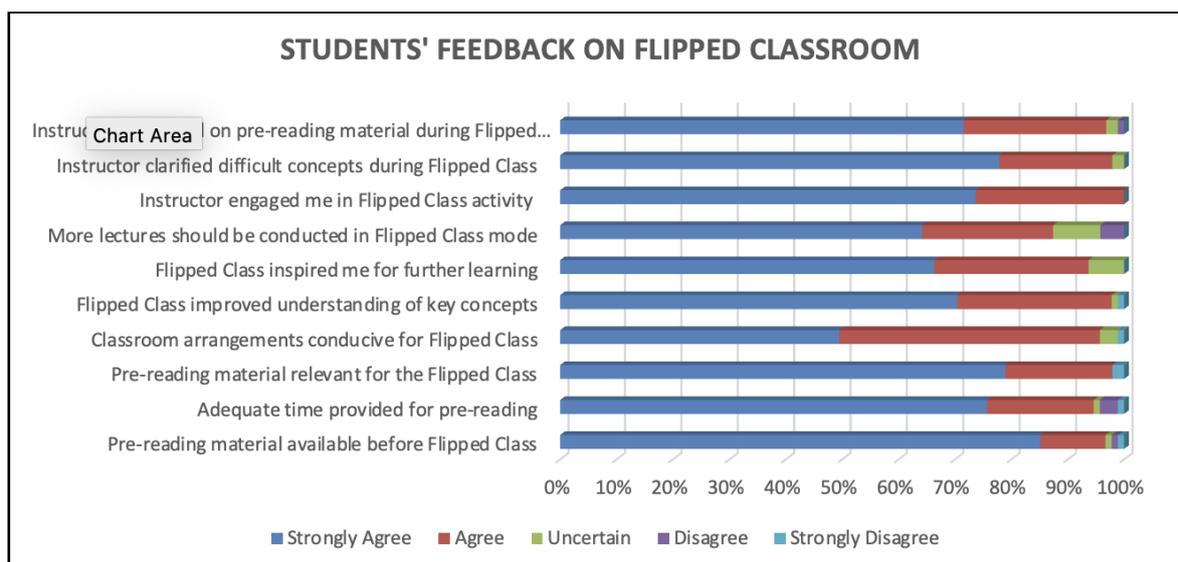
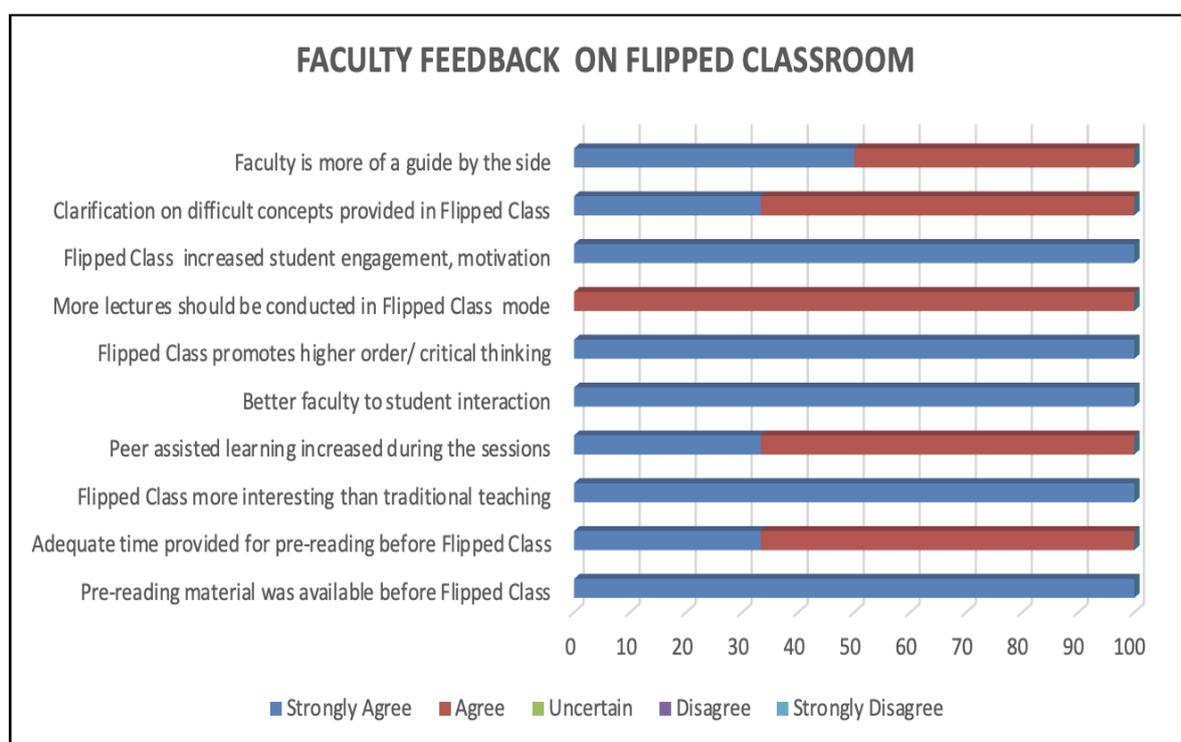


