

Analysing Students Performance and Knowledge creation at Master's Level in Flip Mode Classroom

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Abstract: Flipped classroom is a blended learning strategy that reverses the traditional educational arrangement by delivering instructional content, often online, outside of the classroom and moves activities, including those that may have traditionally been considered homework, into the classroom. A mixed study is conducted at Masters Level to analyse the student's performance and Knowledge creation in a flipped model of teaching-learning. Results from both qualitative and quantitative Educational data mining techniques are used to support the study. A discussion follows stating the implications for the adopting flipped model of teaching in higher education.

Keywords: Educational data mining, flipped classroom, review mining.

I. Introduction

A. Flipped Classrooms

The idea of reverse classroom or Flipped teaching was conceived in 1990's when a pair of high school teachers, Jon Bergmann and Aaron Sams from Colorado began recording their lectures for students who have missed their classes. The strategy first employed to facilitate the students who missed their lecture turned into the concept of authentic learning model. [1]

In 1993, Allison King coined the phrase "From sage on the stage" to "Guide on the side" in her article discussing flipped instruction. In the article king focused on the importance of the use of class time for the construction of meaning rather than information transmission. King directly does not illustrated the concept of flipping the classroom but her work is often cited as an impetus for an inversion to allow for the educational space for active learning.[2]

Perhaps most recognizable contributor to flipped classroom is Salman Khan, graduate from MIT and MBA from Harvard. He took a job as a financial analyst. In 2004, Khan began recording videos at the request of a younger cousin he was tutoring because she felt that recorded lessons would let her skip segments she had mastered and replay parts that were troubling her [3]. Salman Khan founded Khan Academy based on this model. For some, Khan Academy has become synonymous with the flipped classroom; however, these videos are only one form of the flipped classroom strategy. [4]

B. Data mining in education

Educational Data Mining is an emerging discipline, concerned with developing methods for exploring the unique types of data that come from educational settings, and using those methods to better understand students, and the settings in which they learn.

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The work of Baker and Yacef in 2009 can be coined as the early efforts at educational data mining involving mining website log data [5], but now more integrated, instrumented, and sophisticated online learning systems provide more kinds of data.

Siemens and Baker work on reducing learning into small components that can be analyzed and then influenced by software that adapts to the student [7]. Online learning systems also provide student learning data that is being explored to develop predictive models by applying data mining methods for classification and relationship mining. These models act as pivot for building adaptive learning systems in which adaptations or interventions are suggested on the basis of the model based predictions to support their learning.

The concept of longitudinal data modelling is well suited on educational data as some other important features of educational data are time, sequence, and context. The concept of time, length and sequence are important to in terms of time to capture the data, length of practice sessions or time to learn and sequence of concept building on the basis of one another and how practice and tutoring should be ordered. Context refers in terms of explaining results and knowing where a model may or may not work. [6]

The four goals of EDM can be classified as following:

1. Predicting students' future learning behavior by creating student models
2. Discovering or improving domain models that characterize the content
3. Studying the effects of different kinds of pedagogical support that can be provided by learning software; and
4. Advancing scientific knowledge about learning and learners through building computational models

To accomplish these four goals [6], educational data mining research uses the five categories of technical methods: prediction, clustering, relationship mining, discovery with models, and distillation of data for human judgment.

1. Prediction entails developing a model that can infer a single aspect of the data (predicted variable) from some combination of other aspects of the data (predictor variables).
2. Clustering refers to finding data points that naturally group together and can be used to split a full dataset into categories.
3. Relationship mining involves discovering relationships between variables in a dataset and encoding them as rules for later use. It can be further divided into two categories: Association rule mining & Sequential pattern mining
4. Distillation for human judgment is a technique that involves depicting data in a way that enables a human to

quickly identify or classify features of the data using machine learning.

5. Discovery with models is a technique that involves using a validated model of a phenomenon (developed through prediction, clustering, or manual knowledge engineering) as a component in further analysis.

In this paper educational data mining techniques are applied using both quantitative and qualitative method to investigate the Master's Level Students Performance and Knowledge creation in Flip Mode Classroom and compare with the traditional teacher centred teaching model.

