Team Teaching: A Blended Learning Tool in Engineering Mathematics

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Abstract: In this article we discussed the effects of team teaching (TT) as a blended learning tool in teaching of course Engineering Mathematics, offered to students, bachelor of Engineering in Chitkara University Himachal Pradesh. A case study discussed here for 8 sections (appx.420 students) taught by teachers. Distribution of topics among team members and how we implemented TT as a blended learning tool is discussed here using tables and diagrams. Analysis of TT presented here by means of its merits and demerits. Statistical analysis of improvements in various parameters have also presented here.

Key Words: Team Teaching, Blended learning, Engineering Mathematics, Learning process.

1. Introduction

Blended learning (BL) is the process in which traditional methods of teaching are made more effective by introducing more strategies of teaching, adding new innovations, so that leaning process become more effective and interesting. Different strategies in transforming this teaching and learning process are being used See, Bates & Sangra, (2011), Andrew, Ewens & Maslin-Prothero, (2015). According to Halverson, Graham, Spring, Drydale and Henrie (2014) and Maurice Taylor, Sait Atas, Shehzad Ghani (2017), BL is an important model of instruction for higher educational institutes. It has advantages like effective communication, good collaboration among students, new knowledge generation and engagement of students, flexibility in teaching learning process and technology oriented learning, Garrison and Kanuka (2004) and Chew (2009). BL makes the learning process more active and gives flexibility to learner. It was observed that learners improved their outcome in terms of results and has excellent learning experiences, Saliba, Rankine & Cortez (2013) and Maurice Taylor, Sait Atas, Shehzad Ghani (2017). John, Tanzania, Rahat and Eliamani (2018) and Chantelle, Elsa and Gerda (2019), in their work focused on collaborative components of BL which helps in making learning environment more cooperative.

Here in our institute, in teaching of Engineering Mathematics course for students of year-1 Bachelor of Engineering (BE) we experimented with TT as a blended learning tool. Before this we were using traditional method of teaching i.e. lecture method, problem solving method etc., in which one teacher teach one class for full semester. Use of various teaching aids like power point presentations, showing videos, use of internet facilities while solving questions, interactive sessions during this formal process of teaching were used McCombs and Miller

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(2007) and Andrew, Ewens and Maslin-Prothero (2015).

Here in this article my aim is to discuss how TT made functional in our institute. Results of improvements due to TT for various parameters like interest of students, attendance in class etc. are analysed using statistical methods. Merits and demerits of TT also discussed here.

2. Current Method of Teaching

There are different methods of teaching mathematics like;

Lecture method

Demonstration method,

Lecture cum demonstration method

Problem solving method

Project method

And many more

In which teacher occupy central position or students occupy central position. Most of the courses of mathematics in our institute are generally learned and taught using traditional methods listed above.

3. Description of Engineering Mathematics-I Course

The course Engineering Mathematics is a major basic course offered in year-1 for all BE students. The course is divided in two parts, Engineering Mathematics-I in odd semester and Engineering Mathematics-II in even semester. Engineering Mathematics-I is offered for 60 hours and is a 5 credit course, it consist of topics like Matrices, Partial Differentiation, Multiple Integral and Vector calculus with almost equal weightage in terms of time and awards. Course is designed in such a way that each topic is application oriented. Student's hands in their application oriented assignments on regular basis and evaluated continuously. Teachers are there to answer queries of students on regular basis. At the end of the semester students take their closed book examination and their marks are determined from end semester examination and records throughout the semester. Students are evaluated out of 100% and a mark of less

than 40% is deemed to be a failure.

4. Why TT

In a class of 60 students, different students have different taste of learning the content. On the other hand a teacher has unique style of teaching. Which may not be suitable for all students? If there is a lack of coordination between teacher, students and contents to be taught, the students will be on the losing end, because they start losing interest during learning process. It's well said by Han (2004) keeps improving the art of teaching.

So keeping in mind the variable learning interest of student's there is a need for TT as a BL tool, McCombs and Miller (2007), Das Lekha, Sharma, Megha (2020).

5. What is TT?

TT is a process of teaching and learning in which a course is taught to students by team of faculty members. Single faculty is not responsible for completion of course but a team teaches course as per their expertise related to contents of the course. The team is answerable for the full course taught.

