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CHAPTER 7

Effective Utilization of Digital Resources for Undergraduate in Technical Education Through Flipped Learning

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Abstract:

The present paper substantiates flipped learning as one of the improvised and improved learning techniques taking into account different interpersonal and social parameters, e.g., communication skills, group discussion, leadership quality, course duration in terms of working hours in respective subjects, digital resources for teaching etc. Following the Washington accord, noticeable differences are observed in terms of the active participation of students throughout the continuous evaluation process. The quality of content is modified according to the need of the hour, and feedback is taken at the end of the course in terms of method of delivery, clarification of concepts, and teaching of subject matter. Improvement in performance is reflected in some particular courses through overall University grading and the increase of attendance and enrichment of communication ability, whereas interpretation deteriorated in mathematics-based engineering science papers. Outcomes are statistically computed assuming the availability of undisrupted internet sources at each student's home. One point implicated while making the factual graphs is that the entire outcome depends on the student's preparation day-by-day. On the other hand, all the screencasts the faculties share are well-organized, so self-learning is not problematic. Apart from these statistical assumptions, results are very significant and justify the implementation of flipped learning.

Introduction:

The present proposal deals with the performance improvement of the biggest stakeholders of any undergraduate technical Institution through the flipped learning process by partially replacing the conventional input-output-based system, and the result is reflected through the acceptability of the end-products in the industrial market and also in the higher education sector. The persistent problem of the presently adopted conformist system is the lack of interaction between the humans at either side of the tables, which not only creates a negative impact on the semester-wise academic performance of the students, but also reflected through lack of innovativeness while making the projects and designs (Zhang *et. al.*, 2016, Creswell 2012). Attitude difference from the point of view of both learner and facilitator marks a negative outcome, which introduces a few novels and innovative concepts from the pedagogical aspects (Bhargav *et. al.*, 2016, Carini *et. al.*, 2006). A few suggestions were proposed and implemented on an experimental basis by a few great educationists (Delialioglu 2012, Walder 2014, Maaloul *et. al.*, 2016) about a decade ago, and further modifications are made to those

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earlier models e.g., Activity Learning (Hussain *et. al.,* 2011), Adaptive Learning (Liu *et. al.,* 2011), Flipped Learning (Hamzah *et. al.,* 2017). The last is found to as the most significant and promising from the point of view of students' performance which is obtained based on a comparative analysis with the input-output-based system. Also, the facilitators' feedback is considered for further revamping and implementation of the process for better achievement.

The flipped classroom is a new innovative pedagogical model mostly applicable to a theoretical class where lecture sessions and assignment elements are reversed both in the context of location and duration (Butt, 2014, Enfield 2013, Gilboy *et. al.,* 2015). In this methodology, instead of delivering conventional lecture materials at lecture theatre, video lectures /presentations of specific contents are delivered to all the students before the assigned class (Baepler *et. al.,* 2014), and classroom timing is allocated for discussion with peers and professors, and also for solving assignments. This inversion of pedagogical is technically termed "flipping", where 'home' is converted into the traditional classroom with a 1:1 facility, and the physical classroom is used for concept development and enhancement of problem-solving ability. Therefore, a classroom with this technique is now converted into an area for the extension of learning instead of understanding the basics. This methodology is also termed as utilizing classroom timing into a higher level of cognitive skills [as per the Boom's taxonomy].

Research Methodology

In order to implement the flipped learning technique, we consider the first-year batch. We consider the fact that all students have a standard internet facility, and for particular cases, they may get the facility to form the Institute outside the stipulated class hours. Next, a lesson plan for each course is made with smaller sub-modules, and available video lectures are identified. Those lectures are mostly considered from the SWAYAM platform. After selecting the courses, all students are either provided the links for respective course modules of respective subjects, or the downloaded videos are handed over to the students who do not have a very good internet facility till that time.

After the distribution of video lectures, smaller groups of students are allocated for each class. The classes are conducted as a doubt-clearing session. Students are encouraged to ask questions, and the think-pair-share methodology is applied within the class. This will help students to solve problems on their own. Students are given assignments in class and encouraged to solve them themselves. This part is termed as 'Think'. Once solutions are obtained, they are distributed in several groups to discuss the solutions, known as 'Pair'. Finally, the correct solutions are shared among all the students of the class ('Share').

Laboratory classes are also conducted similarly. For software-based labs, experiments and assignments are distributed along with sufficient video links for understanding, and the same 'Think-Pair-Share' strategy is adopted. But the method is not applicable entirely for hardware laboratory classes. Compatible video links with demonstrations are shared, but that seems insufficient for all students understanding. There lies the provision for improvement.