II. Analysis of Student performance and knowledge creation in flipped mode classroom

This study involves students admitted for 3 years Masters Program in Engineering under the fellowship scheme of Chitkara University, Punjab. The students are admitted under the fellowship scheme of the University to pursue their Masters and also act as teaching assistant. The students are assigned to their respective mentors in the very beginning of Masters Program. The responsibility of the student is to assist the respective mentor in academic environment and have the responsibility of teaching the subject to the undergrad students in guidance of the respective mentors. This setting allows the student to work on the Masters dissertation throughout the program. The subjects that have to be studied as course curriculum are taught using flipped mode and students are assigned the courses & contents from various sources where they learn in flipped mode apart from teaching. The target students under this study are from M.Tech Computer Science & Engineering batch 2011-14, 2012-15. Batch 2011-14 witnessed the conventional teaching paradigm whereas Batch 2012-15 witnessed partial flipped modes as some subjects were taught using flipped mode learning.

Table 1: Teaching model adopted in the session 2011-14 & 2012-15

Session →	2011-14	2012-15
Mode ↓		
Teaching Mode	Conventional	Flipped

The students have studied same subjects in both models. The list of the subjects is as follows:-

Table 2: Core Master Courses.

Level	Course
1	Foundation Courses
2	Core Courses
3	Concentration Courses
4	Elective courses designed to support concentration courses
5	Dissertation

The courses from level 1 to 4 are taught in initial 2 years. Each level is of 6 months duration. The courses taught in

first two levels are same for every student whereas at level three students opt for the course which serves as the basic foundation of their research domain. At level 4 there are large variety of courses where students opt for the advanced level of courses in their research domain to narrow down on their area of the research/dissertation. Level 5 is of one year duration where student explores his/her domain area and selects a problem/topic that is to be carried further for presenting a thesis.

In our study the marks scored from level 1-4 are used as the basis of inference for comparing the academic performance between conventional model of teaching and flipped model of teaching. The choice of dissertation topic and comments from the evaluation panel comprising one external expert and one internal expert along with supervisor during the final presentation serves as the basis for inference for comparing the knowledge creation among the students for our study.

As stated previously, this study had two primary goals. First, the study intended to compare the academic performance of the students at master's level and secondly the comparison of knowledge creation in flipped classroom with normal teaching setting. The comparison of academic performance and knowledge creation was based on academic data and practical knowledge. Also the comments from evaluation panel during dissertation and thesis defence were incorporated in comparing the levels of knowledge creation. The comments are given on the basis of novelty and research input of the topic selected hence clearly witness the level of knowledge creation.

The survey questionnaire was prepared on the basis of following points

1. Improve students' critical thinking/creative problem solving/higher-order Thinking/professional skills
2. Increase student participation, engagement, and motivation
3. Improve students' team-based skills and peer-to-peer interaction
4. Customize/differentiate learning
5. Make students the center of learning/encourage student ownership of learning
6. Better faculty to student interaction
7. Increase faculty freedom/Student freedom
8. Improve learning outcomes
9. Dealing with leaves/absences
10. Encourage faculty collaboration
11. Compensate for limited classroom space

The online survey was conducted based on a questionnaire consisting of 22 questions for students and faculty members engaged in Teaching/learning using flipped mode classrooms.

The questionnaire was prepared in two different formats. First questionnaire was for the teachers involved in flipped model and the second questionnaire was for the students.

Both the questionnaires consist of the questions dealing with the same aspect but highlighting the viewpoint in terms of teacher or student. i.e. a question in students questionnaire was asked that "Did you feel that your role changed from passive to active learner in flipped model of teaching" whereas in teacher questionnaire it was asked as "Comment on flipped learning mode changing the role of student in class from passive to active learner".

