

Mind Mapping: An Effective Teaching Learning Evaluation Tool in Engineering Education.

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Abstract:

Active and collaborative Teaching – Learning activities are practiced in outcome based education system. Mind mapping tool is a creative tool, which keeps students engaged and simultaneously active knowledge representation materialize. Mind mapping also helps teachers to evaluate effectively the students' knowledge gain. The Mind Mapping activity was conducted for Final year students of ETC Department, RIT. The results are verified statistically and the outcomes are measured through rubrics.

Keywords: Mind Mapping, Evaluation Tool, Rubrics, teaching.

1. Introduction

In recent scenario, it is observed that it becomes very difficult for a teacher to handle large classroom of 60 to 70 students to understand their knowledge gain. Hence the use of mind mapping enables the teacher as well as the students to gain a simplified method of teaching – learning resulting to a win-win situation for both the parties. This technique brings out the creativity and productivity of the students.

It is noticed that mind mapping supports the teachers to evaluate the learning gained by the students within a very short duration. For this activity, it is very important that the question framing should be focusing on deep learning and bounded to the course. As well as the faculty should take, care to design rubrics in a well-framed manner. Hence, we can conclude that Mind mapping helps both course owners as well as the students to gain quick review of whole course within a very short span of course material.

1.1. Objectives:

- Promote active and collaborative teaching, learning tool
- Engage students with fun learning.
- Promote rubric evaluation of learning

2. Literature review

Omue Kizilgol, Burcu Isguden Kilic, Hasan Abdioglu, (2016) In the paper titled - The effects of using the concept mapping and the traditional method on the academic achievement of students in learning the fundamental topics of cost accounting the authors have made a study on the comparison of the effects of using the concept mapping and the traditional method on the academic achievement of students in learning the fundamental topics of cost accounting. Also the author opined that the knowledge gained through concept mapping make students learn in a very ambitious and consistent manner.

Shraddha, Raghvendra, Nikita, Nalini, Ajit (2015) The authors in their study on Mind mapping: An useful technique for effective learning in large classroom, have opined that the Mind mapping technique proves to be very efficient and effective for the ability of the student for interactive learning to improve retention and reduce revision time. The authors have specified that the major important positive outcome of the experiment is that maximum number of students have clearly indicated that this technique has given them a very good opportunity to evaluate, work on and improve their ability for interactive learning.

Bang Khanh Nong, Tuan Anh Pham, Thy Nu Mai Tran (2016) in the study on the topic "Integrate the Digital Mind mapping into Teaching and Learning Psychology" authors have studied about the difference between digital mind mapping over paper-based mind mapping and conventional teaching method on students academic achievement and attitudes in teaching and learning also its effects are studied herewith. The authors in this paper are of the opinion that there is a noteworthy difference in the academic achievement of students' as well as the attitudes towards learning is positive through the computer-based teaching and learning mind mapping method.

Joanne Broggy, George McClelland, (2009) The paper titled - Integrating concept mapping into higher education: A case study with physics education students in an Iris University, attempts to map the students engaged in meaningful learning. According to the authors, the study suggests that Concept Mapping can serve as a valuable tool in physics education by helping students to understand the complex concepts in a more better manner, link themselves to new knowledge and represent their understanding of those complex concepts in a easy way.

Cui Jingjing (2016) In this paper titled - The application of mind mapping in foreign language teaching advances in social science, education and humanities research, the author through his study is of the opinion that Foreign language learner's thinking ability can be enhanced by mind mapping, as well as stimulate the learner's association to think out of box. According to the authors, mind mapping "classroom - based" teaching model can encourage the development of students' divergent thinking ability and the formation of a new teaching and learning strategy.

Shaimaa Salah Abbas, Ahmed Sharaf Eldin, Adel Elsayed, (2018) The authors of the paper titled - The effect

of concept mapping and mind mapping utilization on students' understanding level: an empirical study, are of the opinion that the technique of mind mapping would significantly affect learners' understanding level and speed. The results of the study show that such knowledge representation methods have positively affected students' perception about the understanding of key concepts implicit in challenging texts in an easy and better way than the traditional methods of learning.

