

## ORIGINAL RESEARCH PAPER

# Introducing flipped classroom to undergraduate students in microbiology

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### ABSTRACT

**Introduction:** Didactic lectures are teacher centered and passive method of imparting knowledge with minimum ability to stimulate students to understand and apply concepts. Flipped Classroom (FCR) is also known as 'reversed' or 'inverted' classroom. It is a type of blended learning that integrates distance learning outside the class and face to face learning in class. FCR is a learner centered model in which class time explores topics in greater depth and creates meaningful learning opportunities. **Materials and methods:** FCR model was introduced, as a teaching learning method to undergraduate students in teaching Microbiology and feedback was taken from Students and Faculty through validated questionnaires. **Results:** A total of 84 second year UG students participated in this study. Overall positive responses were received from the students and faculty for Flipped Classroom teaching. On analysis of student's feedback, students (83.3% n=70) wanted this Flipped classroom technique to taken for future classes. Moreover, 84.5% (n=71) students agreed that Flipped Classroom was useful for studying Microbiology which is otherwise is a difficult subject to retain. Overall 85.7% faculty in our department was keen to introduce FCR for future classes in Microbiology. **Conclusion:** FCR has been useful in studying Microbiology with prime objectives of motivating undergraduate students and cultivating skills of self learning. The class time can be utilized to develop their applied knowledge and instill critical thinking among the students. In the newly introduced CBME curriculum, the student centric approach can be well justified by Flipped Classroom as a beneficial teaching learning method.

**Keywords:** Student centric approach; self directed learning; blended learning.

### 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.<sup>1</sup> 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' (FCR) or 'inverted classroom' approach.<sup>2</sup> In this model, the activities carried out during traditional class time and self-study time are reversed or 'flipped.' It is a type of blended learning that integrates distance learning outside the class and face-to-

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face learning in class.<sup>3</sup> FCR is a technique that was introduced by Jonathan Bergmann and Aaron Sams in early 2000 where they delivered their lectures as video records for students to watch at home and the students did more constructive activities during freed class time.<sup>4</sup> According to Bergman and Sams, students need assistance of teachers to answer questions and when solving problems in an assignment but not when listening to a lecture.<sup>2</sup> With the advancement of technology in the new millennium, where students have access to information at the tip of their fingers, the importance of lectures keep diminishing in adult education. Newer technologies make it easier for educators to adopt innovative ideas such as flipping the classroom that allow students to access and study lectures at their own pace. Freed class time would allow teachers to engage in techniques that involve students in higher order cognitive work.<sup>5</sup>

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 from being the 'sage on the stage' to the 'guide by the side'.<sup>6</sup> There is evidence to demonstrate 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.<sup>7</sup>

The Flipped Classroom provides scope for interactive teaching i.e. additional face-to-face interaction time with students in the classroom by minimizing the amount of direct instruction used in a traditional classroom setting thus giving opportunity to the students to participate actively through discussions or problem solving.<sup>8</sup> It is one of many methods adopted in the broader blended learning domain where students move between learning modalities.<sup>9</sup>

In contrast to traditional classrooms where class time is filled with instruction and assimilation followed by homework to consolidate learning, Flipped Classrooms reverse classroom content and homework. Thus 'first exposure' occurs before class and work typically done as homework is undertaken in class with instructor guidance.<sup>10,11</sup> Time is a scarce learning resource and the most often cited benefit of flipping classrooms is that it frees in-class time for other activities.<sup>12</sup> In terms of Bloom's revised taxonomy this too is 'flipped', with lower level cognitive work undertaken outside of class and in-class activity focused on higher levels of cognitive work in a peer/instructor supported environment.<sup>13</sup> The Flipped Classroom is thus a student-centred learning approach where in-class time can be dedicated to more effectively engage in active learning of

relevant discipline concepts, exploration of topics in greater depth and creating richer learning experiences and there is increased opportunity for teacher-to-student mentoring and peer-to-peer collaboration.

Objectives of the study were to introduce Flipped Classroom to undergraduate students in Microbiology; to sensitize the Faculties and Students to Flipped Classroom model and to obtain feedback from Students and Faculties regarding their perception and experience of the Flipped Classroom model.

