

Innovative Class Room Activity with Flipped Teaching in Fluid Mechanics – A Case Study

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Abstract: The Concept of flipped class room technique has been recently introduced in Higher Education. Recent studies indicate that student attendance at lectures drastically reduced both at nationally and internationally, has prompted researchers to introduce new methods in course delivery and classroom engagement. It makes students to gain necessary knowledge before class and allows instructors to guide the students to participate in discussion during the lecture hours. Also, the students share their knowledge during the class. It is observed that most of the Engineering programs have lagged in integrating the blended learning approach into curricula. The present case study is an attempt to prepare students before entering the class and provide deeper thinking in the subject of study. The instructor provided material for the selected subject (fluid mechanics) for eight selected topics before starting of the class and had interaction with the students during the delivery. From the case study carried out, it is found that students actively participated in the flipped teaching approach and also observed that the efficiency of the students improved during the course of delivery.

Keywords: Flipped classroom, student learning outcomes, Video lectures, handouts, Fluid mechanics

1. Introduction

The education system is evolving in India for the past five years and educators continuously working to introduce innovative techniques for class room teaching. Yet teaching faculty of engineering are still largely using outdated approach for teaching technical and problem solving concepts [1]. The main key factor in Engineering Education is problem solving, analysis, synthesis and design. Most of the traditional tutors are giving home work format and later applied to learner centre approach. But it poses many difficulties to the students who are not self motivated when the content of the subject is highly student centric. Engineering students are satisfied with the blended learning and hence tutors accepted to implement the blended learning methodologies in the course delivery [2].

One of the promising approaches is to deliver the course content before the hand so that student prepare / understand the concepts without the tutor and enter the class with an object oriented approach. In the class room traditionally teacher tries to explain the concepts and find out the understanding levels of the students by questioning [7]. The effectiveness of flipped classroom can be observed with respect to content coverage, student performance and perception of flipped classroom teaching [3]. But in a flipped class room the student will interact with the teacher based on the available material with him and easily raise questions on his understanding. By answering these questions many students understand the basic concepts of the subject and hence the learning becomes student centric. There are research trends observed in flipped classroom teaching. The technology tools and online platforms make students to prepare before the classroom discussion [9]. Many researchers in education strategies indicated that the flipped classroom teaching has advantage over traditional classroom teaching [9]. Hence, the self motivated students have additional advantages with the flipped classroom teaching. Teacher also prepared the content based on the student understanding and gives exercises for better learning particularly for course like communication skills and other language courses through online platforms [4]. The flipped classroom model provides a forum for students to tackle with difficult concepts where teachers and peers are ready to support learning. Also, the redesigning of curricula is important aspect when flipped classroom technique is implemented in a semester and a considerable time commitment from the teaching team is an important task in preparing the lecture material [5]. Different teaching methods have been discussed and compared with the flipped classroom teaching and found that flipped classroom is having advantage for better learning [6]. Yusong Li and Tareq Daher [8] have made a case study using flipped teaching in water resource engineering. In their study it was found that most of the students are happy with the flipped module. The prime motivation for the teacher is (a) plan for interactive activities (b) present the

course materials in a different format of the course material beforehand (c) encourage students to become self learners and help them to practice the subject [3]. One of the basic advantage of the flipped classroom technique is that the instructor need not explain his 50/60 minute lecture either teaching on the board or using a power point / video. Students enter the class with different doubts and instructor is responsible to make them understand based on the doubts raised by the students [4]. Another advantage is even students can interact during non teaching hours and can get their doubts clarified.

2. Methodology

The author prepared class notes, power point presentation and videos for the following contents in fluid mechanics:

1. Properties of fluid flow and pressure measurements
2. Hydrostatic forces
3. Fluid kinematics
4. Fluid dynamics
5. Closed conduit flow
6. Measurement of flow
7. Laminar and turbulent flow
8. Hydraulic similitude

The videos were prepared for a maximum duration of 5 minutes and power point presentation with a maximum number of slides 20. They have been distributed one week before the commencement of the class work. The assessment tools adopted in the present study are given below

i) Assessment tools: For assessing the students the following principles are used.