Genevieve Zipp, Catherine Maher, (2013) The authors of the paper titled - Prevalence of mind mapping as a teaching and learning strategy in physical therapy curricula, are of the opinion that the Mind mapping technique uses a multi-sensory learning approach, which can support a student's ability to explore associations amongst information. The authors suggest in their paper that although this technique is not widely used in the physical therapist courses, it should be introduced and widely published to support the academics and enhance learning ability of students.

Kenesha Wilson, Eddia Copeland-Solas, Natalie Guthrie-Dixon, (2016) The authors in the study on - A Preliminary Study on the use of Mind Mapping as a Visual-Learning Strategy in General Education Science classes for Arabic speakers in the United Arab Emirates, demonstrate that mind mapping technique provide a quick way to highlight student misconceptions and knowledge gaps. The study also portrays that students are enthusiastically responsive to the technique of mind mapping, they have become engaged in the course and as such take pleasure in learning the course. The authors say that the main success of this mind mapping technique is that, the students are able to discuss and organize their thoughts externally along with their peers.

3. Problem Identified:

- Effective summary writing of chapter was not done by students
- Faculty does not evaluate the knowledge gain by students of every chapter.

Visual writing is more effective than normal summary writing. Visual writing clears the concepts of knowledge with interconnection and takes little time to write or draw. The evaluation is easy compare to normal summary writing.

4. Research Methodology:

The effective evaluation teaching learning tool was implemented at Rajarambapu Institute of Technology. Faculty does the analysis of every chapter. The visual drawing or mind mapping was used for analysis of student's knowledge gain of every chapter and finally the course. The mind mapping was done for all the six units one after the other. After this final mind mapping of the whole course was conducted at the end of the semester. The evaluation of knowledge of students is done first evaluating the every mind mapping. The data analysis is done on mind mapping. The statistical analysis tool was applied to test the hypothesis

finalized by faculty. For statistical analysis the chi-square test and variance among the mapping is tested. For analysis the variables used are core words used, branches linked, sub point included, application listed, interpretation of points.

5. Mind Mapping:

The concept of mind mapping is graphical representation of knowledge. It benefits students to recall, create new concepts, blend, comprehend and analyze the contents in one diagram. There are four types of mind mapping:

1. Process Mind Mapping,
2. Idea Mind Mapping,
3. Information Mind Mapping and
4. Application Mind Mapping.

The drawings of Mind Mapping is divided into two types, one is using software and other type is hard Mind Mapping using sketches as shown in below mentioned figure.