Table 2: RESPONSES OF FACULTY FEEDBACK QUESTIONNAIRE

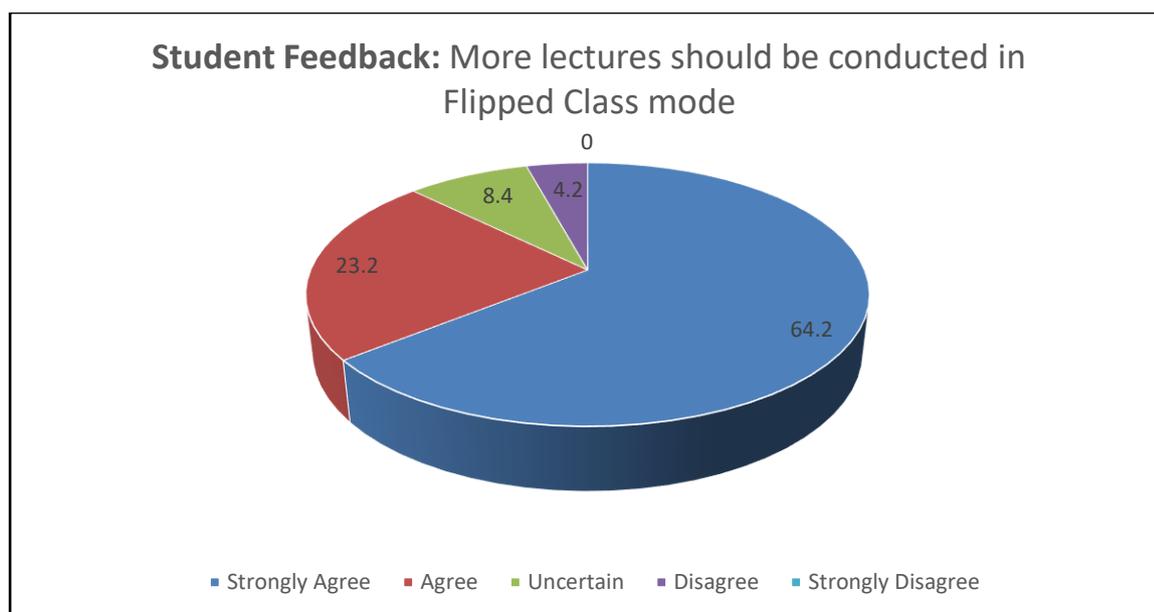
	Response on Likert Scale					M	SI
	5	4	3	2	1		
1. Pre-reading material was available on e-learning portal before the Flipped Classroom activity.	6 (100)	0	0	0	0	5	100
2. Adequate time was provided to spend on the pre reading material before the Flipped Classroom activity.	2(33)	4(66.7)	0	0	0	4	86.66
3. Flipped Classroom is more interesting than traditional 100 teaching.	6 (100)	0	0	0	0	5	

4. The Faculty feel peer- assisted learning increased during the sessions.	2 (33.3)	4 (66.7)	0	0	0	4	86.66
5. There was better faculty to student interaction.	6(100)	0	0	0	0	5	100
6.The Flipped Classroom sessions promote higher order thinking/ critical thinking amongst the students.	6(100)	0	0	0	0	5	100
7. More lectures should be conducted in the Flipped Classroom mode	0	6 (100)	0	0	0	4	80
8. Flipped Classroom activity has increased student engagement, motivation and participation.	6 (100)	0	0	0	0	5	100
9. Faculty was able to provide clarification on difficult concepts during the Flipped Classroom activity.	2 (33.3)	4 (66.7)	0	0	0	4	86.66
10. Faculty is more of a guide by the side.	3 (50)	3 (50)	0	0	0	5	90