## **MATERIALS AND METHODS**

The study was carried out in the department of Microbiology, Jorhat Medical College, Jorhat, Assam. The population involved were Undergraduate students and Faculties of Department of Microbiology. Prior permission was taken from Institutional Ethical Committee (IEC). At the outset a meeting was organized with Head of Department and faculties of the department of Microbiology in order to sensitize about the concept of Flipped Classroom. Subsequent meetings of faculty were conducted to introduce FCR in microbiology classes. The details of methodology including pre class and in class activities were explored. The topic 'Herpes Virus' was selected and outline of study was formulated. Student feedback questionnaire with both closed and open ended questions was prepared and peer validated. For closed ended questions, a 5-point Likert scale was used. Students were also sensitized about the method. They were informed about the study in details and then informed written consent was obtained. They were asked to make a WhatsApp group for receiving instructions and link of online material. A power point presentation was prepared on 'Herpes Virus' and few references regarding the topic were distributed through that WhatsApp group one week prior to the scheduled class. Students were instructed to study the topic themselves with the help of the references along with text book material from a designated standard book. After one week, the in class activities was conducted in two scheduled classes of an hour each. All the students were divided into ten small groups where each group was given problem based questions and MCQs to solve regarding the topic. Each group was guided by faculty as facilitators. The students discussed the solutions in their groups. Then each group presented their assignments in the large group. The students were also encouraged to clarify the doubts by asking questions at the end of each presentation. Immediately after the two classes, student's feedback was taken through questionnaire. Feedback from Faculty was also taken.

## **RESULTS**

Out of all hundred students, eighty four students participated and have filled up the feedback forms. Seven faculty gave their feedback. Based on the analysis of the feedback forms the following observations were seen.

