Performance Analysis of Conventional and Innovative Teaching Learning Methodologies in Engineering

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Abstract— Imparting engineering education to millennial learners is a challenge for the educators. An innovative teaching method, namely, MILA (Multiple Interactive Learning Algorithm), was developed and implemented for an experimental set of learners of second year undergraduate learners of Electronics and Communication Engineering. The one-hour class session was broken into three twenty minutes sub sessions. Activity for each sub session was planned for effective learning. Revision period was included before the summative assessment. The performance of learners was assessed for a period of one semester, by way of Internal Assessments and End Semester Examination. The learners were observed to be very enthusiastic in learning and actively participated in the activities. The level of understanding the concepts improved which was evident in the end semester results. The learners who underwent conventional methods of teaching gave a pass percentage of 76.26, while the experimental set of learners gave a pass percentage of 84.03. Thus, proving the need for a paradigm shift.

Keywords— Multiple Interactive Learning Algorithm (MILA), Active learning, T- Test.

***JEET Category* —Research & Practice**

I. INTRODUCTION

The current generation learners are extremely talented and they obtain all information and knowledge from the internet, which is available at the tip of their fingers. This raises a question of "the need for teachers". But technology can never replace teachers. To get connected with the learners, to impart knowledge and guide them in the right path is the prime responsibility of teachers. Teachers should understand that they are not just teachers but facilitators. The traditional way of teaching will not be sufficient. The expectations of learners are increasing day by day, as there is vast development in technology. When we are ready to change the way of booking tickets, booking cab and the like, we should also be ready to change the way we teach. An alternative method is inductive learning, where in we begin the class with some experimental data to interpret, a case study to analyze or a complex problem to solve (M.J. Prince and Felder 2006). That is the basic reason for the introduction of different pedagogies or algorithms to make learning a joyful one. Learners learn in various ways, and teachers should vary their use of instructional strategies in order to relate learners' learning styles and needs (Tiia Rüütmann 2011). So, we need to do active learning in our class by asking a question, pose a problem and we may ask to work individually or in small groups to come up with a response and give them some time to do (Felder 2009). This provides learners with opportunities to learn independently and from one another and coaches them in the skills they need to do so effectively (Felder 1996). At the same time, the faculty members need to spend time in designing the activity, plan effectively to carry out the activity in the class, make all the learners to participate, make observations, evaluate their performance and then provide feedback to the learners (Barbara 2013). The pedagogical changes need to be done form the first year of engineering education, especially in STEM courses. Researchers like Freeman (2014) has reported that learning in STEM courses is found to get improved on introducing activities in the class room. The pedagogical initiatives have started in engineering education to improve the retention ratio of the learners and to improve the job opportunity after the degree course (R. Senthil 2020), since learners with less conceptual knowledge struggle to sustain in the job environment. The introduction of experiments related to concept, makes the learners to visualize the concept and this enables them to make attempt to solve real time problems when they choose their mini- project or project work (N. Vijaya kumar et al 2021). The courses like Mathematics were also taught using this interactive method, very specific real time examples of electronics engineering. were used to explain the concepts. In recent past, many software

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and ICT tools have been developed to be used in the class room that attracts the learner and learn happily (Lilia Halim 2012). Further the use of You tube to create video for flipped class has become very common (Yingmin Liu et al 2022).

II. IMPLEMENTATION OF INNOVATIVE TEACHING

The second year ECE learners were taken as test cases for the implementation of an innovative teaching learning process at our Institution. The department had an intake of 300 learners divided into 10 sections, each section with 30 learners. It was decided to have a conventional method of teaching for section A2, B2, C2, D2 and E2. The test classes for the MILA concept was A1, B1, C1, D1 and E1. It has been found that the human brain can concentrate on a particular topic for only 20 minutes. The time table was modified to allot two continuous periods to each course. Then the 120 minutes of class duration was further broken into six sections of 20 minutes each. Lesson plan was prepared in such a way that each 20 minute of teaching was followed by an activity. The MILA (Deepak 2022) included following activities