6. Role of TT in Engineering Mathematics

The course Engineering Mathematics consists of four units and offered for year-1 students of bachelor of technology. There are 8 sections(S-1 to S-8) of almost equal strength and a team of six faculty members [Teacher, T-1 to T-6] was indentified for TT of this course. Course consisting of four units distributed into five different modules for TT. Then topic of interest was taken from each faculty members and on the basis of their topic of interest, a schedule of delivery of lectures was planned as per Table-1, keeping in mind needs of students (Maxwell and White, 2017). The schedule was planned in such a way that teacher got chance to interact with different students in different modules (Mod), so that the teaching learning process become interesting Eison (2010) and Sawhney Sahil, Sharma Kulwant Kumar, Gupta Ankur (2020).

a. Schedule of TT in Engineering Mathematics

TT Schedule Sections

M-Matrices

PD -PD

MI- Multiple Integral

SFVC-Special Function and Vector Calculus

VI- Vector Integral

b. Faculty Assignment for Mod-1 and Mod-2: TT in teaching of Matrices (M) and Partial Derivatives (PD)

Table 1

Sections	S-1	S-2	S-3	S-4	S-5	S-6	S- 7	S-8
Mod-01 12 lectures	M	PD	M	PD	PD	M	M	PD
	T- 1	T-2	T-3	T-4	T-5	T-6	T-3	T-4
Mod-02 12 lectures	PD	M	PD	M	M	PD	PD	M
	T- 4	T-3	T-5	T-6	T-1	T-2	T-5	T-6
Mod-03 14 lectures	MI	MI	MI	MI	SF VC	SF VC	SF V C	SF VC
	T- 3	T-1	T-4	T-1	T-6	T-5	T- 6	T-2
Mod-04 14 lectures	SF VC	SF VC	SF VC	SFV C	MI	MI	MI	MI
	T- 5	T-5	T-6	T-2	T-3	T-1	T- 4	T-1
Mod-05 08 lectures	VI	VI	VI	VI	VI	VI	VI	VI
	T-2	T-6	T-2	T-5	T-4	T-3	T-1	T-3

Topic of interests was taken from each faculty members and on the basis of their topic of their interest teachers identified. T-1, T-3 and T-6 are interested to teach Matrices and T-2, T-4 and T-5 are interested to teach Partial derivatives, see

c. Process of TT in teaching of Matrices (M) and Partial Derivatives (PD) (Mod-1)

So there are two independent units (Matrices and Partial Derivatives) to teach, eight sections to be taught and six numbers of teachers for TT. Contents of two independent units were designed in such a way that each must have equal delivery time and equal weightage. So in Mod-1 consisting of 12 hours we offered Matrices for four sections and Partial Derivatives for remaining sections of students. Each unit has to be completed in 12 lectures. Here in Mod-1, T-1, T-3 and T-6 teaches Matrices to S-1, S-3, S-6 and S-7 and on the other side T-2, T-4 and T-5 teaches Partial Derivatives to S-2, S-4, S-5 and S-8, see Figure-2.

d. TT in teaching of Partial Derivatives (PD) and Matrices (M) (Mod-2)

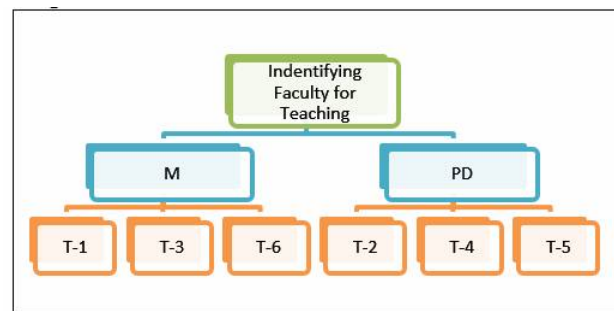Mod-2 also consisting of 12 hours here we offered

Fig. 1 :Faculty Assignment for Mod-1

Matrices for four sections S-2, S-4, S-5 and S-8 taught by T-1, T-3 and T-6 and Partial Derivatives for remaining sections of students taught by T-2, T-4 and T-5. Each unit is to be completed in 12 lectures, see Figure-3.

So in this way a T-1 is teaching S-1 in Mod-1 and S-5 in Mod-2. Here we found that teachers were more confident, as they have to deliver same topic. It was observed that there is a kind of competition between teachers which strengthen their teaching skills Singer and Stoicescu (2011).

e. Faculty Assignment for Mod-3 and Mod-4: TT in teaching of Multiple Integral (MI) and Special Function and Vector Calculus (SFVC)

Again based on the interests of each faculty member, we indentified T-1, T-3 and T-4 are interested to teach Multiple Integral and T-2, T-5 and T-6 are interested to teach Special Function and Vector Calculus see Figure-4.