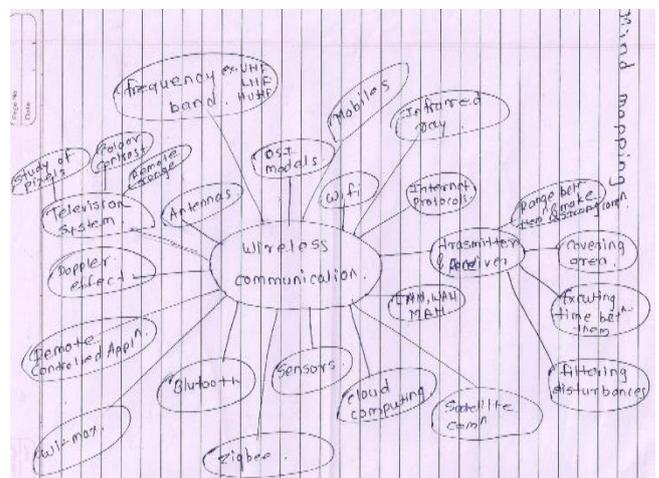


Fig.1. Mind Mapping of wireless Communication1

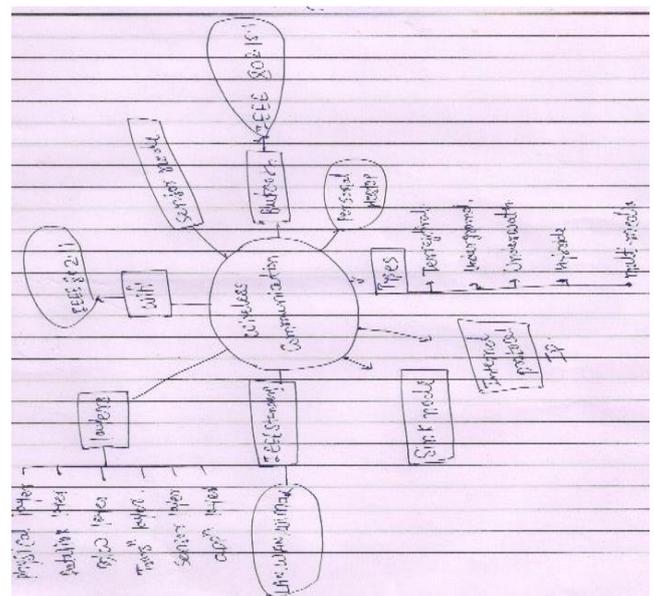


Fig.2. Mind Mapping of wireless Communication2

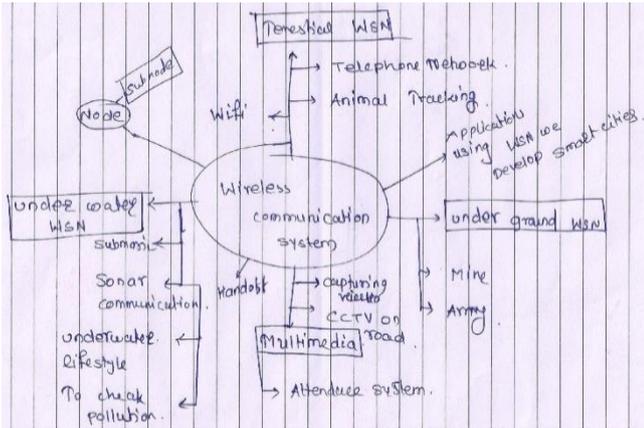


Fig.2: Mind Mapping of wireless Communication system

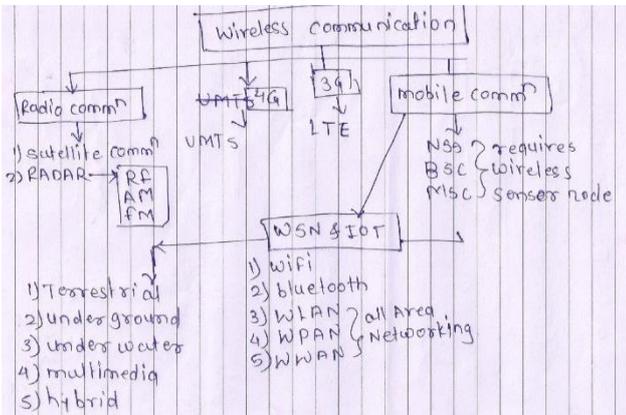


Fig.4.: Mind Mapping of wireless Sensor Networks and IoT

The online mind mapping is also done. The free online mind mapping software's are as following: Bubbles, X Mind 8, Wise Mapping, Mindomo, Free Mind, Idea Flip, Mind Node, Scapple, Mind Manager and Lucid chart. The free hand drawing is used for Mind mapping.

3.2 Types of Mind mapping activities:

Mind Mapping have four types:

Problem Solving Mind Mapping:

Problem solving mind mapping is used solving the industrial problems. This mapping is used in family to solve any problem.

Project Mind Mapping:

Project mind mapping is used to summarize the project and understand the project is simplest way.

Knowledge Mind Mapping:

Knowledge mind is used for evaluation and learning of knowledge in education institutes. The paper used knowledge mind mapping.

Online Mind Mapping:

Online mind mapping is used for online study evaluation and learning.

3.2.1 Advantages of Mind Mapping for Students:

- Students recall and represent the information in a short period.
- Mind mapping develops creativity and summarization skills.
- Supports for developing short notes effectively.

