

Mind Mapping: An useful Technique for Effective Learning in Large Classroom

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Abstract— The real time experience of Signals and Systems has been embedded in the form of mathematical expressions. The learners find difficulty in applying these mathematical concepts in a real time scenario. This paper presents the details of effective learning technique attempted for the Signals and Systems course at the under graduate engineering program using mind mapping. Mind mapping as a technique tests the student's ability for interactive learning to improve retention and reduce revision time. This paper discusses about the effects of digital/ paper-based mind mapping over conventional teaching method to shift an teaching centric to learning centric. This learning not only focuses on retention of concepts but also caters to the generation of ideas required for solving an engineering problem, which in turn improves the writing skills of the students. Findings showed that there was a significant positive difference in student's academic achievement and attitude towards learning the subject through the paper/digital based mind mapping.

Keywords: Mind mapping, ABET, Signals and Systems.

I. INTRODUCTION

The conventional chalk and talk technique has proved to be one of the best technique for transfer of information but does not guarantee about the transfer of knowledge in large classroom. Visual teaching technique aids for effective learning as 65% of students are visual learners. Signals and Systems is one of the fundamental course introduced in the curriculum of Instrumentation Technology. Signals and Systems course focuses on mathematical representation of real time signals and its processing systems. These representations are supported by general definitions, theorems,

proofs, rules, theories and transformations. These transforms being highly mathematical and concept driven are generally considered as difficult courses. As it is known that 65% of students are visual learners [1] any concept which is difficult to grasp can easily be recalled using a visual learning technique. Signals and Systems can be learned through graphically visualizing the mathematical concepts involved in the course. One of the means to achieve the above mentioned purpose is by using Mind Mapping as a learning technique.

The concepts of mind mapping have been used for centuries from now. The first person thought to use mind mapping was a philosopher of 3rd century B.C named

Porphyry of Tyros to form his ideas and make learning simpler for all[2]. Leonardo da Vinci also used mind mapping and was considered as a historical person to popularize the mind mapping technique. In 1960's Tony Buzan made it very popular and used it extensively as a learning tool.

Mind mapping is an activist learning method for capturing ideas on a horizontal surface. It is a graphical way to represent large information into a useful knowledge base and also helps in connecting the knowledge base with real time scenario. It is a visual thinking tool that helps in efficient note taking and organizing information as it offers an overview about a concept and its salient features. This facilitates the students to build better and new ideas.

A mind map is created around a single concept, drawn as an image in the centre, to which associated

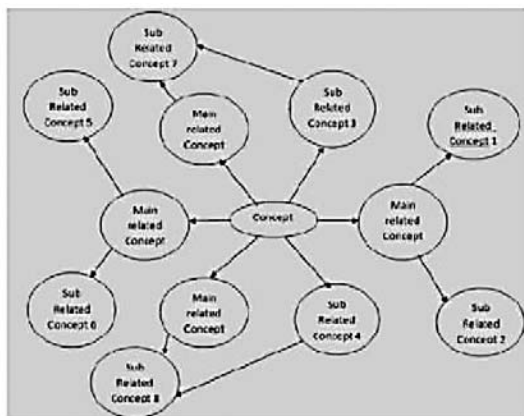


Fig.1. Illustration of the standard mind map which resembles a web like structure

representations of related topics are connected. This connection could be through phrases, images, colors, symbols, and drawings etc which can easily be recalled by the learner even in long term. Major ideas are connected directly to the central topic and later other ideas are branched out. Mind map provides "deep" and "not surface approaches" to learning. Mind map is an individual, personalized map, which reveals the thoughts of its creator. It is not involuntarily self explanatory as no two people in this world can have like flow of thoughts and ideas. A standard mind map resembles the following image like a spider diagram or like a tree as shown in the Fig. 1. [3]

Mind map opposes the traditional way how human beings brain works[4] that is, our brain works linearly. The work involved in mind mapping is both methodical and imaginative. Mind map forces both side of the brain to work left side is responsible for logic, words, linearity, sequences, analysis, lists. The right side of the brain performs tasks[5] like multidimensionality, imagination, emotion, colour, synthesis etc. Hence map making requires more active involvement in a much richer way of the learner's brain, help in all its cognitive functions and it is more of excitement while preparing a mind map. It is a beneficial learning tool to help brain storm any topic by the students and think creatively.