Present Work

The authors have conducted an extensive study at JIS College of Engineering [www.jiscollege.ac.in], an Engineering College in INDIA, and flipped learning method is applied to the 1st-semester students in 4 (four) different disciplines. Different internal and social parameters are considered input variables, e.g., syllabi, course duration in terms of working hours in respective subjects, human resources for teaching etc. The noticeable difference is substantiated in terms of active participation throughout the continuous evaluation process. The quality of content is modified according to the need of the hour, and feedback is taken at the end of the course in terms of method of delivery, clarification of concepts, and teaching of subject matter. Performance improvement is reflected through the overall University grading system and the increase in attendance and enrichment of communication ability. The encouraging result is the driving force for further implementation of the strategy in the coming semesters assuming the cons non-availability of undisrupted internet sources at each student's home. One point assumed while making the factual graphs is that the entire outcome depends on the student's preparation, and we assume that all the students have prepared their lessons quite well daily. We also assume that all the screencasts shared by the faculties are well-organized so that self-learning is not a problematic factor. Apart from these statistical assumptions, results are very significant and justify the implementation of flipped learning.

Results and Discussions

Based on the data available, we have computed results for three courses for the 1st-semester students, one in basic science, one in humanities, and one in engineering science. We have taken data for two consecutive years, 2016 and 2017. It may be mentioned that data for 2016 is obtained when teaching-learning is carried out in conventional input-output method; flipped learning was adopted in 2017. We have categorized the students' performances following the grades division provided by the University. A comparative study is performed to estimate performance improvement. It is found that improvement is vividly noticeable for a few courses, whereas performance is vividly noticeable, whereas performance has slightly deteriorated for a few papers. Following curriculum and syllabi analysis, it is noticed that papers that required a solid mathematical foundation have not been accepted through flipped learning to date. In contrast, students feel flipped learning comfortable for subjects less mathematical or subjects related to humanities. Fig 1a, Fig 1b, and Fig 1c show the remarkable progress in student performance for three subjects, whereas Fig 1d, Fig 1e and Fig 1f show deterioration of results. For clarity purposes, we mention the name of the papers corresponding to the paper codes used in the graphs:

CH101: Chemistry-I
HU101: English for Communication
EE101: Basic Electrical Engineering
M101: Mathematics-I
PH101: Physics-I
EC101: Basic Electronics engineering
ME101: Mechanical Engineering

The comparative study is graphically represented in Fig 2.