3. 2.2 Advantages of Mind Mapping for Faculty:

- Effective evaluation tool to recognize the knowledge of students
- Single page represent the whole topic as well as course learned.
- Help for teachers to change the teaching learning process.

6. Stastical Analysis:

Mind mapping is analysed using stastical tools.

6.1. ANOVA Testing:

ANOVA testing is applied for every unit of mind mapping. One sample unit mapping is given in table 1.

Table1: ANOVA testing for Unit3

Test Result Variables		Sum of Squares	df	Mean Square	F	Sig.
No of words	Between Groups	.139	1	.139	.184	.670
	Within Groups	38.615	51	.757		
	Total	38.755	52			
Application	Between Groups	.786	1	.786	1.103	.299
	Within Groups	36.346	51	.713		
	Total	37.132	52			
Branches	Between Groups	.218	1	.218	.420	.520
	Within Groups	26.462	51	.519		
	Total	26.679	52			
Connection	Between Groups	.407	1	.407	1.048	.311
	Within Groups	19.782	51	.388		
	Total	20.189	52			
Interconnecti on	Between Groups	.103	1	.103	.447	.507
	Within Groups	11.783	51	.231		
	Total	11.887	52			
NEW Things	Between Groups	.490	1	.490	.734	.396
	Within Groups	34.038	51	.667		
	Total	34.528	52			

The all significance value of one-way ANOVA is greater than 0.05. From the table it indicates that there is no significance difference between variable. The mind mapping is used to support students for fast recall and summarization.

6.2. Descriptive Statistics:

Descriptive statistics produces the mean, maximum, minimum and standard deviation of the variables. The mean gives that the students have sufficient information. Standard deviation gives the deviation from the mean means that the deviation of level of students' knowledge gain from assumption or designed variables. 53 students descriptive analysis is represented in table 2.

Table2: Descriptive Analysis

	N	Minimum	Maximum	Mean	Std. Deviation
MM1	53	1.00	5.00	2.7170	.86330
MM2	53	1.00	4.00	2.5472	.84503
MM3	53	2.00	4.00	2.6038	.71628
MM4	53	2.00	4.00	3.3585	.62309
MM5	53	3.00	4.00	3.3396	.47811
MM6	53	1.00	4.00	2.9057	.81487
FMM	53	3.00	4.00	3.5094	.50469
Valid N	53				

6.3. Reliability Statistics:

Reliability analysis gives the for checking the internal ability of activity. Here reliability refers to the confidence of questions asked for students to represent the same value when the measurement is repeated. Cronbach's Alpha is commonly used reliability testing. The ideal value of Cronbach's Alpha is - 0.7. The table 2 represents the value -0.036. This represents that scale is slightly not consistent should be slightly reversible. There is need to use innovations in mind mapping.

Table3: Reliability Analysis

Cronbach's Alpha ^a	Cronbach's Alpha Based on Standardized Items	N of Items
-.036	.038	7

6.4 Kolmogorov-Smirnov Test:

Table4: Kolmogorov-Smirnov Analysis

	MM1	MM2	MM3	MM4	MM5	MM6	FMM	
N	53	53	53	53	53	53	53	
Normal Parameters	Mean	2.7170	2.547	2.603	3.3585	3.3396	2.9057	3.509
	Std. Deviation	.86330	.8450	.7162	.62309	.47811	.81487	.5046
Most Extreme Differences	Absolute	.250	.270	.329	.284	.422	.244	.344
	Positive	.250	.270	.329	.284	.422	.209	.334
	Negative	-.176	-.183	-.200	-.282	-.256	-.244	-.344
Kolmogorov-Smirnov Z	1.818	1.963	2.393	2.064	3.070	1.778	2.504	
Asymp. Sig. (2-tailed)	.003	.001	.000	.000	.000	.004	.000	