The contribution of this work is summarized as follows. Signals and systems can be learned through graphically visualizing[2] the mathematical concepts involved in the course. As it is known that the concept understanding seems to be grasped when it is taught in the class but revision or recalling becomes difficult. The objective of designing this activity is to provide students a learning environment in which they can be engaged in an interactive manner to learn the course and to design a efficient learning revision method that could help students remember important concepts of the course just before exams as well as to reduce the cognitive workload by means of learning using a text book.

Organization of rest of the paper is as follows. Section II describes the methodology, Section III describes the implementation details, Section IV describes the Assessment of the activity, Section V describes the Effectiveness of the activity, Section VI describes the Experimental Outcomes and Discussions and Section VII describes the Conclusion.

II. METHODOLOGY

Transmission of knowledge present in the information by teachers does not guarantee an effective understanding of the student in a large class room which has been a greatest challenge[9]. Conventional teaching methods involve problem solving on boards as normal chalk and talk method it works only for a small group of students. In order to address the large class room visual techniques must be used as 65% of students are visual learners. The approach has to be shifted to learning centric from teaching centric.

The details of this activity are presented in this section. The activity involves the following

- Concept analysis: In this, students have to analyse the concepts dealt in the class and build a mind map based on their understanding of the topics covered in the class individually in every hour of the class on daily bases.
- Group formation: In this the students in a group of four have discussions on the individual mind maps, gather all the information from different

mind maps exchange views and the group has to come up with a master mind map comprising of the view points of every individual in a team.

- Presentation: In this phase the master mind map has to be presented in front of the class at the end of the week.

III. IMPLEMENTATION

Fostering of creativity and ideas is addressed in this activity. Groups have been formed comprising of four students, they have to co-ordinate, organize and prepare a mind map in a team. Mind map is an interactive approach that forces the students to be attentive in a class as this approach provides much time for students to fit in the topics and make revision not a boring issue. [4]

Process of creating a mind map in this activity :

- Begin the Mind Map with a concept at the centre that symbolizes the main topic.
- With an open and creative attitude start with a brain dumping process that will stimulate new ideas and connections.
- Put down all the topics related to the central concept without evaluation and judgment. This will build the mind map having branches and sub branches moving outward the central topic.
- Keywords, symbols and pictures should be used for recording the ideas quickly.
- Topics related to the concept must be connected and organized in a better manner.

One of the case study of Signals and Systems using the mind mapping technique is briefed below

Example:- Signal analysis of audio amplifier system. The solution involves the identification of the following

- Type of the signal: Environmental/artificial/speech and music
- Nature of the signal: Periodic/A- periodic, Continuous/discrete
- Operations required: A m p l i t u d e scaling/time scaling/ time reversal
- Spectral Analysis: Suitable Transformations

The brief description of the case study is as follows. Given a real time signal analysis for