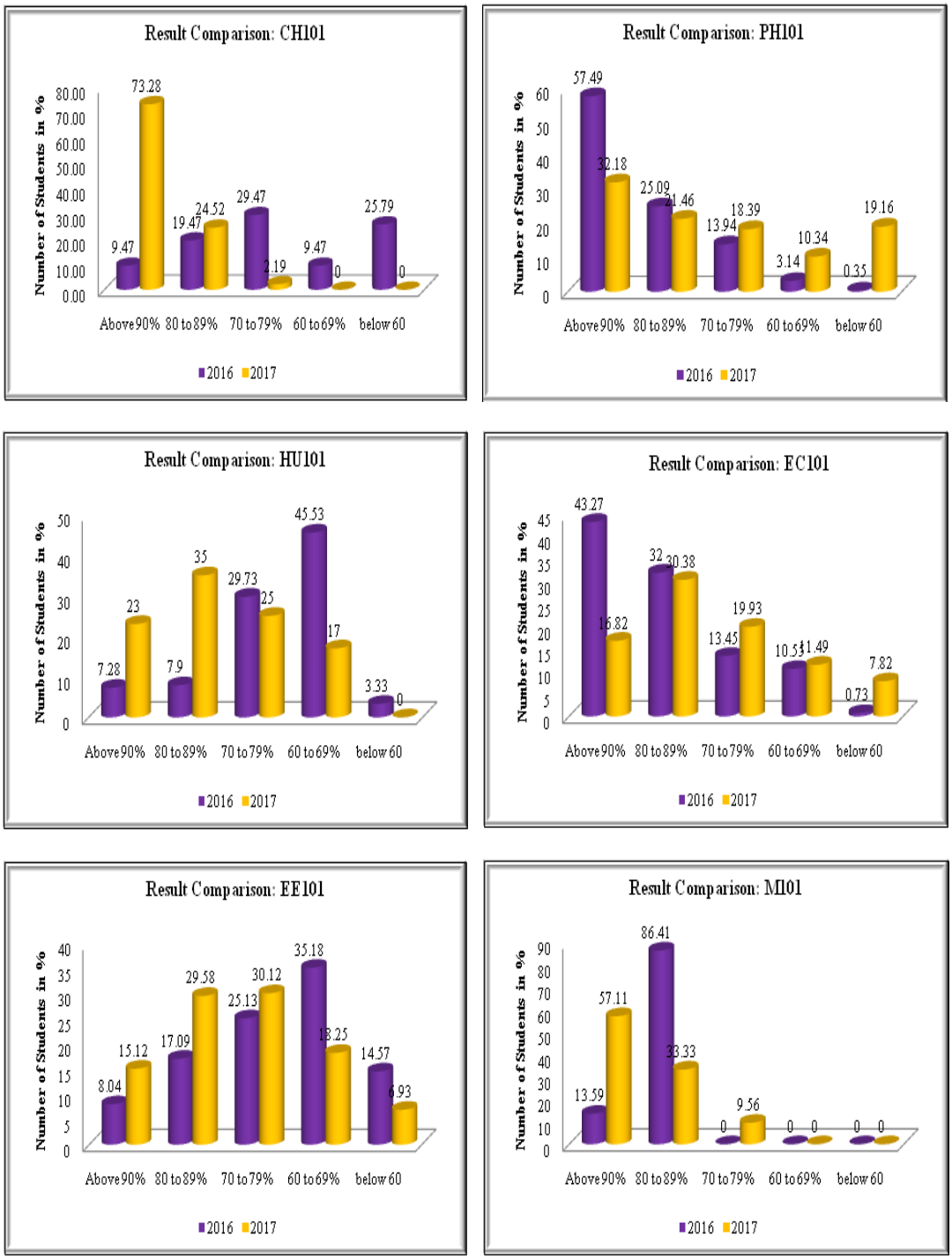


Fig 1: Comparative analysis for results in the paper [a] CH101 for 2016 and 2017, [b] HU101 for 2016 and 2017, [c] EE101 for 2016 and 2017, [d] M101 for 2016 and 2017, [e] PH101 for 2016 and 2017 [f] EE101 for 2016 and 2017

Table 1 presents a comparative analysis of student's results under conventional teaching learning mode and flipped mode. Conventional teaching-learning mode was followed in 2016, while flipped teaching was introduced in the year 2017. The subjects (paper code) considered for the survey are CH101, PH101, M101, HU101, EE 101, EC101, M101 i.e., 7 different subjects were considered for comparative analysis. The percentage of marks is segregated as

1. Above 90%
2. 80-89%
3. 70-79%
4. 60-69%
5. Below 60%

Fig 2 is the pictorial representation of Table 1. Table 1 shows that students have far better results (above 90%) for CH101, M101 and EE101 in flipped teaching mode. For PH101 and EC101, the result is reversed. For the other papers like ME101 and M101, the results are not yet conclusive, and we have to analyze data for a further 2-3 years. It is also found that for a few papers, namely, PH101, EC101 and ME101, the conventional teaching-learning mode has more students in the above 90% category than flipped teaching mode.

Table – I: Comparative Analysis of Student's Result under Conventional teaching-learning mode (2016) and Flipped mode (2017)

	CH101		PH101		M101		HU101		EE101		EC101		ME101	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Above 90%	9.47	73.28	57.49	32.18	13.59	57.11	7.28	23	8.04	15.12	43.27	16.82	53.13	23.45
80 to 89%	19.47	24.52	25.09	21.46	86.41	33.33	7.9	35	17.09	29.58	32	30.38	37.29	44.74
70 to 79%	29.47	2.19	13.94	18.39	0	9.56	29.73	25	25.13	30.12	13.45	19.93	9.58	7.1
60 to 69%	9.47	0	3.14	10.34	0	0	45.53	17	35.18	18.25	10.55	11.49	0	0
below 60%	25.79	0	0.35	19.16	0	0	3.33	0	14.57	6.93	0.73	7.82	0	5.29

