KI3A model for Effective Delivery of Course Content

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Abstract:

Effective teaching is about what students perceive and understand the intended concepts or skills rather than how and what a teacher does in the classroom. It ensures the students total involvement that exposes their self-interest and desire for learning. Teaching effectiveness is directly proportional to the proper balance between instructor's subject knowledge and teaching (pedagogical) ability. With this focus, the purpose of this paper is to describe the three Aces of Effective Teaching model KI3A (Knowledge, Involve, Assess) as a conceptual framework for increased self-reflective practice among teachers in higher education settings. The 'knowledge part' focuses on instructor's subject knowledge, and knowledge about the students. The component 'involve' avows the active engagement of students in the teaching learning process through visualization, summarization and demonstration. The 'Assessment' constituent evaluates the students understanding and skill using fuzzy logic, and suggests the corrective measure for improvements. This model facilitates student's involvement in the learning process and accurately assesses the knowledge and skill acquired by the students.

Keywords:

Traditional teaching, student centered learning, concept mapping, Fuzzy based Assessment.

Introduction:

The noble profession 'teaching' recognizes and acknowledges that the instructors have promised obligations to bring overall development of their students in academic as well as nonacademic level. The primary aim of any education system is to provide a suitable environment for the students to make use of their full potential to achieve the total development for the benefit of self and society. It is possible only through the active participation of students kindled with self interest in the learning process. Hence it is essential to find an appropriate teaching pedagogy which ensures student centered learning with active involvement of students. Basically teaching methods include two major components sending and receiving information. Therefore the delivery methods should be in such a way that it should ensure whether the receiver has got the correct information what is intended for. The traditional talk and chalk method emphasis on "one way flow" of information which doesn't guarantee the outcome of delivery. Since the teacher is a central focus in the traditional approach, students are expected to do what the teacher is instructed, less exposure to reveal their aptitude and skill through response, feedback and activities. Therefore the focus of student centered approach is to offer appropriate pedagogy which motivates the child to reveal them fully via active participation in the various activities.

In student centered learning approach, teacher is acted as a 'Facilitator' to help the students to achieve the intended knowledge and skill through their complete participation. The challenging task here is to find the best suitable teaching practice which uses modern technology in order to attain intellectual and imaginative power, understanding and judgment, problem solving skill, and communication skill.

Many researchers worked on it before in order to find suitable teaching methods that invoke student's active participation. Many studies also aimed at determining the effectiveness of technology in courses without sacrificing the quality of education. One effective method to teach mathematics called 'Open-Approach' was introduced by Nohda [95,97,98,99] and the aim of this approach was to foster mathematical thinking and creative activities of students in order to cultivate mathematical intelligence. Damodharan [1999] proposed the use of multimedia into traditional teaching method that helps to visualize the concepts. Boud D [1997] addressed the challenges in problem based learning. Martin [2009] worked on "Calculus students' ability to solve geometric related problem. Bressoud et.al [2013] made a study on the background of the students who take calculus and changes in student attitudes towards mathematics and intention to continue in mathematics. Epstein [2013] suggested the "Calculus concept inventory-Measurement" in order to give the effective teaching methodology in mathematics. From the literature review it is observed that gradual shifting of traditional teaching to student centered teaching is the need of the present-day. They all approve on a common point that the traditional talk and chalk method is not enough for quality delivery especially the subjects like Mathematics. We should adopt effective teaching pedagogic practices that ensure students active participation in the learning process along with proper continuous assessment methods.

With this focus, we propose a model KI3A (Know-Involve-Assess) that confirms the active involvement of students. This model enhances intellectual, understanding, imaginative, problem solving, communicating and thought provoking skills in a student so that they perform well in the written examination with clarity of concepts. The remaining sections are organized as follows. The section 2 gives the overview of the method. The section 3 gives the effectiveness of the method and implementation followed by the conclusion.

2. KI3A Methodology

This method is based on the principle "Tell me, I will forget, Teach me I remember, Involve me I will learn". Once it is possible to ensure students %100 involvement, definitely it will result in an effective learning. Therefore, in this model an attempt is made to involve students through various activities. It's a three level approach in knowledge transferring where teacher acts as a facilitator or a coach. The overview of the method is shown in Figure 1. The approach has three steps; 1) K- Know 2) I- Involve 3) A –Assess.