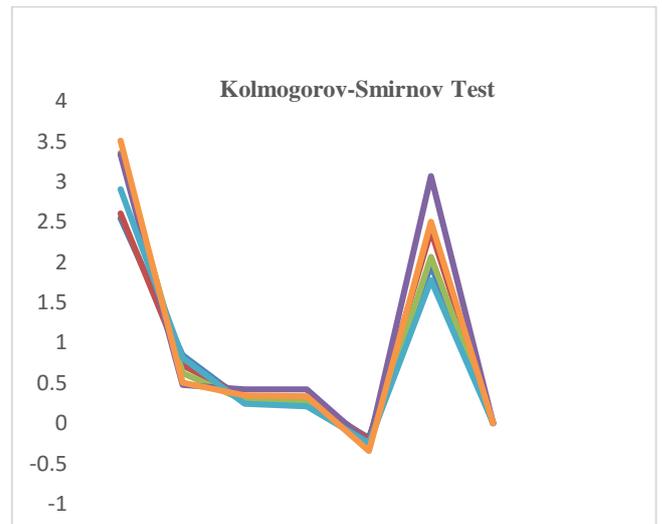


Fig. 5: Kolmogorov-Smirnov representation

Kolmogorov-Smirnov represented in table 4 and fig.,5 gives that the analysis of mind mapping to test the mind mapping variables distributed normally or not, both shows that the data is normally distributed means mind mapping variables links all the variables simultaneously.

6.5. Chi-square test:

Chi-Square test is most commonly used statistical tool for analysis. Chi-square test is used for categorical variables. The data calculated in chi-square test is randomly selected from independent variables. This test is sensitive for sample size. The sample size selected for this test are 53. Chi-square test represents the relationship between the used variables for evaluation of mind mapping.

Table 5: Chi-Square test Analysis

	MM1	MM2	MM3	MM4	MM5	MM6	FMM
Chi-Square	34.830 ^a	18.321 ^b	12.491 ^c	16.113 ^c	5.453 ^d	18.321 ^b	.019 ^d
df	4	3	2	2	1	3	1
Asymp. Sig.	.000	.000	.002	.000	.020	.000	.891

Table 5 shows the relationship between the first unit 1 mind mapping to final mind mapping at the end of the course. There exists a relationship in all six units Mind Mapping.

6.7 Inter item correlation matrix:

Inter item correlation mind mapping must show the positive value for positive relation. Table 6 shows the some values negative and some values positive means there should be need to change the teaching learning process for few contents. Individual statistical analysis indicate the weak point, which helps teachers to improve the teaching process. The analysis is the indicator of interconnection s of unit 1 to unit6 knowledge gain by students’ evaluation.

Table 6: Inter item correlation matrix Analysis

	MM1	MM2	MM3	MM4	MM5	MM6	FMM
MM1	1.000	-.153	-.185	-.022	-.042	-.066	-.060
MM2	-.153	1.000	-.112	.059	.055	-.063	.145
MM3	-.185	-.112	1.000	.195	.007	.099	.090
MM4	-.022	.059	.195	1.000	-.029	.144	.142
MM5	-.042	.055	.007	-.029	1.000	-.114	-.093
MM6	-.066	-.063	.099	.144	-.114	1.000	.119
FMM	-.060	.145	.090	.142	-.093	.119	1.000

7. Rubrics used for mind mapping Evaluation:

Rubrics are used for evaluation of mind mapping of every student. Table 7 rubrics are used for evaluation of mind mapping.

Table 7: Rubrics for evaluation of mind mapping

Factors	Student Performance Indicators				
	1	2	3	4	5

No. of Words	Poor	Fair	Moderate	Good	Excellent
Branches	Poor	Fair	Moderate	Good	Excellent
Sub Branches	Poor	Fair	Moderate	Good	Excellent
Application	Poor	Fair	Moderate	Good	Excellent
New things	Poor	Fair	Moderate	Good	Excellent
Creativity	Poor	Fair	Moderate	Good	Excellent

8. Results and discussion:

The feedback is collected form students using google form by designing a questionnaire for students.