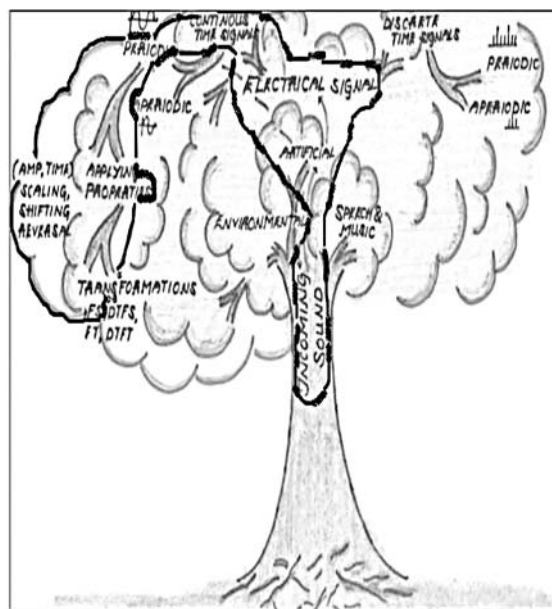


Fig. 2. Mindmap for Analysis of incoming audio signal

students that is, an incoming signal is sinusoidal signal then students have to analyze according to the method mentioned above and select an appropriate path that is, the incoming sound is an artificial sound which is to be converted to an electrical signal, it is a continuous time signal and is periodic signal, if the strength of the signal is to be increased then amplitude scaling has to be applied and to study its spectral analysis Fourier series has to be applied to convert the signal from time domain to frequency domain as shown in the Fig. 2.

Evaluation criteria was based on the effectiveness of interactive mind mapping, ability to find the connectivity between topics, utilization of interactive patterns of mind mapping and organization guided for Signals and Systems classes.

This learning method helps the students to select an appropriate connectivity and solve a given engineering problem. The other examples covered in mind mapping learning are related to the signal and system analysis in biomedical signals and



Fig. 3. Mind map for concepts of signals

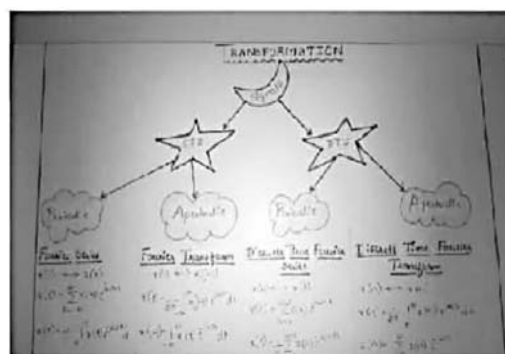


Fig. 4. Mind map for transformations

vibration signals created by vehicles. The samples of mind mapping on the concepts of signals and transformations is shown in Fig. 3. and Fig. 4.

IV. ASSESSMENT OF THE ACTIVITY

The effectiveness of the activity has been assessed through the student's performance performed in the semester end exams of academic year 2012-13 to the academic year 2013-14 and feedback provided by the students. Each student was assessed based on his/her individual contribution and in the group.

The assessment criteria for evaluating the performance of the students are as shown in Table I.

TABLE I. ASSESMENT CRITERIA

Sl. No	Assessment criteria	Weightage
1	Extent of coverage	15%
2	Number of illustrations used in a mind map.	20%
3	How well images, symbols and keywords clearly and dynamically convey the understanding of the concept.	25%
4	Indication of connectivity and categorization of topics throughout the mind map.	25%
5	Presentation of the mind map (Vocabulary, confidence)	15%

V. EFFECTIVENESS OF THE ACTIVITY

With this activity, students were able to have

thorough analysis of the concept being learnt in the class.

Feedback Questionnaires for this activity is listed below:

TABLE II. QUESTIONNAIRES FOR STUDENT FEEDBACK

Q.No.	Particulars
1.	In future where will this mind mapping help you in better understanding in other courses and project?
2.	Did mind mapping help you to improve the ability of organizing the information and help recalling the salient features?
3.	How well images, symbols and keywords clearly and dynamically convey the understanding of the concept
4.	Did this activity help you to improve the quality of practical and written work in your course?
5.	Did mind mapping inspire you for collaborative learning?
6.	Any other comments or feedback.

Question 1 relates to whether the students will use this learning technique in future for interactive learning. In response students were very interested to use mind mapping technique for group concepts, project idea generation, planning of the project and for preparation of competitive exams. Question 2 reflects on the improvement on the memory in recalling, and in response 87% students agreed that