2.1 K-know: One of the key components in the effective teaching learning process is to have thorough knowledge of the subject that we are going to teach, and knowledge about the students whom we deliver the lecture. In addition to the good knowledge of the subject, knowing the participants is an important and integral part of teaching. It is important for a teacher to get to know their students because the more they know each student the better they can teach them. The prior knowledge of the strength and weakness of a student would help the teacher to choose the proper delivery method that brings out the best from each student. So, at the beginning of each course, a PRE-Requisite test, is conducted to know the level of each student in the class. This test ensures all fundamentals needed for the course. If the test score is not up to the mark, remedial steps are taken to get all fundamentals needed for that course.

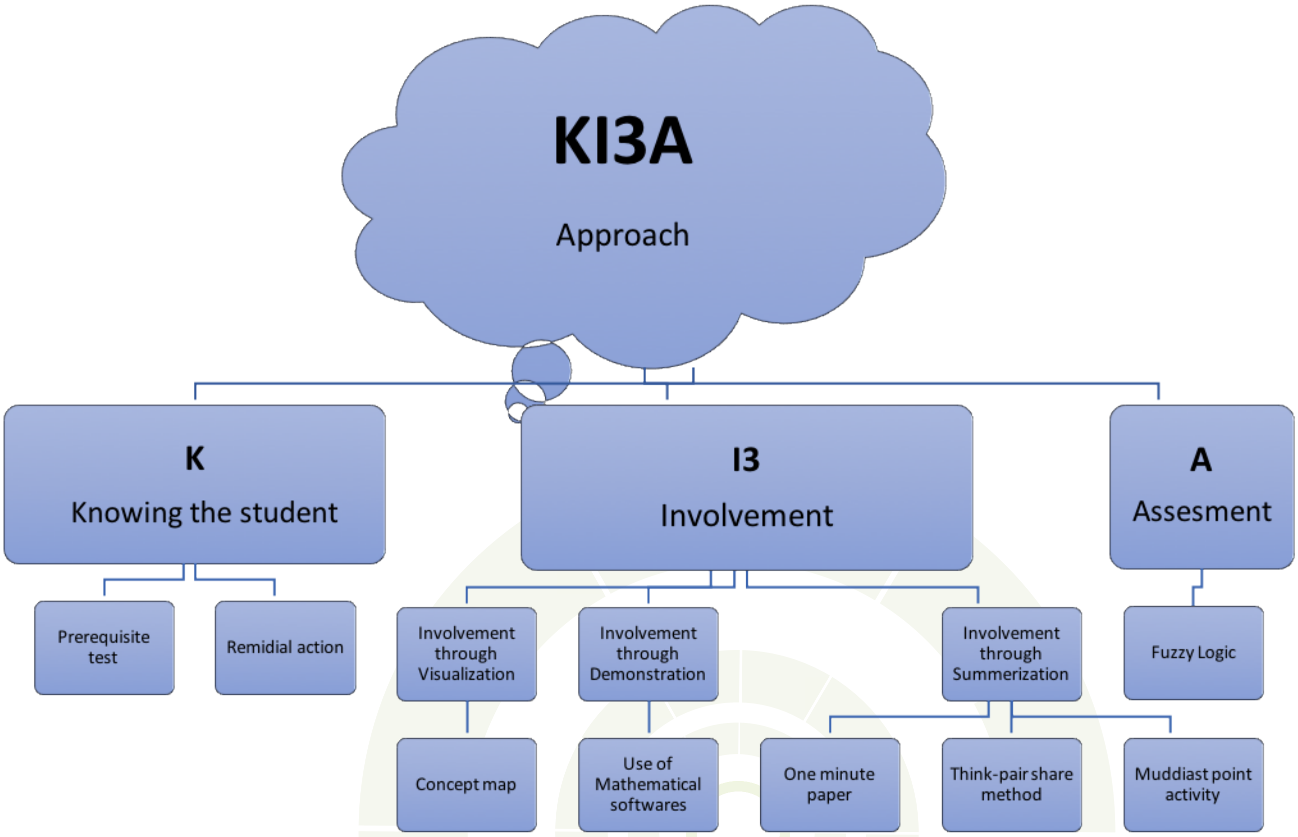


Figure 1: Overview of the approach

2.2 I-(Involve): Active student involvement is another step of a successful teaching method which contributes to a well-managed classroom. If the students are engaged in learning, there is little time for disruption and it will lead to more focused learning. It is true that the human brain cannot concentrate on a lecture more than ten minutes unless otherwise it is interesting for him. Therefore, in between the monologue lecture, some activity should be carefully planned to make sure it reaches the students properly. The key is to keep a good balance between teacher-talk and active involvement in the learning. Once we can ensure the total involvement of the students in the learning process, effective teaching will take place. It can be achieved through following way.