1. Flipped class- Classroom environment is flipped. Teaching at home and working it in class. Videos are created for the topic and learners view them at home and discussion on the topic would be done in the classroom.
2. Jigsaw-In this cooperative learning technique learners work in groups to teach each other the given topic. The groups are given a large amount of content to prepare, and each learner in the group becomes an 'expert' on a smaller part of it.
3. POGIL - Process Oriented Guided Inquiry Learning. Learners were asked to form groups and the activities were developed to make learners learn best.
4. PBL - Project/ Problem based learning- Problem-based learning (PBL) is an approach which was used to teach a topic in the laboratory by doing the experiment. Some class open ended questions were used to solve the problem.
5. SCALE-UP -Student-Centered Active Learning Environment with Upside-down Pedagogies. Learners can perform a task and then explore the concept used. Can be used for theory cum lab courses.
6. Concept map-A concept map is a diagram or graphical tool that visually represents relationships between concepts and ideas. The activity is used to revise the unit and make the learners understand the relation among various topics of the chapter.
7. Role play-Learners enact a process/ working principle to make the peer group understand.
8. Peer led Team based learning- A heterogenous group is formed based on the learners' performance. This activity is used to encourage the slow learners with the help of fast learners. It is a structured, learner-centered activating learning method – in which the learner is an active participant.

MILA Class learners were permitted to use mobile and Laptops during the class with strict monitoring. The assessment pattern was changed from the conventional type, where in two Internal Assessment tests and one Model exam was conducted for the conventional classes. For MILA classes, Unit tests were conducted after the completion of each unit. The Internal Assessment schedule was modified with a learning hour during fore noon session and a test in the afternoon session.

Out of the mentioned activities, flipped class was popularly used by all the course handling faculty videos that were uploaded in College Portal before the class. Learners were asked to watch the videos before attending the class. Certain derivations that took longer time to do in the class were easily understood by the learners by watching the videos and the time taken to complete the portion was considerably reduced. A sample video screen shot is shown in Fig. 1 that was used to teach a topic in Digital Electronics. The topic needs nearly two hours to make the learner understand, but with flipped class strategy, we were able to make it out in one hour. Moreover one problem related to the topic was completed.

Flip Class- Video link- https://youtu.be/YB6ZJObejv0

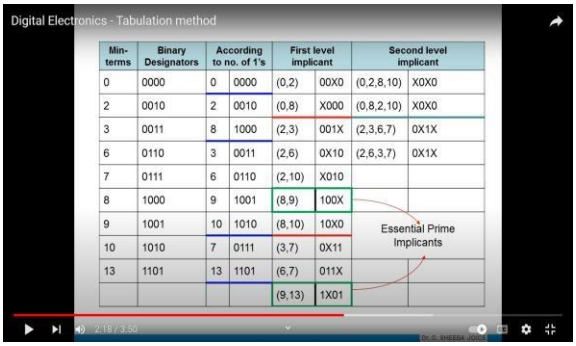

Fig.1. Screenshot of video uploaded in You tube to learn Tabulation Method

Role play was the next method that was used to teach topics that were difficult to imagine. Learners enacted the roles as per the topic. In Digital Electronics, Binary addition for more than confusion. Fig. 2 depicts the enact of the addition of decimal numbers by computer used in Binary adders in Digital Electronics. Initially, the learners were given instruction how to enact. Also, the properties to be used during the activity were prepared beforehand by the learners. The learners participated enthusiastically in the activity.

Fig.2. Image of learners taking part in Role Play to learn Binary Adders

Concept map was used to revise and relate the topics taught in particular unit. learners were divided into groups of 4 learners. At the completion of Unit 1, learners were asked to list the key topics, relate them with each other and then frame them into a concept map. The Fig. 3 shows one group of learners working on concept map for the subject Electronics Circuits I.