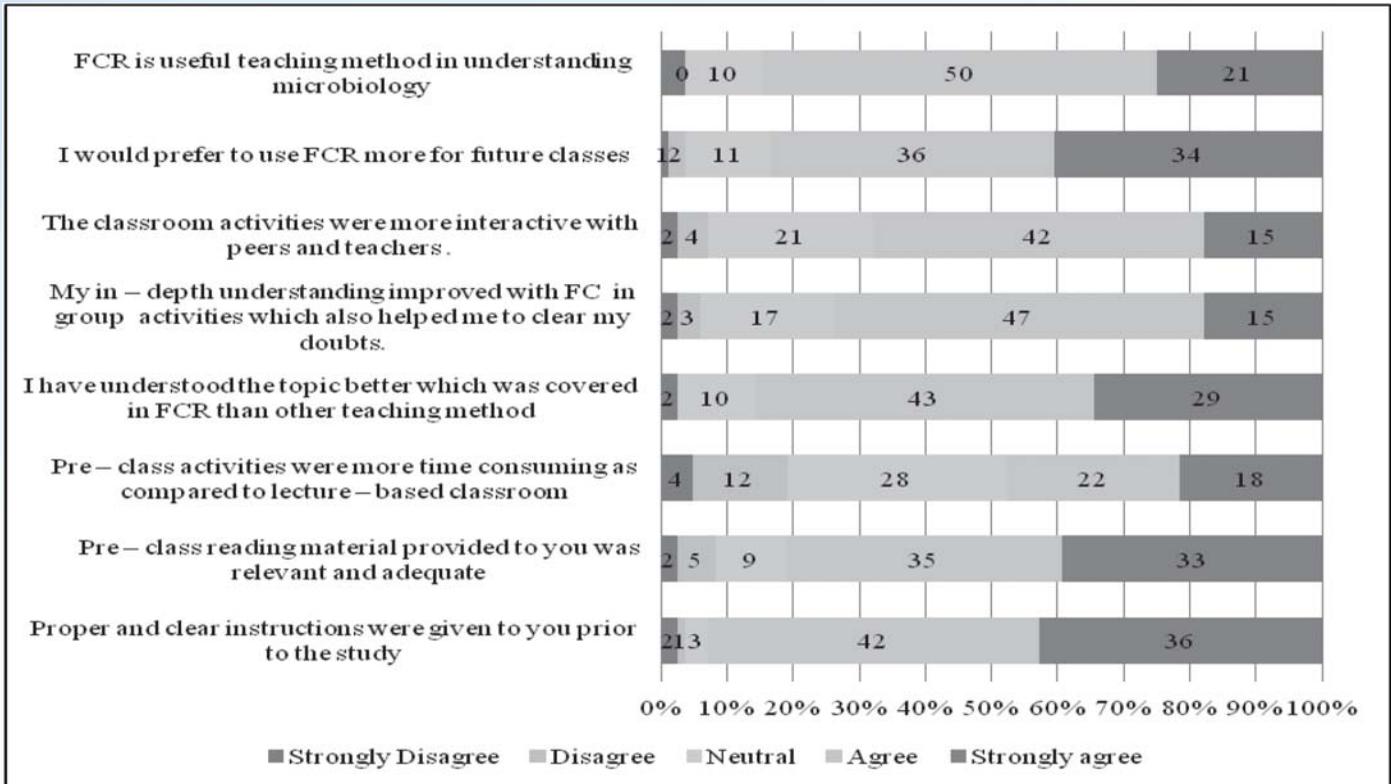


Figure 1 Students feedback on FCR

On analysis of students’ feedback (Figure 1), 80.9% (n = 78) revealed that the pre class materials provided to them were adequate and sufficient and 47.61% (n = 40) found that it was not time consuming as the students found it easy to study at their own pace. The topic was better understood by 85.7 % (n=72) students through FCR. The students (73.8%) (n = 62) found that group activities helped them to clear their doubts. The students (67.8%, n = 57) found that they can interact more with peers and facilitators than didactic lectures. The students (83.3% n = 70) wanted this FCR for future classes. At last, 84.5% (n = 71) students agreed that FCR was useful for studying Microbiology which is otherwise a difficult subject to retain.

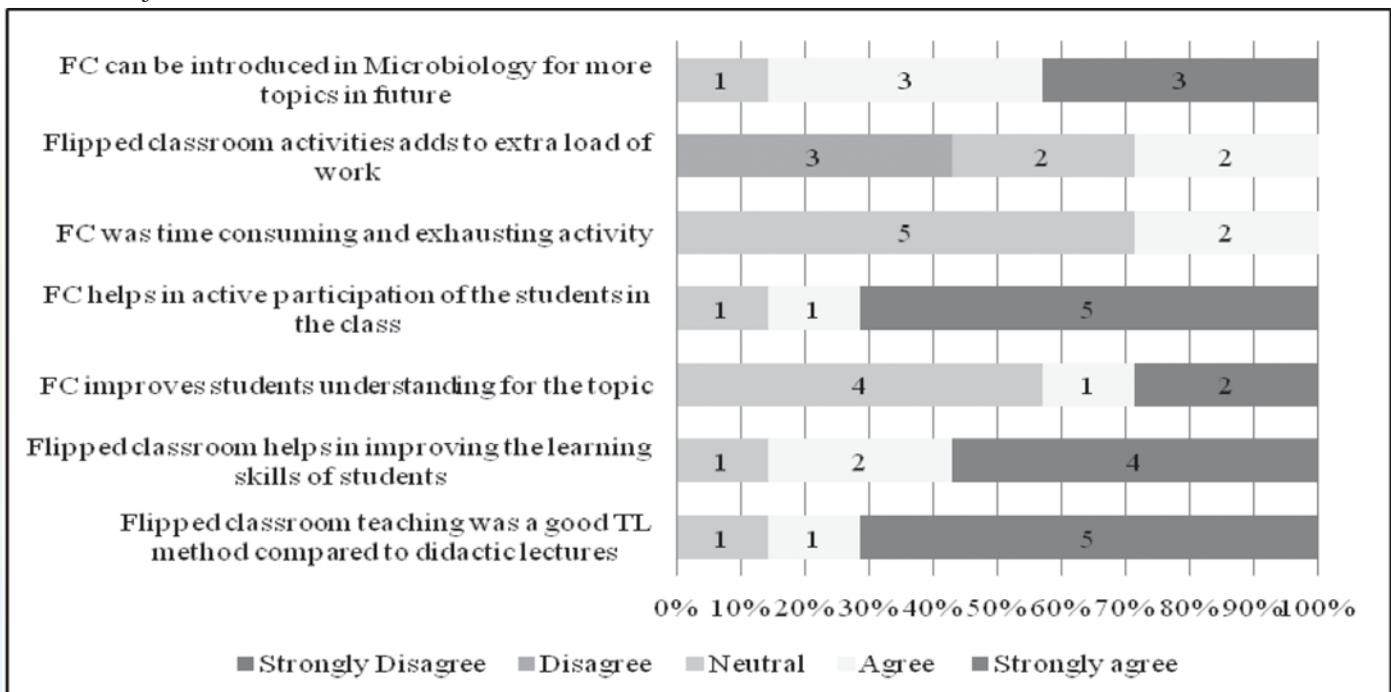
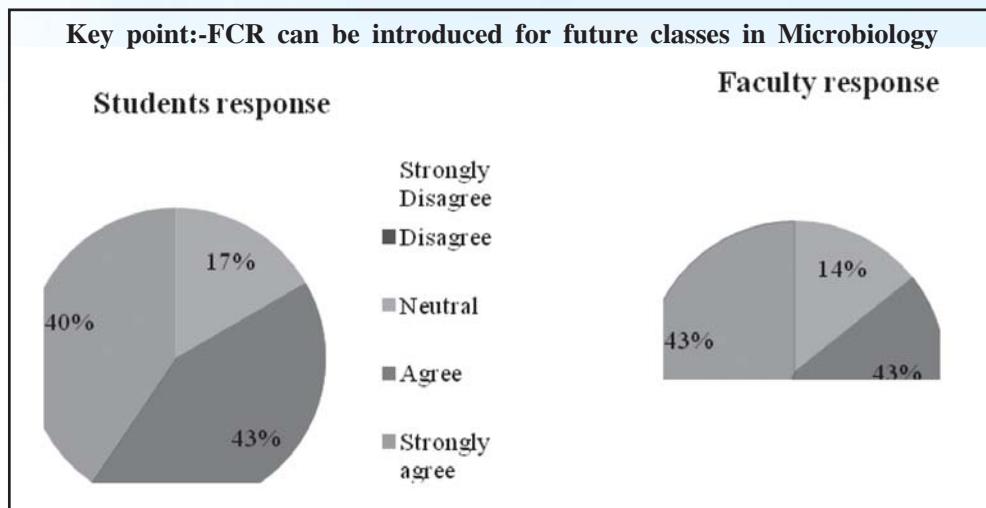