2.2.1 Involve through Visualization: 'A picture is worth a thousand words'. The brain scans the images and records the sound quickly compared to text, and is lasted for a long time in the memory. Visualization of concepts will have high impact on the clarity and deeper understanding and one of the effective method for it is concept mapping. The concept mapping is suitable for any course and it can be done at the end of a chapter or important topic which connects multiple topics. This technique was introduced in the education by Novak [1983]. Further it was extendedby Gowin et al.[2009] , Karolina [2009] and many more other researchers.

A concept map is a diagram that depicts relationships between all concepts of a topic. It is a graphical tool that we can use to organize and to visualize the content of the lesson. Concept maps have a hierarchical structure. The mapping is the creative process of organizing content and can be used in planning lessons, learning, individual and group work, developing mathematical literacy and fostering mathematical thinking. Conceptual mapping can be easily applied to other subjects also and to everyday life. Figure 2 summarizes the idea of concept mapping:

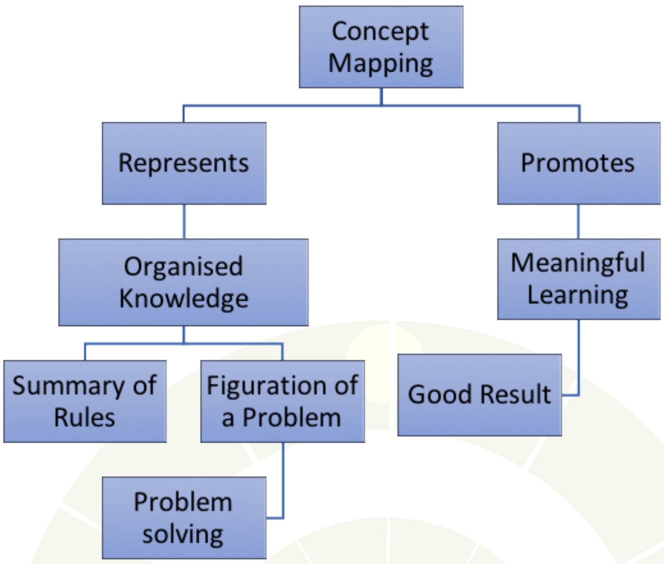


Figure 2: The general idea of concept mapping

At the end of each chapter, students prepare a 'Concept mapping' based on his/her creative thinking which logically connects all the topics in that chapter. A sample Concept mapping is shown in Figure 3. The advantage is that students are able to link all the concepts in that chapter using their own creativity, thereby attaining clarity and interest in the subject. It helps to provide comprehensive view of the lesson, organize teaching material, visualize the teaching process, introduce new concepts and link them with the known, decompose complex ideas, check the level of understanding, identify weak points, explore the reasons for misunderstanding among students, encourage student activities, connect interdisciplinary and so on.