Values are presented as number of responses to each statement (%). Response on Likert scale. 5=Strongly agree, 4=Agree, 3=Uncertain, 2=Disagree, 1=Strongly disagree, M median, SI satisfaction index



All faculty strongly agreed that flipped class is a more interesting teaching learning methodology compared to the traditional method. There was better faculty student interaction and that it promoted higher order thinking in the students. Findings regarding a positive perception of flipped class are also objectively supported by the MCQ test score where more than 80% of students scored above 70% marks.



The study observed high satisfaction score regarding teaching and learning through flipped class on a five point Likert scale. Response reflecting a positive perception were seen in the open ended questions regarding this methodology. Some of the opinions expressed by the students in the form of open ended questions are mentioned below:

“Have access to lecture for review and can read at my own pace.”

“We were able to correlate the topic clinically.”

“Going through the reading materials specially the prerecorded lectures was very useful in solving the problems during class.”

“Interactive and interesting classroom session, had opportunity to ask questions.”

“More lectures to be conducted as flipped class.”

Some of the students opined that:

“It requires good time management.”

“If I don’t go through the pre reading material it is difficult to participate in the discussion during the class.”

Some of the comments of faculty were:

“It is an interesting way to teach .Even students participate actively.”

“It provides more opportunities for students to engage in critical thinking.”

“We can focus on the critical part of lecture, applied knowledge and problem solving skills during the class.”

“Faculty student interaction has increased”

“It will increase our workload if implemented for more topics”

DISCUSSION

With medical education shifting to competency based medical education, flipped class model has the potential to be an effective and beneficial teaching learning methodology. As suggested by Klein et al “innovative learning format should be developed to address both perceived and unperceived education needs in a supportive environment that is both enjoyable and competitive”; and the flipped classroom model could possibly do that. ^[10]

In this study we assessed the effectiveness of flipped class and perception of students and faculty regarding flipped class approach in teach biochemistry.

The flipped class has been used in many educational settings. In our study all the students and faculty have reflected their satisfactory experience with flipped class which can be considered as a success. The findings are in line with Surywanshi et al and Ramnanan et al who concluded that students were more satisfied with this approach and there was an overall improvement and in depth learning improved. ^[11, 12]

The findings in this study reinforce the theory of Bloom's revised taxonomy for cognitive domain. ^[13] The students were able to do the lower level of cognitive work (gaining knowledge and comprehension) outside the class and focus on the higher forms of cognitive work (application, analysis, synthesis or evaluation) in the class through various activities.

This study shows that both the respondent groups agree that there is increased interaction of students with fellow students and faculty during flipped class. This is consistent with the findings of study conducted by Galway et al which reported that the classroom sessions increased interaction. ^[14]

The reading material was shared with the students four days prior to the class. A few students suggested that the resources may be shared at least one week before the class. However, a majority of the students and faculty agreed that adequate time was provided to spend on the pre-reading material before the classroom activity. Sharing the resources one week in advance may provide better results but a definite answer is not known. ^[15] The ideal format of preparatory material and the quality of material to be prepared is also not known in flipped classroom implementation. ^[16]

The faculty and students strongly agreed that flipped class is more engaging during classroom sessions compared to traditional teaching. The students learnt the basic concepts on their own by going through the reading material. The faculty said that they could utilize the class sessions more effectively. This is evident from open ended responses like "*We can focus on critical part of lecture, applied knowledge and problem solving skills during the class.*" This is also supported by the findings of Milman N who found that flipped class allowed more time for engaging students and focused classroom discussion. ^[17]

The study conducted by Nori revealed that a majority of students had a positive attitude towards flipped class which strongly correlates to the perception of increased motivation, engagement and effective learning. Easy access to study material by students as reported by Nori is similar to the findings of our study where students have shown high satisfaction index on this matter. ^[18]

Our study showed that flipped class promotes active learning. The students take ownership of their learning process for a better learning experience. This teaching learning methodology provides opportunity for students to align their prior knowledge gained outside the class with the problem solving skills during the class. These learning experiences will help the learners to become self-directed learners, build their confidence and create a learning environment of open questioning.