III. Discussion

A. On the basis of the survey

The output of the study reveals that when the concern is students engagement in the class, we found that students are more engaged, more involved in the flipped classroom in comparison to the conventional delivery approach. More than 80% of the students surveyed who witnessed flipped mode of learning voted 'YES' in the column "Increase student participation, engagement, and motivation" compared to 75% in the traditional classroom environment. One of the interview questions asked the faculty to describe their role in the flipped classroom. Interestingly, all of the faculty interview participants described their role as a facilitator rather than an instructor since it increased the level of the questions asked by the students as they come to class to clear their doubts that arise during the video lectures and the responsibility of the teacher in the class changed from "sage on the stage" to Guide on the side".

When asked from the students to describe their role in the class some of their descriptions included: actively helping, actively learning, actively listening, actively participating, and actively working. Moreover, the student participants openly acknowledged their passive interactions during class lectures and limited communication between their teacher and other peers prior to the flipped classroom intervention. During the flipped model of instruction, however, the students witnessed an increase in their classroom participation and communication. Thus, the flipped model of instruction had a positive impact on student engagement. Also, the question dealing with leaves/absences was answered "YES" from all the participants of the questionnaire i.e. students and faculty. Therefore flipped mode can be advised in the scenario where numbers of meeting hours are not available for covering the full syllabus and the available time can be utilized in solving the queries and problems from the students rather than conventional mode of instructional teaching.

The question related to improved learning outcome was answered "sure" by 44% of the students

"Not sure" by 30% and "no improvement" by rest 26%. So we can easily see that in spite of majority of students support flipped mode in terms of increased participation, engagement and motivation they are not supporting flipped mode in terms of improved learning outcome.

Table 3: Categories and Subcategories Resulting from the Data Analysis

Categories	Sub Categories
Academic Performance Expectancy(APE)	Study Efficiency
	Motivation
	Skill Development
	Open source Multiple Learning Resources
Knowledge Creation	Socialization
	Collaboration
	Integration and skill development
	Implementation in Dissertation

B. On the basis of the students academic performance

The academic performance in terms of the marks scored in end term examination demonstrated near about similar performance abilities between the traditional and flipped classrooms. Specifically, the mean (average) for the traditional classroom was 83.26 out of a possible 100; the mean for the flipped model of instruction classroom was 80.36 out of a possible 100. An independent-samples t-test analysis confirmed the conclusion that no significant difference in performance existed between those students who were taught traditionally and those in the flipped model of instruction classroom.

We did a two-tail test (inequality) using SPSS and we found that $t \text{ Stat} > -t \text{ Critical two-tail}$ or $t \text{ Stat} < t \text{ Critical two-tail}$ i.e. $-2.022 < 1.938 < 2.022$. Therefore, we do not reject the null hypothesis.

Table 4: T-Test: Two-Sample Assuming Unequal Variances

	Variable 1 (Batch 2011-14)	Variable 2 (Batch 2012-15)
Mean	83.26315789	80.36363636
Variance	18.87134503	27.38528139
Observations	19	22
Hypothesized Mean Difference	0	
Df	39	
t Stat	1.93818362	
P(T<=t) one-tail	0.029932062	
t Critical one-tail	1.684875122	
P(T<=t) two-tail	0.059864124	
t Critical two-tail	2.022690901	

The observed difference between the sample means (83.26, 80.37) is not convincing enough to say that the average number of marks between traditional and flipped model of learning differ significantly.

Not only was a new approach to learning introduced to the students, but extremely challenging content was also

presented to them. While the students noted their preference for the flipped model of instruction, they felt the instructional approach should have introduced to them during easier content in order to lessen the demands and challenges of having to learn both a new approach and extremely difficult content. Unquestionably, the impact of the flipped model of instruction on student performance demonstrated similar results when compared to the traditional approach.

Comparing student interactions in the flipped model of instruction to the traditional environment revealed significant information. The students were more actively involved in the flipped classroom than the traditional environment. The environment was more of a student-centered environment within the flipped classroom. The students worked collaboratively among the various groups as they learned from each other by discussing problems, explaining procedures, and confirming answers. The teacher functioned as a facilitator, only guiding and directing when needed.