A. Muddiest point: Clearing most confusing part from the material provided to the students. In this aspect students will be engaged on understanding of the content and learning outcome.

B. Summary: Students will be asked to summarize the material provided to them in order to get their understanding of the topic.

C. Concept Mapping: Concept Mapping helps the instructor how well the students learned the fundamental concepts and understanding of the diagrams provided in the material.

D. Formative Assessment: For each topic provided to the students a formative assessment is conducted and results were analyzed.

Around 63 students participated in the flipped classroom teaching. Initially, the author distributed expected learning outcomes of fluid mechanics subject and conducted two tests to the students to meet all the student learning outcomes (SLO). The following are the student learning outcomes list for Fluid Mechanics. The outcome based evaluation of the student is done with a test and the evaluation is done to meet all the student learning outcomes. After completion of the course, the student is able to

- Describe the physical properties of a fluid and solve problems (SLO 1).
- Calculate the hydrostatic pressure and force on plane and curved surfaces and formulate the problems on buoyancy (SLO 2).
- Explain the properties of motion for fluids and identify the type of motion (SLO 3).
- Apply the equation of the conservation of momentum and energy for fluid motion and find the losses in a pipe (SLO 4)
- Derive the dimensionless numbers and apply the similitude concept and set up the relation between a model and a prototype (SLO 5).

The student learning outcomes have been tested and the results are shown in Table 1.

Table 1 Attainment of Student Learning Outcomes

Student Learning Outcome	No. of students with % marks					
	<40	40 - 50	60 - 70	70 - 80	80 - 90	>90-
SLO 1	3	17	22	10	8	3
SLO 2	2	15	24	14	6	2
SLO 3	2	13	25	12	7	4
SLO 4	1	12	29	12	7	2
SLO 5	6	11	21	14	8	3

From the above table, it is found that the success rate of the students is high and pass percentage in the subject is around 90% and many students got more than 60% in the test conducted. Also, found that 65% of the students secured more than 60% marks.

A student survey has been conducted to get their perceptions on the experience of flipped class room for the topics described above. The questionnaire mainly consists of understanding of the concepts, class room management of the teacher, student engagement and problem solving skills. A rubric has been prepared and circulated to the students. After conducting the survey the students have been asked to compare the advantages between traditional teaching and flipped class room teaching. It is found that around 68% of the students are in the opinion to continue for the flipped module when compared to black board teaching and traditional teaching. Also the author identified the slow learners (<60% in the diagnostic test) and fast learners before starting the course delivery and training is given to the slow learners. Post assessment survey of the students indicates that students are not having the knowledge of flipped class room module. But they believed that it will be one of the improvements that can be made the teaching-learning process. It is understood from in the feedback of the students in the class room that more than 95% of the students watched the videos and followed the power point presentations without any interruption. More than 60% of the students understood the concepts without any help and hence they could discuss freely in the class room. Comparison was made based on

the formative test scores conducted both for flipped module and traditional teaching technique (previous batch) proved that the students enrolled with the flipped module have better score (class average percentage). The positive finding is attributed that the students have additional opportunity to re-visit the concepts during the class room teaching. Also, the impact of the flipped classroom on student learning outcomes were analysed through a comparison of results with the previous batch final exam results. It is found that the pass percentage in which the batch has undergone flipped classroom teaching has slight increase in pass percentage compared to traditional teaching method classroom teaching.

3. Concluding remarks

The present case study suggested that flipped module is beneficial to the students for the selected subjects and the topics. Even though the instructor is not having any experience with the flipped module teaching, the student survey suggested that more than 60% of the students agreed for the class room management, better understanding and better student engagement including problem solving. Most of the students are interactive in the muddiest point and summary of the topic. The instructor needs to engage more classes for making them to understand the concepts and problem solving for the selected topics. Overall the students felt that they could devote more time on the topics given when compared to direct teaching in the class room using chalk and board. Students also felt that they have to put more effort in understanding the concepts before actual teaching took place. Future studies need to be carried out to identify the lacunae in the flipped classroom engagement for other courses too. Also, a thorough analysis is required for good practices and guidelines for flipped classes for better quality delivery.

4. References

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