Figure 2 Faculty feedback on FCR

On analysis of faculty feedback (**Figure 2**) it was found that 71.4% (n = 5) faculty felt FCR was a good teaching learning method compared to didactic lectures. Maximum faculty 85.7 % (n = 6) were of the opinion that self directed learning skill can be improved. Through FCR, 85.7% (n = 6) faculty of the department felt that there was active participation in the class activities as compared to traditional teaching . Faculty 71.4% (n = 5) had a neutral opinion regarding that FCR activities might be time consuming and exhaustive. Faculty (42.8%, n = 3) disagree that FCR activities will increase work load. Overall 85.7% faculty were keen to introduce FCR for further classes in Microbiology.



**Figure 3** Key Point of Student and Faculty perception for introducing FCR for future classes

The FCR was well accepted by the faculty as well as the students and both (85.7% faculty and 84.5% students) recommended that it can be introduced for teaching Microbiology (**Figure 3**).

The following were the responses from the open ended questions:-

**Table 1** Responses of students to two open ended questions

Responses of students to two open ended questions	
What did you like the best in flipped class room method?	<ul style="list-style-type: none"> <li>• Prior knowledge of the topic helps to clear the doubts in class.</li> <li>• Motivates self learning.</li> <li>• Interaction between batch mates and teacher was good.</li> <li>• Retention of the topic is more.</li> <li>• Correlation of the topic is better because of pre and in class activities.</li> <li>• Group discussion improves the understanding of the topic.</li> <li>• Did not have to listen to lectures.</li> <li>• Activities could hold attention during the entire class</li> </ul>
What did you dislike in flipped class room method and how you would like to improve this further?	<ul style="list-style-type: none"> <li>• Nothing to dislike. In class activities is time consuming.</li> <li>• Difficult to read lecture given through soft copy.</li> <li>• Need reading material as hard copies.</li> <li>• More topics should be covered by FCR.</li> <li>• FCR should be started in other subjects too.</li> </ul>

**DISCUSSIONS**

Although the perceptions of students towards the FCR have been evaluated in several disciplines and at varying levels of learning, such data is not much available for medical students. More specifically, studies on the efficacy of this model in the teaching of Microbiology are only sparsely available.