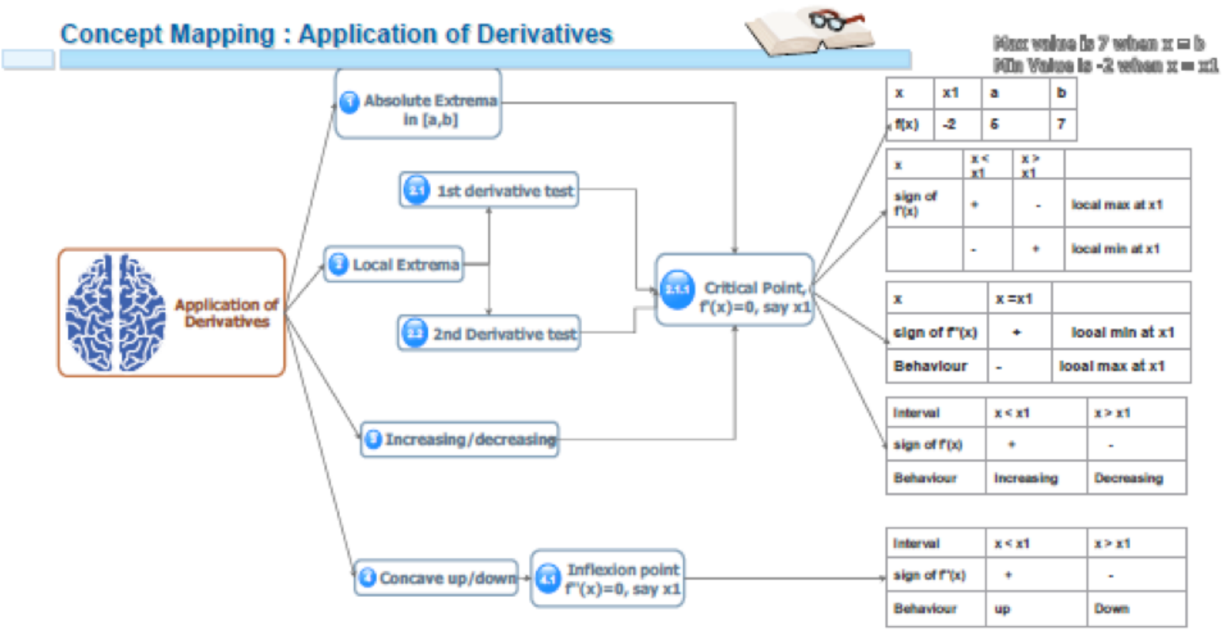
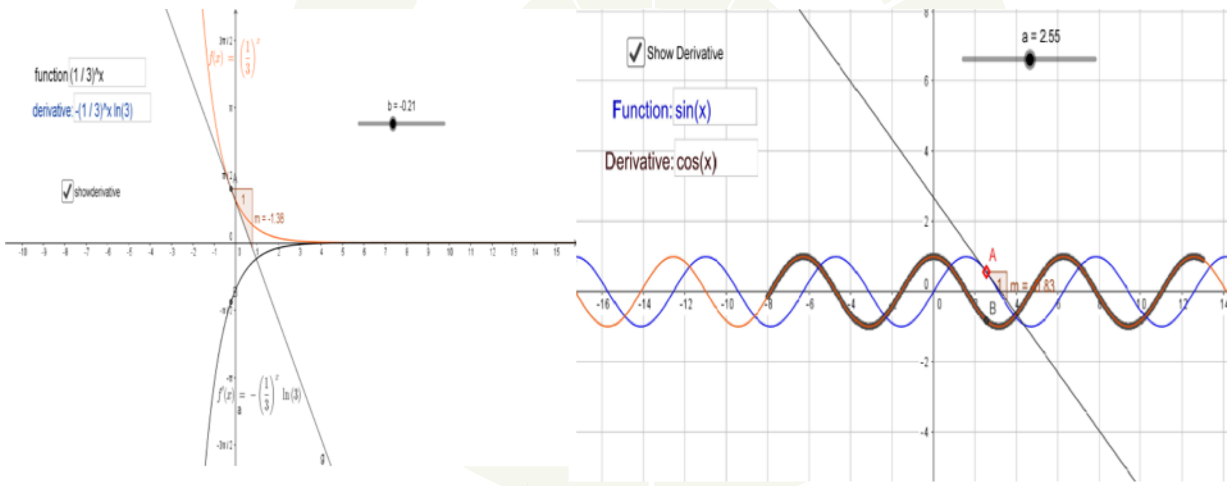


Figure 3: A sample concept mapping of concepts in "Application of Derivatives'.

2.2.2 Involve through Demonstration: 'A picture is worth a thousand words'. The human brain is more sensitive to 'doing', rather than 'observing'. It will be lasted in the memory for long time with clarity. There are many methods like solving problems, coding the concepts, demonstrating through virtual lab etc. can be used to enhance the clarity and long lasting. As an example, an open software 'GEOGEBRA' is used here to demonstrate the concepts 'derivatives' in calculus. A sample demonstration of the concept of derivative using GeoGebra is shown as Figure 4.



2.2.3 Involvement through summarization: At the end of each lecture, important points are summarized using graded/non-graded activities like one minute paper, muddiest point activity, Think-share pair etc. The advantage is that the effective delivery of the topic takes place as per intended objectives.