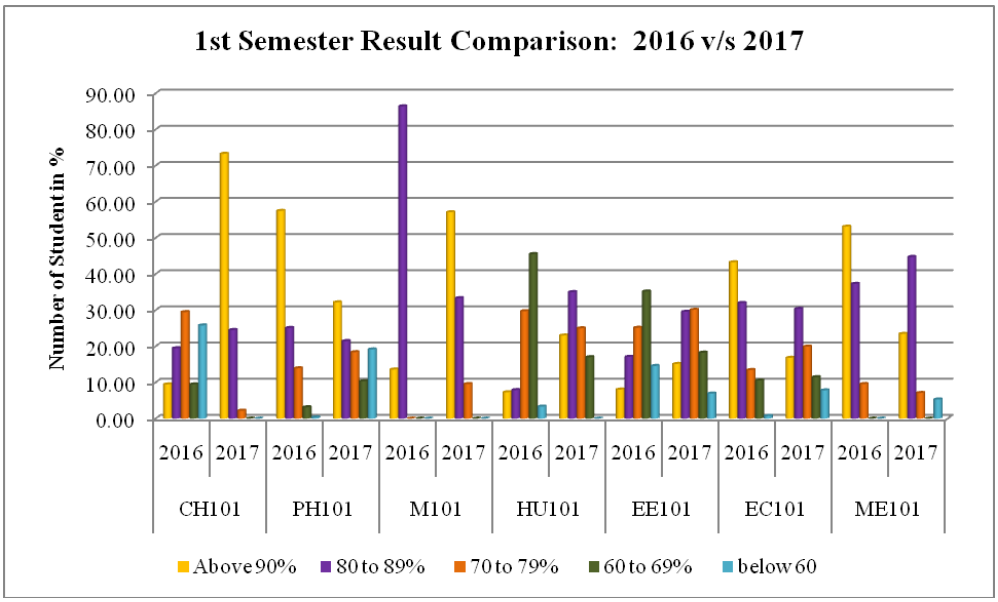
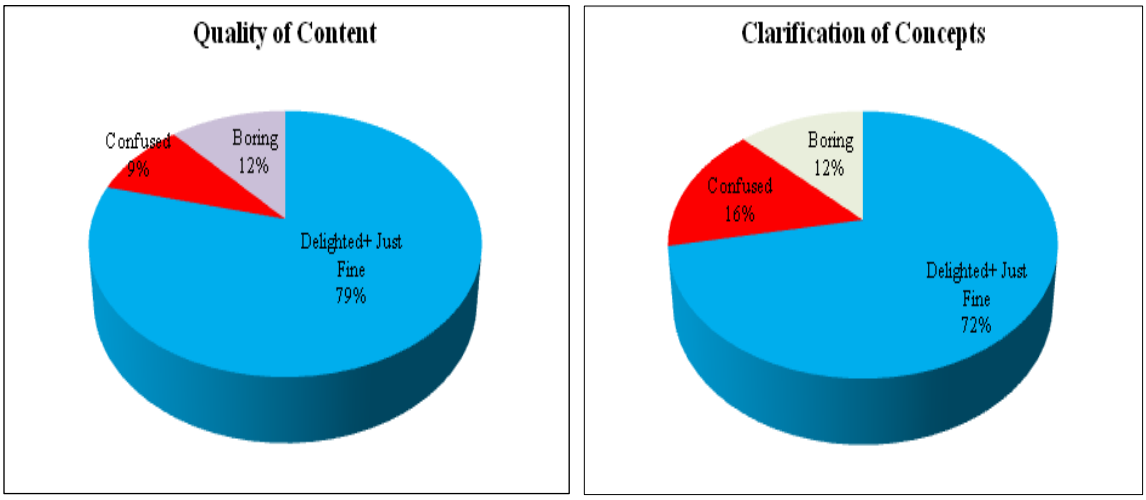


Fig 2: Comparative analysis for seven (7) different papers in 2016 and 2017

Next, we analyze the response of the biggest stakeholders based on the flipped teaching methodology. We have divided the summative response by four major parameters like [i] Quality of Content, [ii] Delivery, [iii] Clarification of Concepts, [iv] Teaching the Subject Matter. Also, we have considered and given due weight to the overall experience. Finally, data is taken for both batches, and the result is represented graphically in Fig 3.