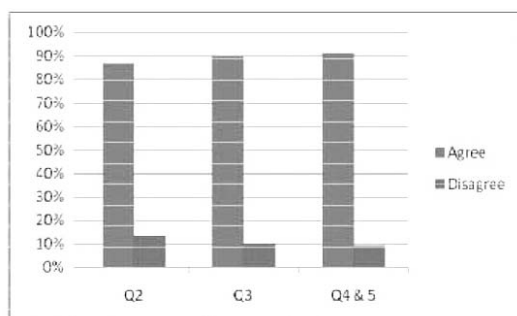


Fig. 5. Feedback Summary of Signals and Systems course by students

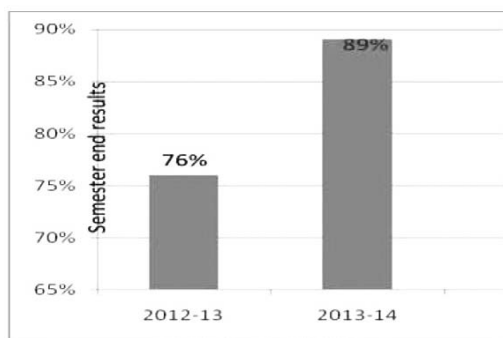


Fig. 6. Comparison of results

this learning method helped them to increase their retention capability. After using this tool 90% students agreed that this technique helped them in improving their writing skills and presentation which is reflected in question 3. For question 4 & 5, an achievement of 91% is observed to justify better understanding of the concept and enhancement in collaborative learning as shown in Fig. 5.

The effectiveness of the activity proposal has been reflected in the performance of students [12]. The performance of students in Semester end exams in the academic year 2012-13 for Signals and Systems is compared with the performance

of the students in Semester end exams in the academic year 2013-14 and is observed that the passing percentage of students is increased as shown in Fig. 6.

VI. EXPERIMENTAL OUTCOMES AND DISCUSSIONS

Mind mapping as a learning technique is mapped to the learning outcomes a to k of Accreditation Board for Engineering and Technology (ABET) [6] criteria as shown in Table III.

TABLE III. ACTIVITY OUTCOMES MAPPING TO ABET PROGRAM

Steps	Performance indicators attaining the Program outcomes	Program outcomes a-k criteria's addressed
Team work	To collaboratively select the best solution with justification	d
Concept analysis	Students can apply their knowledge of engineering to develop a mind map and have a better understanding of the concept.	a
Extended learning	Students should be able to use this learning technique in any course	i
Presentation	To improve communication skills	g
Soft skills	Students have to come up with both paper based mind mapping and digital mind mapping using tools available.	k

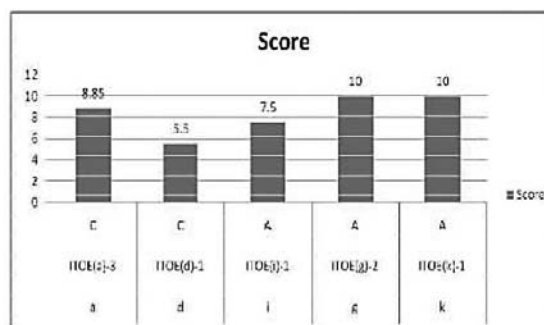


Fig. 7. Program Outcomes Attainment through Performance Indicators

The attainment of Program outcomes through performance indicators is shown in the Fig. 7.

By the above graph we can infer that by adopting this learning centric method we are able to achieve the outcomes a, d, i, g, k. A number of

improvement points have been identified through this measurement.

- In collaborative learning method students have to intensively practice brainstorming and generate ideas thoroughly as a team for a given problem.
- Contribution from all the members of the team to solve given problem.

VII. CONCLUSION

This paper presents an effective learning technique in large classroom for the course Signals and Systems which is introduced in the curriculum of Instrumentation Technology and in this study it reflected that the students who used interactive learning technique that is, mind mapping found it easier to learn and visualize the concepts of Signals and Systems. As this is a collaborative learning technique the students were motivated to learn the course. Students who were not good in mathematics found it easy after using this technique as they could analyze the connectivity between different concepts.

The most prominent positive outcome of the experiment is that over 90% of the students have clearly indicated that this has given them a very good opportunity to evaluate, work on and improve their ability for interactive learning.

This interactive learning approach adopted has great impact in significantly improving the overall teaching learning process, encouraging the faculty and the students to extend the same to the relevant courses in the curricula program.

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