The noteworthy comments are that it helped them to understand better, active engagement helped them to learn the topic, opportunity to discuss and clarify their doubts with the facilitator. This was possible as much of the material was learnt prior to class. Students agreed that active engagement was consistently encouraged by the instructor and they also realized that good preparation for the class was necessary for an optimal utilization of time. This feedback obtained after the flipped teaching session in this instance mirrors data from study by Pierce R.<sup>14</sup>

The key success of this FCR 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 on students, the freedom to prepare for the class at a time that suits them, the opportunity to revise the material 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 needed for both teachers and students to acquire and adapt to these new skills required is much more.

In this present study it was evident that a majority of the students preferred the FCR to the traditional lecture of teaching. The students were very comfortable with the materials provided to them and that it was not time consuming as the students found it easy to study at their own pace and it also enabled them to have a better understanding of the topic. Visualising and watching the lessons on videos number of times improves the understanding ability. Mahmood et al and Sreegiri et al in their studies attributed to the fact that video lectures provide flexibility in learning and a chance to review and repeat the sessions.<sup>15,16</sup> Moreover the web sources with references kindled a greater interest to read as compared with didactic lectures. The students also felt strongly that this method provided them with an incentive to actively engage with the topic before the class which was comparable with similar findings which have been reported by other studies.<sup>1,17,18</sup> Jones & Edwards, 2010; Fulton, 2012; Roehl, et al., 2013 also reported flipped content assists them with their preparation for class independently and at their own pace.<sup>19,21</sup>

Majority of the students in the present study opined that Flipped Classroom method gives better opportunity to interact and communicate with teachers and other students in the class as well as it is more engaging. Students understood the topic better which was covered in Flipped classroom and found that group activities helped them to clear their doubts in this type of teaching learning method. Tucker, 2012; Zappe, et al., Fei, et al. 2013; Lie & Cano, 2001 also found that the class time is more benefitting because clarification of confusing content is possible while discussing the topic.<sup>13, 22-24</sup> Studies by Nouri and R Veeramani et al also reported that students expressed a positive attitude to flipped classroom agreed that it is easier and more effective to learn with the flipped classroom approach and that they feel more motivated as learners.<sup>1,17</sup>

In the present study, 83.3% students wanted this Flipped Classroom technique to be taken for future classes. In another study Zhao et al reported that nearly half of the respondents preferred the flipped model.<sup>18</sup> Similarly other

studies S K Gubbiyyapa et al, Veeramani et al, Morgan et al found that student satisfaction was very high and majority of the study subjects considered flipped classroom as effective teaching learning tool and students opined that more such flipped classroom sessions should be organized in the future.<sup>1,25,26</sup> Similar to our findings, a study conducted at Ripah University, using a similar pedagogy to teach third year MBBS student during clinical rotation, reported that students found FCR as a better mode of teaching in their setup as well.<sup>27</sup>

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.<sup>28</sup> 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.<sup>2</sup> In our present study all the faculty involved also had the same opinion that active learning takes place through active participation in the class activities as compared to traditional teaching. 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. 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.<sup>29,30</sup>

Finally, it is important to plan and consider the academic time taken to deliver a course using a FCR. The findings and the experience of this study supports the view of other studies that FCR is an effective teaching learning method and student and faculty response were largely positive, indicating it to be an approach worth pursuing in future years and also for the newly introduced CBME (Curriculum Based Medical Education) curriculum where student centric approach is the main theme.

## CONCLUSION

The perception of the students in the present study reveals that FCR helped in better understanding and clearing of doubts amongst them and is a good teaching learning method. This student-centric approach creates an environment for interaction and flexible learning. By making the lecture available through online, it encourages self learning in students at their own pace. Use of technology along with individual and group activities in class time adds value to students in depth learning of the subject and also addresses individual learning style and preference. Majority of the students wanted this method to be continued for more topics in the subject. It was also felt by faculty that FCR is

feasible to plan and conduct in undergraduate teaching. With the rolling out of the new CBME curriculum which is a learner centric approach, this FCR model might find a place to instill self directed learning in students and in the long run will help to inculcate the habit of lifelong learner among the Indian Medical Graduate. Therefore this method can be adopted and incorporated in addition to other teaching learning method in the undergraduate teaching.

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**Contribution of authors:** “We declare that this work was done by the authors named in this article with equal contributions.”

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