Table1: Questionnaire for students

Questions	Strongly Agree (5)	Good (4)	Agree (3)	Neutral (2)	Disagree (1)
Could you recall the contents in short time?	[]	[]	[]	[]	[]
Does mind mapping help you to improve your exam performance?	[]	[]	[]	[]	[]
Does this activity support your goal setting?	[]	[]	[]	[]	[]
Can you use this activity for your project?	[]	[]	[]	[]	[]

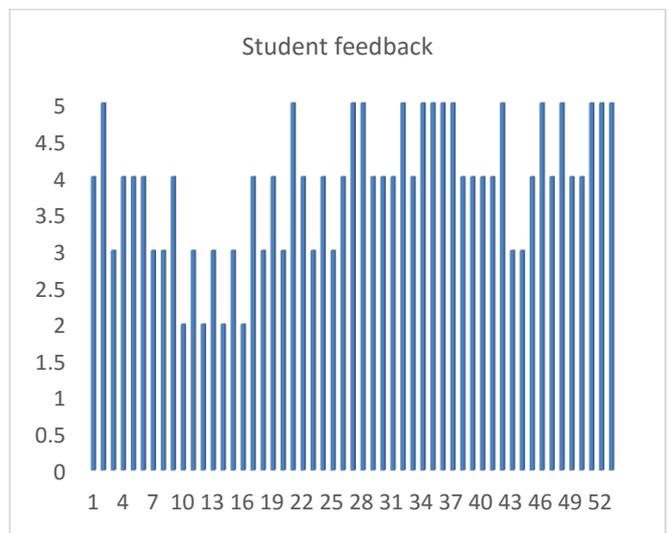


Fig. 6: Kolmogorov-Smirnov representation

Fig. 6 shows that students performance is improved due to mind mapping activity.

9. Conclusion:

Mind Mapping is an effective evaluation tool proved statistically. The question framing should be focusing on

deep learning and bounded to the course. Faculty should take care to design rubrics in a well-framed manner. Hence, Mind mapping helps both course owners as well as the students to gain quickly review of whole course within a very short span of course material.

10. Outcome:

The outcome of the activity is that student attainment is improved. One sample attainment is given in the fig. below.

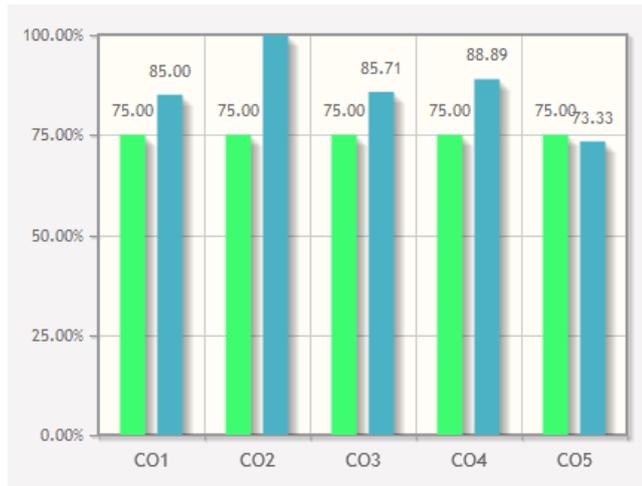


Fig. Student Individual attainment

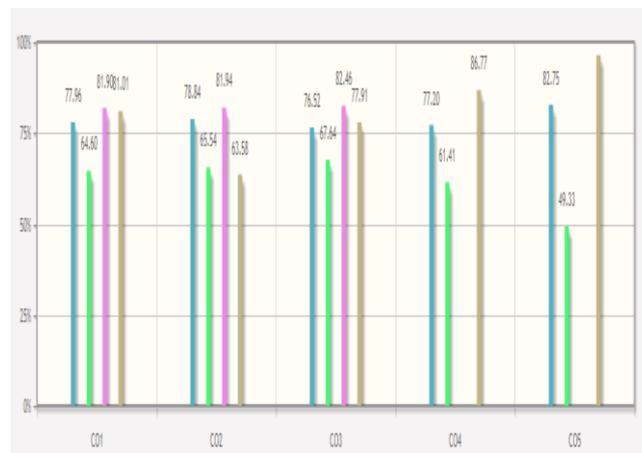


Fig. Student Comparative attainment

The CO attainment are achieved. Individual student performance is increased in the examination.

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