One of the student responses in the open ended questions was "*If I don't go through the pre-reading material it is difficult to participate in the discussion during the class.*" It is important for faculty to get the students on board by explaining the importance of going through the preparatory material before the class. As a facilitator, one should begin by keeping it simple and avoiding information overload. ^[19]

Some of the faculty were of the opinion that flipped class implementation will increase their workload. The teacher will have to spend more time in preparing interesting modules. ^[20] The

materials to be shared needs to be of good quality. Low quality reading materials and unfamiliarity with the activity of teaching learning inside and outside the flipped class will make things more difficult. More time will be required by the teachers to design good learning material to keep students engaged and interactive during class.

As seen in this study, flipping the traditional classroom is both feasible and acceptable among the students as well as the faculty. It will help students empower themselves to develop higher order cognitive skills. A blend of methods may also be adopted to help achieve the desired outcome.

Outcome:

The flipped class approach was a relatively new method for both the faculty and undergraduate students at GIMS.

Flipped class is an effective method to engage students into active learning.

The students took ownership of their learning, thus helping them become proactive learners.

Flipped class promotes increased interaction amongst the student and faculty.

The faculty got trained in preparing and conducting flipped classes.

Limitations:

A majority of the students in the study have experienced flipped class for the first time. The results may be the influence of adopting a new methodology which is breaking the monotony of traditional teaching method and not necessarily because of specific benefits of the flipped class approach.

This study had no control group.

Flipped classroom approach cannot be used for all topics.

The faculty involved needs to be trained in this methodology.

High level of commitment from the side faculty is required in planning the module, preparation of pre-reading material and conducting of the flipped class.

This study was limited to Phase I MBBS students in biochemistry at one institution. It can be conducted on a larger scale.

Conclusion

The shift in teaching learning methodology from being teacher centric to being student centric has led to significant improvements in medical education. The strategies which promote student centered active learning are the need of the hour. Several studies have found that flipped classroom promotes student engagement. It has been demonstrated to be a more active form of learning.

The students were found to appreciate the flipped class room method. For all students in general, the results indicate that students' perception of effective learning through flipped classroom are associated with:

- Easy accessibility of reading material before the classroom session.
- Ability to study at their own pace at their convenience.
- The sessions improved their understanding of the key concepts.
- It inspired them to pursue further learning of the topic on their own.
- More interaction between the students and faculty in and outside the class.
- Clinical case oriented classroom sessions under active supervision of faculty.

The faculty opined that flipped classroom is an effective way of teaching learning method. They were in agreement that classroom sessions were utilized actively promoting deeper level of thinking amongst the students. However all of them said that implementation of flipped class on a regular basis would increase their work load.

In conclusion, the study indicates that flipped classroom is an effective and motivating way to engage students. The response among both the students as well as the faculty has been largely positive. It is certainly an approach worth pursuing in future.

Implication

Implementation of flipped class is a movement towards learner-centric approach. For successful implementation, the curricular goals, learners' needs and instructional modalities need to be aligned. Flipped class has shifted students' learning from a teacher-centered approach to student-centered with more class activities focused on deeper student engagement. The students today are more technology friendly leading to greater scope for adoption of several new and innovative teaching learning methodologies. The COVID 19 pandemic has reinforced the fact that we need to adopt alternative teaching methods. Flipped class is an alternative model to develop high quality teaching and learning. The teachers need to understand that the essence of flipped class lies in the interaction among students and teachers outside and during the class.

The learning will take place in class and also outside class, so students will have to take responsibility for their own learning. The positive attitude of faculty towards this new methodology is encouraging. Further studies on flipped class method can be done in our institute in other departments also. The Medical Education Unit can conduct programs for sensitizing and training the faculty. It may be noted that flipped classroom requires access to information technology for students and faculty. The institutional authorities need to be convinced for providing the same.

This model helps to motivate students as proactive learners. Flipped class promotes collaborative learning. It leads to increased interaction between the students and faculty. This opportunity can be used by faculty to facilitate active learning, build role modelling and give feedback to promote longitudinal learning. The faculty feel they are more of a guide by the side. Flipped class also provides an opportunity for multi-institutional collaboration in preparing academic material and sharing experiences through research. The adoption of new instructional technologies, keeping in mind learners' needs will help in achieving effective outcomes. The future flipped classroom studies can use a variety of research designs which will further add to developing different models, techniques and modules. The findings of this study will contribute to deeper understanding of future research requirements in flipped classroom.

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