Harnessing the Power of Active Learning based Engineering Mathematics Module

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Abstract

Teaching mathematics to engineers using Modules is trending to peaks this day. Today engineering students are failing in integrating with the B. Tech course and espouse the same inherent learning strategies. This article is a clear concern to analyze the standard of a student and present a module specially for 1st year B.Tech students. To keep the students motivated and engaged throughout, strap up appropriate learning outcomes, skills and attributes in an ordered approach by conducting simple activities at stipulated time intervals during the first year course is presented and found to be the best current pedagogical practices.

Keywords: Engineering Mathematics, Knowledge Gaining, Module, Modular Technology, Student Centred

1. Introduction

Mathematics in the education of engineers and other STEM(Science, Technology, Engineering and Mathematics) related disciplinesare vital. Students who possess feeble precise skills normally thrash about to reach the knowledge of Mathematics based courses, exhibit poor commitment in content and have issues with retention. The survey revealed that many students entering higher education do not possess the full set of mathematical skills required to succeed in technical programme's. In the highly technological world of today, the student is more rapidly to clinch technology and adapt to changes as they are introduced. With the changing needs and expectations of the student a pedagogical shift from a "passive" learning environment to "active" learning is required in order to stimulate a deeper learning experience. This approach is supported by a rising interest in research literature which points to students becoming more engaged and empowered when they are employed as agents of their own learning. In an active learning environment, the center of attention shifts from comfortable delivery by the faculty to energetic involvement of the student. The work in the direction ofdeveloping active learning methods in higher education is discussed.

In 2002, Steven etal.¹, focused on the transformed method of integrating the different lively learning strategies into a conventional lecture. The explanation of the growth of energetic learning is proposed to highlight the inspiration and incentives necessary for bringing about the transform.

In 2006, Michael etal.², presented alternative teaching approaches by using explicit remarks, problems, reviewed different effective teaching learning methods. The author defined each method, presented concepts of interest and disinterest.

In 2010, Charles etal.³, presented a technique to maintain efficient knowledge gaining and imparting the concepts of engineering mathematics by unfolding an organized way for developing a component, which promotes deeper learning.

Charles etal.⁴, in 2011, conformed several standard methods and seek to develop personal,interpersonal and professional skills through an active and interactive learning paradigm. Also discussed the content, pedagogy and efficacy of the module in relation to student motivation, engagement and attainment over a three-year period. It is shown that such an approach is successful in this regard.

In 2013, John etal.⁵, discussed sufficient number of

knowledge gaining methods elaborately. They chose the method which was easy to use and hence could be implemented. Also, learning methods like rereading, etc. was chosen because learners result dependsheavily on them.

Marisa and Edmund⁶, in 2014, constructed a project and analyzed its usage as a part of latest knowledge gaining process. The proposal was intended to supplyvigorous support to 1stB.Tech students. This process provides an atmosphere of accomplishment and possession that allows students of all levels to take pleasure in the knowledge gaining process.

In 2015, Natanael⁷ discussed the practice of imparting knowledge of Calculus for the 1stB.Tech students, the knowledge gaining and imparting process is a stabile combination between the teacher and learner. Vasanti and Vinod⁸, promoted technical education students in learning engineering mathematics through special modules designed for the purpose. Designed the module by dividing the curriculum into various stages and correspondingly graphical user interfaces were developed. Efforts were made to attract the students as per their interests developing four methods of accessing the modules emphasizing the effective mathematics learning through information technology.

All these articles presented various ideas. implementations of different active learning methods and the results. With necessities, at the first year B.Tech level, in mathematics teaching and learning, a good amount of success is achieved and further more is required for different level of students. The main aim of this article is to develop pin point strategies for 1styear B.Tech students with regard to Engineering Mathematics using the Modular Technology (MT), present the module for an active knowledge gaining and imparting of engineering mathematics. The move towards the practice of best existing pedagogical practices is based on the skill gained by the authors in this area.

2. Methodology

In this article we discuss the organized academic progress of the 1styear B.Techengineering mathematics module. The importance of this paper is:

- Energetic involvement of each and every learner in a class in the 1styear course.
- Promote conceptual learning at different levels.
- Encourage problem solving with self-learning.