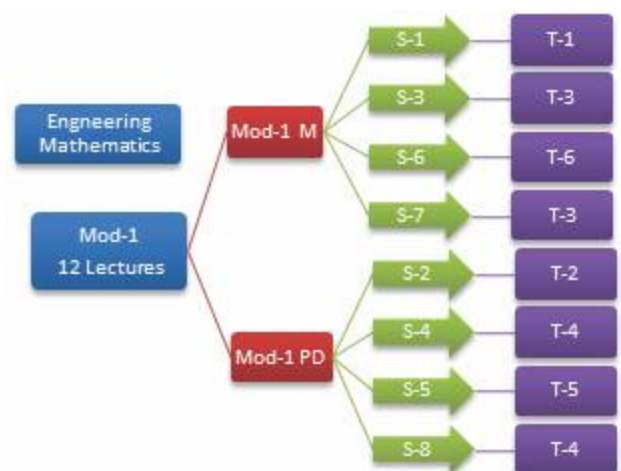Similarly in module 3 and 4 two units Multiple Integration and Vector Calculus were chosen and TT

Fig. 2 : Process of TT in Mod-1

applied with same group of faculty members. Each unit was given 14 lectures. Here T-1 is teaching section 2, 4 and 8 in Mod -3 and Mod-4. And in the last module which consist of 8 lectures the group of TT has to teach vector integral. So almost 86.66% of the contents of the course were taught using TT. Remaining 13.34% of the contents were taught by all teachers due to time constraints.

7. Methodology and Results:

At the end of each module attendance of students were analysed and it was found that most of the students were interested in TT. Also teacher was found very active during each module and curious about their interaction with new group of students whenever
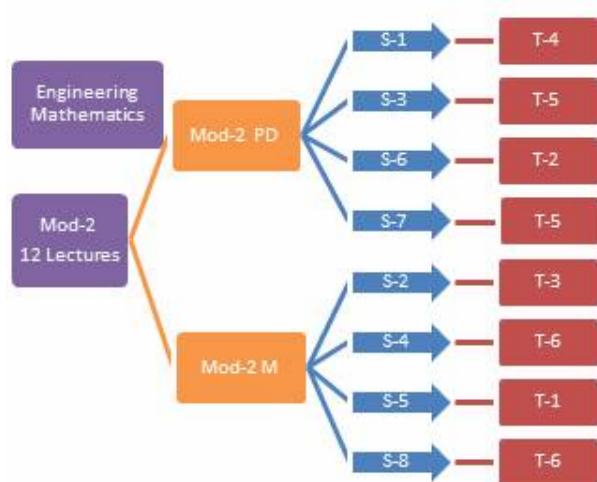
Fig. 3 : Process of TT in Mod-2

modules of teaching changed. Statistical methods were used to analysis various parameters and the outcome is shown in the form of Pi-charts

a. Analysis of Attendance and Marks:

It was noted that Students attendance was better this time as compared to attendance of previous batch of students. The students of current batch performed better as compared to previous batch of students in terms of marks in course Engineering Mathematics, see Table-2

b. Analysis of Interest:

Feedback related to TT was taken from students on prescribed format with three parameters very much interested, interested and not interested It was found that interest of students was on high level. About 71%
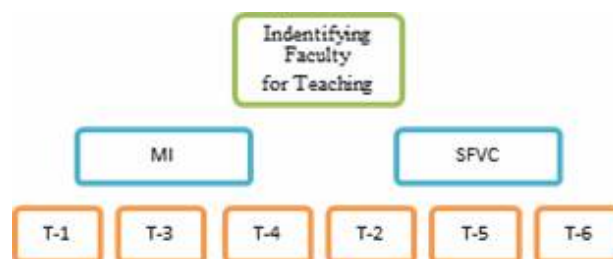
Fig. 4 : Faculty Assignment for Mod-3 and Mod-4

of students shown great interest in TT, only 5% students found not interested in TT and want to study from single teacher, see Figure-5.

c. Analysis of outcome of TT:

Outcome of TT was measured on the basis of five parameters: Excellent, Very good, Good, Average and Poor. It was found that 74% students had given very good and excellent response for TT. Poor responses were noted for only 5% students out of 420 numbers of students see Figure-6.

It was found that there was an improved learning in Engineering Mathematics (Deslauriers, Schelew and Wieman, 2011).

8. Discussion:

Following advantages were observed:

- Student got chance to study from all six teachers.

Table 2 : Analysis of Attendance and Marks

Batch	Previous Batch (412 students)	Current Batch (420 students)
Percentage Average Attendance	80%	89%
Percentage Average Marks	60%	66%

The TT schedule was planned in such a way that student got chance to study from all teachers involved in TT. So students got a balanced type of teaching where they interacted with very intelligent and intelligent teacher, teacher having excellent, very good and good teaching feedback.