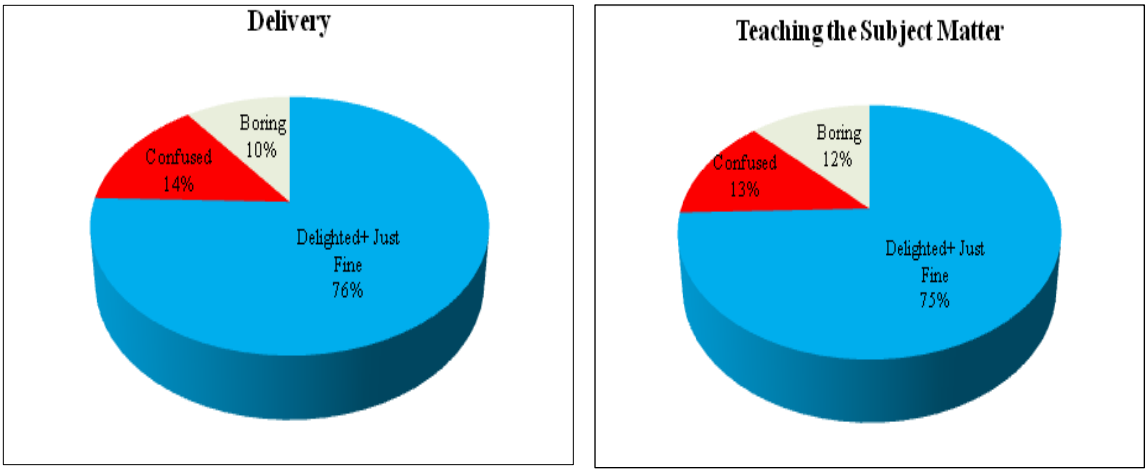


Fig 3: Graphical analysis of different feedback parameters: [a] Quality of Content, [b] Clarification of Concepts, [c] Delivery, [d] Teaching the Subject Matter

In table II, feedback analyses of students are given with three different satisfaction levels delighted, confused and bored. The parameters used in the analysis are quality of content, delivery, clarification of concepts, teaching the subject matter and overall experience. It can be seen from the data that in most of the parameters, the percentage of delighted students are more than 70%, and in most of the parameters, the percentage of bored students is less than 10%. Data are taken for around 1000 students. Students' feedback is most delighted in percentage with respect to the quality of content. The satisfaction level is delighted in the parameter of students' overall experience is 72%. It can be stated that flipped learning has changed the learning scenario, which enhanced the teaching-learning experience. When flipped learning was introduced, the percentage of bored and confused students was minimized. The parameters in which the percentage of delighted students increased at the maximum rate are quality of content, delivery, teaching the subject matter and overall experience.

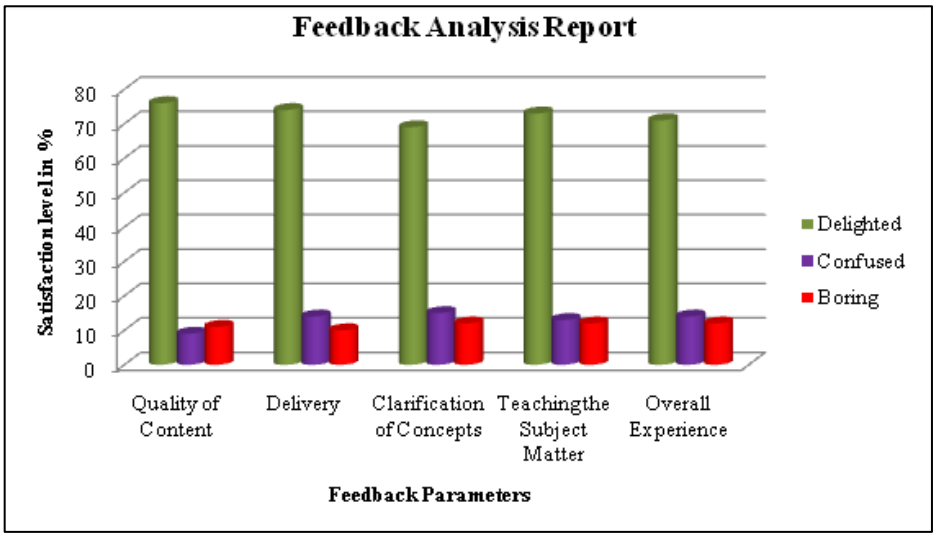


Fig 4: Comparative analysis of different feedback parameters

Table – II: Comparative Analysis of Student's Feedback under Flipped mode (2017)

Parameters	Delighted	Confused	Boring
Quality of Content	76	9	11
Delivery	74	14	10
Clarification of Concepts	69	15	12
Teaching the Subject Matter	73	13	12
Overall Experience	71	14	12

Conclusion:

A detailed analysis is carried out over two consecutive batches for identical subjects in an Engineering Institution, where one batch is subjected to conventional teaching-learning mode. In contrast, the other is obtained when flipped learning is implemented. The comparative analysis gives a mixed degree of performance. While the papers with less mathematical modeling are successful for the newly adopted technology, the core engineering papers involving detailed mathematics provide just the opposite response. One point may be noted in this context that while analyzing, we have assumed that all the students should have identical facilities of receiving uninterrupted internet supply. We further assumed that statistically, all the students prepare themselves before the commencement of any class. The total result also suggests that for a few papers where mathematics has an integral part, the introduction of flipped learning may not lead to a fruitful outcome. Thus flipped learning procedures may be implemented in technological campuses where the choice of subjects sets the path of adaptation.

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