• Development of learning attitude, communication skills and time management skills.

The method develops the concepts of engineering Mathematics with active learning andteaching, by identifying the standards of students. Then to achieve the curriculum design challenge, recommendations of selected techniques were done based on learning conditions of the 1stB.Tech students. The analysis and benefits of each technique can be easily assessed.Figure 1 shows the illustration of the whole process of the module.



Figure 1. Model design.

All the techniques are presented with sufficient pictures:

2.1 Technique-I: Basic Formulae Wallet

An important aspect in pedagogy is to review and develop the basics for a course. Many students for higher education enter colleges/ universities with gaps in necessary prerequisite knowledge of mathematical topics; this can hinder significantly the introduction of new mathematical ideas through novel approaches. A model is being designed for active participation in reviewing the Basic formulae by conducting different activities like asking particular students to prepare charts for different basic topics, one minute games, multiple choice questionnaire, puzzles, etc.

In this model, participation of every student is beneficial for active learning or to develop zeal in a student to develop by self-learning. In the first few classes in the beginning of the semester, a chart with sufficient boxes for writing formulae is displayed on the board by the teacher as shown in Figures 2, 3, 4. One after the other every student has to write a formula of Integrations suppose, in the boxes specified of the chart displayed but the student has to take care that no formulae presented on the chart is repeated. Hence motivating the student to be proactive and revising all the formulae already presented on the chart by his/her friend.



Figure 2. Shows student of IstB.Tech, AITAM College, participating in Basic Formulae Wallet preparation.

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Figure 3. Sample of Basic Formulae Wallet.

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Figure 4. Sample of Basic Formulae Wallet.

2.2 Technique-II: Puzzle Presentation

A classroom consisting fixed number of students working in fixed groups prepare puzzles, then post it to next group for solving. The puzzle is passed to next group if the first group fails to unfold the puzzle. The lecturer serves as catalyst, observing and from time to time approaching individual and classroom-wise necessities. This style of problem solving motivates the student for self-learning and self-confidence as shown in Figures 5, 6 and 7.



Figure 5. Shows Student of IstB.Tech, AITAM College, participating in Puzzle Solving.



Figure 6. Shows Student of IstB.Tech, AITAM college, participating in Puzzle Solving.

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Figure 7. Sample of solved puzzle presented by a student of IstB. Tech class of AITAM college.

2.3Technique-III: Identification of Suitable Mathematical Methods

Students generally fail to identify the correct process of solving a problem because of accessibility of diverse number of techniques of solving a problem andinsufficient practice. It happens that a problem can be solved by more than one method leading to ambiguity in students. Different activities are carried out for students to develop capacity to identify the method(s) suitable to solve a problem, like match the following questions, fill in the suitable method, etc. For example, "Fill in the suitable method" is presented in Figures 8and 9.



Figure 8. Sample of identification of suitable problem solving method presented by a student of IstB. Tech class of AITAM College.

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Figure 9. Sample of identification of suitable problem solving method presented by a student of IstB.Tech class of AITAM college.

2.4 Technique-IV: Question Bank Solving

A well prepared class of students with prefixed groups, suppose represent two questions from each group to

frame a question Bank on a chart paper/Black board. Then each group is allowed to select a question from the questions posted by the other groups and allowed to solve in a stipulated time. The instructor motivates a student from the group to solve the selected question on the board whose score is the score of every member of the team as shown in the Figure 10. In this model, every student is supported by the other members of the group in problem solving as their score is indirectly linked on the performance of every member, finally developing good team work.



Figure 10. Shows the example of question bank preparation and solving for IstB. Tech students of AITAM college.

3. Conclusion

The innovative methods of learning and teaching mathematics in engineering education will facilitate the conceptual understanding and constructive learning including novel pedagogies (e.g. collaborative learning, inquiry/puzzles/game based learning), with real-world examples, stimulating motivation and self-efficacy beliefs. The vigorous interactive knowledge gaining methods, combined with the entertainment approach, provides direct person progress. In addition, it offers a pleasant and productive knowledge gaining environment fostering a more constructive approach towards learning mathematics.

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