Fig. 3. One Group preparing concept map for the course Electronics Circuit I.

Scale Up activity was used to teach the topic for which experiment can be conducted. The courses that have lab experiment were taught in laboratories. The learners were given with lab manual and instruction to do the experiment, like taking reading, drawing graph, model calculation was given before the conduct of experiment. After the experiment, the concept was discussed through a questionnaire session. This approach made the learners to think and have better visualization of the phenomenon associated with transistors.

Jigsaw puzzle was used in one of the classes, but could not effectively make impact on learner's learning. It was taken up as a game by the learners.

Fig: 4. Learners in the Laboratory working on Electronic Circuit-I for Scale Up activity.

Peer Led team-based learning was used during revision classes to help the slow learners by the fast learners. The class was divided into group of six, each had 2 slow learners, two or three mediocre learners and one fast learner. The fast learner used to explain the concept to all and then frame question to ensure that their peer has understood. During the activity, the learners were asked to evaluate each other to make all learners to participate actively. Table 1 shows the Peer Evaluation done by learners during the activity. The revision test was conducted after the activity. Learners were able to perform well which was observed in the End Semester results.

Table 1. Sample group evaluation table for Peer Led team-based learning

Team Number	Number of Team Members	MCQ test (Avg Marks) (10)	Peer Evaluation (10)	Team Score	Team Performance less than Median score (15)
1	6	7	8	15	No
2	6	8	8	16	No
3	6	9	9	18	No
4	6	8	7	15	No
5	6 (two AB)	6	5	11	Yes

III. OBSERVATIONS AND ANAYSIS OF THE OUTCOME

After every internal test, result analysis was compared for the MILA classes and the conventional Classes. In CIA I, all MILA Class performance was better than conventional class except for Transform and Partial Differential Equations, Electronic Circuits- I and Object-Oriented Programming and Data Structures. Similar observations were found in CIA II and Model performance. In the End Semester Results, performance of learners from sections B1 and D1 were very appreciable that gave a T- Test Variance was below 0.5 in five subjects. A1, C1 and E1 could perform better in three subjects. Finally, the End semester Results were improved to 87% for the III Sem, as compared with 78% in the previous academic year. T Test analysis of all courses and for all classes are tabulated in Table 2. The values less than 0.5 are highlighted.

Table 2. T Test analysis of all courses and for all classes

T- TEST ANALYSIS									
Course Codes		**Object Oriented Programming and Data Structures**	**Digital Electronics**	**Signals and Systems**	**Electronic Circuits- I**	**Transform and Partial Differential Equations**	**Electrical Engineering and Instrumentation**	**TOTAL**	**% Marks**
A1 & A2	University Exam	0.752	0.195	0.167	0.167	0.978	0.906	0.427	0.427
	MODEL	0.145	0.797	0.774	0.519	0.815	0.300	0.792	0.792
	CIA II	0.966	0.014	0.768	0.032	0.002	0.386	0.052	0.050
	CIA I	0.000	0.654	0.435	0.000	0.666	0.003	0.078	0.078
B1 & B2	University Exam	0.484	0.754	0.175	0.029	0.414	0.127	0.747	0.747
	MODEL	0.341	0.565	0.674	0.750	0.773	0.236	0.863	0.863
	CIA II	0.295	0.009	0.006	0.188	0.050	0.247	0.124	0.135
	CIA I	0.003	0.055	0.359	0.135	0.936	0.000	0.003	0.003
C1 & C2	University Exam	0.963	0.168	0.008	0.693 EC6304	0.351	0.771	0.214	0.214
	MODEL	0.023	0.131	0.862	0.272	0.002	0.367	0.000	0.055
	CIA II	0.005	0.001	0.021	0.751	0.000	0.001	0.001	0.001
	CIA I	0.008	0.069	0.291	0.438	0.697	0.002	0.231	0.230
D1 & D2	University Exam	0.788	0.264	0.009	0.257	0.188	0.261	0.153	0.153
	MODEL	0.138	0.086	0.343	0.000	0.000	0.113	0.032	0.000
	CIA II	0.295	0.080	0.357	0.595	0.161	0.120	0.348	0.348
	CIA I	0.994	0.055	0.068	0.788	0.000	0.307	0.695	0.695
E1 & E2	University Exam	0.924	0.650	0.345	0.518	0.030	0.254	0.722	0.722
	MODEL	0.006	0.841	0.566	0.577	0.646	0.002	0.241	0.241
	CIA II	0.581596	0.016463	0.399102	0.165967	0.558658	0.012067	0.380208	0.380114
	CIA I	0.397	0.931	0.020	0.359	0.637	0.754	0.901	0.901