- Student Interest was on high level. It was observed that learning interest of students was different than the traditional class room teaching learning

process. Every new module comes with new teacher and hence new content.

•   Learning experience of students was great as they were taught by teacher expert of his/her area of expertise. Teachers were indentified on the basis of their expertise in the contents of Engineering Mathematics. So here during TT they taught at their best.

•   Punctuality: It was observed that students were more punctual than the traditional teaching learning process. So improvement in punctuality
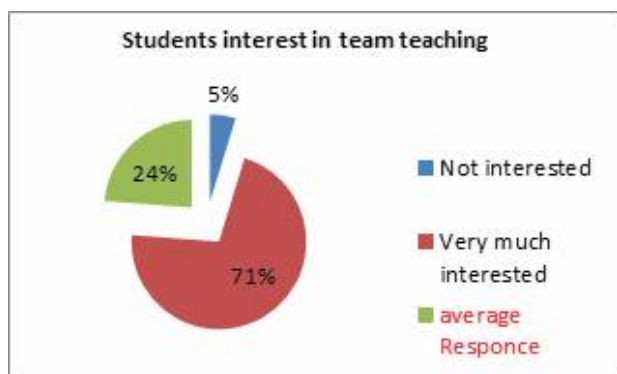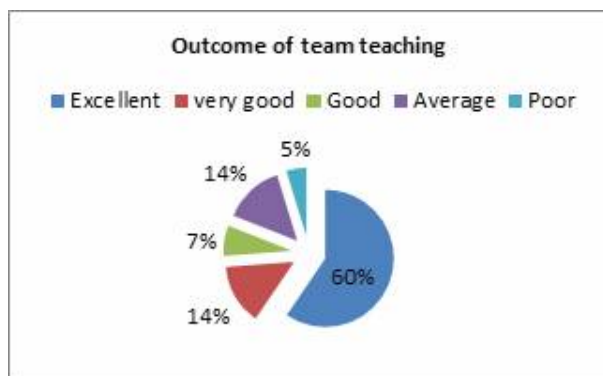

Fig. 5 : Analysis of Interest

Fig. 6 : Analysis of outcome of TT

of student found. Their class attendance was found more than normal.

•   Team spirit observed among teachers. Teachers taking same unit were found interacting with each other through personal meetings or course meetings. How one is teaching other wants to know about it. All were discussing problems got from students and they were found solving the problems as a team.

•   Good coordination between teachers found.

Teachers were sharing notes with each other, following teaching style and teaching skills to deal with a particular topic during the course of TT. If a teacher is on leave than the lecture got adjusted between the team members only.

•   Strengthening competency of teachers. There was a healthy competition between teachers. Each teacher wants to give their best as he/she wants to be best among team of TT.

•   It was found that the passing percentage of students were higher as compared to previous batch.

•   Completion of course: The course was completed in all sections on the same day as per the time allotted i.e. in 60 hours.

•   More options for students to clear their doubts. In traditional teaching learning process students got an opportunity to interact with only one teacher and clear doubts from the same teacher. But here students got chance to get solution of their problems by interacting with a team of teachers involved in this teaching and learning process with TT as BL tool.

Following disadvantages were observed:

•   Lack of bonding between teacher and student. Due to very less time spent by teacher in a particular section the bond between students and teacher was found week.

•   Course design/lecture allotment as per modules [see Table-1], i.e. we have to select contents in such a way that units in each module must be completed at same time, in equal number of lectures.

•   Record keeping: Who will keep the records like marks, attendance, assignments etc.? So record keeping was lacking.

•   Few students want to study from single teacher and not interested in TT. Some students shared their experiences that different teacher has different style of teaching and they fail to adapt to the teaching style of some teachers in TT of Engineering Mathematics.

•   Teachers interest to teach full course. Some

teachers were interested to teach full contents of the course. As full course expertise may help them in further competitive examinations.

9. Conclusions

Change in teaching techniques or method of teaching motivate students for learning. Different methodology in teaching learning process increases the interest of students (Levy H.M. 2008), as well as teachers and is a key tool for BL. So here in this article we found that by means of TT students have shown great interest in this leaning process, improvement in marks and attendance. Good coordination between teachers observed, students got chance to interact with different teachers and learn from his/her teaching skills, improvement in punctuality and results observed.   Also Faculty members have to interact with different student's after completion of content of expertise and repeating same content of expertise in other sections of students. Record keeping was a challenge. Few students shown disinterest in TT due to lack of bonding they wanted.   There are some advantages and disadvantages in TT but here students have shown huge interest in course, in attending classes of Engineering Mathematics with TT in our institute.

Acknowledgement

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