Interestingly, the student participants responded favorably to the flipped model of instruction; however, their academic performance did not show any significant changes when compared to students taught under the traditional approach. While the flipped model of instruction offered a sound way to modifying classroom instruction, this study did not reveal any significant changes among the students' academic performance when compared to students within the traditional classroom. Thus, depending on the content, the traditional approach may be the most efficient method of instruction; yet, the flipped model of instruction may be the best approach for other content.

C. On the basis of Final presentation of Dissertation

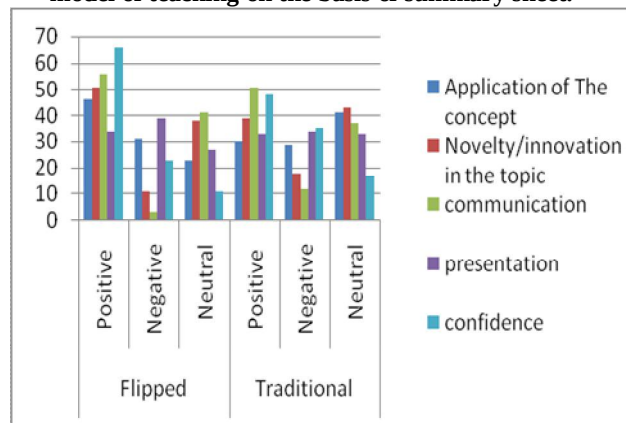
The reviews or comments of the evaluation panel were recorded and manually fed to the database system. Irrespective of the name of the student two separate datasets of comments were stored for flipped model and conventional teaching. Review mining was applied on both the data sets on the basis of following features listed below:-

- Application of the concept
- Novelty/Innovation in topic
- Communication
- Presentation
- Confidence

For each feature we identify review opinion sentences and decide whether they are positive or negative. A summary sheet for all the features in both teaching models was produced and we concluded that the positive reviews in flipped mode classroom were more than the traditional teaching model hence clearly witnessing the increase in the knowledge creation level of the students in flipped classroom in comparison to the traditional classrooms.

The knowledge creation level was judged on the basis of application of the concept and Novelty/Innovation in topic.

Fig. 1 : Feature comparison of traditional vs. flipped model of teaching on the basis of summary sheet.



IV. Conclusion

The applicability of flipped learning on every subject/ topic needs to be determined on the basis of experience. Every class may not be suitable for flipped learning. The implementation of the flipped learning depends on number of factors where the most influencing factors that are determined are quality of online lectures available related to the topic, and preparedness of the teacher for the session. Results and findings indicated that students were more engaged, more involved in the flipped model of instruction when compared to the traditional delivery approach. Students in the flipped classroom experienced quality instruction that was student-centered and student-focused. The flipped classroom allowed for improved use of class time utilizing various instructional strategies, including hands-on activities and project-based learning structures. While research on the effectiveness of the flipped model of instruction is limited, this research study provided additional, valuable information regarding the model's impact on student engagement and performance. Even though the flipped model of instruction is a relatively new instructional approach, it certainly has the potential to be deemed effective in terms of improving student engagement and performance at Masters level classroom.

V. Limitation and Future Scope

First of all, relatively small number of respondents exhibited some limitations as it can reduce the representativeness of the sample, which makes it difficult to generalize the results to a larger population. This study can thus only be regarded as a case study.

For another, Discussions among two groups of participants, as well as the interaction among same group of participants, can encumber the independence of participants' answers.

Secondly, the selection of participants was restricted to M.Tech students. This limitation reduced the representativeness of this study further. In the future, this researcher can be expanded to the sample of a wider range,

including B.Tech Students at lower knowledge creation ability levels than participants in this study.

Thirdly, as the participants were all Master Level students involved in teaching B.Tech students and Faculty involved in teaching M.Tech. They all are matured volunteers, their personality, to some extent, was more inclined to be active rather than passive compared to normal students who are not into the role of teaching. In this way, the results of this study lack the ability to explain the knowledge creation of the students who are less active or passive in personality. Regardless of the limitations, however, this research has brought to the surface important findings that help to move the field forward.

VI. References

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