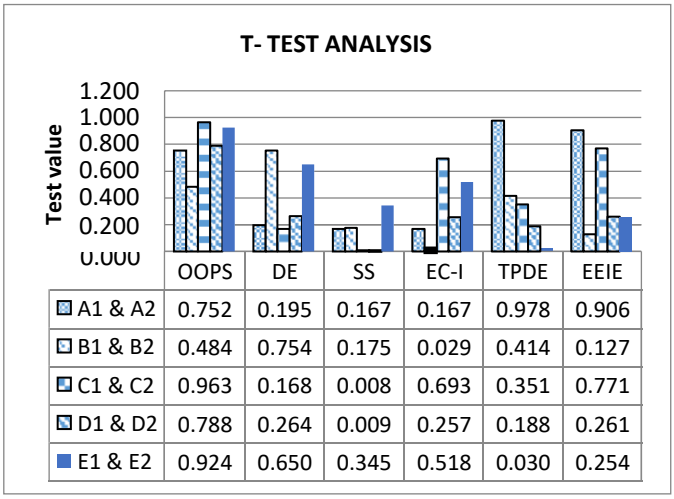

Fig. 5 T- Test Analysis chart of all Courses for End Semster Examinations

The T- Test analysis chart for the End Semester Examination of all courses is shown in Fig. 5. The learners of C1 section outperformed the C2 learners which resulted in T-test value less than 0.5 in all courses. Table 2 shows the pass percentage of MILA classes and conventional classes. The learners of C1 section participated more effectively in all the activities carried out by the faculty members and were able to show the improvement in the performance as compared to other sections. Hence the T- Test value and the overall pass percentage of the class has more deviation from the conventional section C2. There is around 20% pass percentage variation is observed. The other sections were able to show a variation of 4% to 8% improvement only. The average pass percentage of all learners of MILA class and the conventional class has a 4% variation in their pass percentage. During this period, the number of learners with arrear was less and so the department pass percentage that

used to be affected by II Year course made a remarkable change in the overall pass percentage.

Table 2: End Semester Result comparison for MILA and Conventional class.

MILA Classes		**Conventional Classes**	
Section	**Overall Pass**	**Section**	**Overall Pass%**
A1	90	**A2**	86.66
B1	76.66	**B2**	72.4
C1	93.5	**C2**	74
D1	80	**D2**	72.4
E1	80	**E2**	75.86
Average	**84.032**	**Average**	**76.264**

IV. CONCLUSION

Instead of covering the syllabus, we uncovered the syllabus. The time taken to uncover the syllabus was less compared to the traditional method. Learners enjoyed learning, were able to understand the concept better and enthusiastically participated in the activity. The time allotted for reviewing the topics before writing the exam enabled the learners to perform better as compared to traditional methods. Even though all the activities were implemented during the class, we had sufficient time to uncover the syllabus and also to revise the topics.

The results obtained in Anna University Examinations proved that classes in which MILA models were implemented performed better than the conventional classes. The feedback from learners also was very encouraging for the innovative pedagogy.

In future, more innovative methods can be explored, and implemented for all courses and for all classes. This will make learners enjoy learning and the facilitators will also have complete satisfaction.

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