Muddiest Point Activity: Muddiest Point exercises are active learning techniques typically conducted at the end of a topic, chapter or class period. In a Muddiest Point exercise, students are anonymously asked to write down the concepts or topics on the previous lesson/topic that are confusing or unclear. Lecturers collect all responses and analyze them to see what areas of the lesson students are unclear about. As a remedial measure, teacher start off the next lecture by clarifying confusing topics or provide simple explanations, etc. on a course website.

One Minute Paper: At the end of a topic or module, students can be instructed to note down the most important/significant concept from a certain lesson, and list their major questions related to a lesson/lecture/chapter. One Minute paper can be debriefed by providing written feedback on student's response, writing major points on the board, and plan subsequent classes accordingly.
Think – Share Pair Method: After 10 or 15 minutes lecture, faculty members pose a question to the class and then allow a couple of minutes for each individual student to think and discuss with the student next to him. Finally, the lecturer will ask one or two random pairs to share their response with the class.

2.3 A-(Assessment) : Finally, the effectiveness of the course delivery is assessed based on attainment of course outcomes using Mamdani[1975] Fuzzy model, that computes a numerical output y from numerical inputs X = x1,x2,x3…, using a set of rules "IF X is A_k THEN Y is B_k.. The overview of this model is shown as Figure 5z.

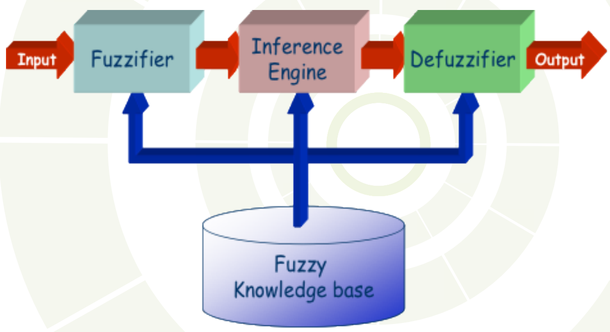


Figure 5: The Architecture of Fuzzy Inference system.

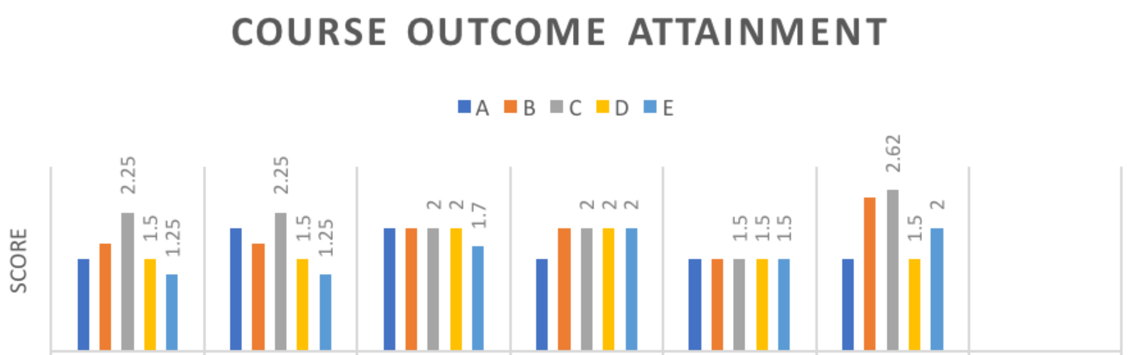
This approach has been applied in the diploma level calculus course where each Course Outcome (CO) is calculated from the marks obtained from all tests and classroom activities. Each course outcome gets a value in the range [1 ,0] based on the mark obtained in Quiz, Assignment, midterm, Final Exam and other classroom Activities. The sample course outcomes used for the subject 'calculus' is

iqueAt the end of the course student will be able to:
CO1: Compute the existence of a limit, continuity and differentiability of a function at a point and its value, if exists.
CO2: Determine the derivative of polynomial, trigonometric, exponential and logarithmic functions using standard techniques of differentiation.
CO3: Solve tangent problem, rate of change, extreme value, increasing/decreasing interval and concavity using derivative.
CO4: Verify Mean Value theorem and Rolle's Theorem
CO5: Evaluate definite and indefinite integrals of functions using standard integration techns

The target is set as 3 levels and average of the score obtained for each CO from various activities are calculated. A sample calculation is shown in Annexure 1.

LEVEL	TARGET	SCORE
LEVEL 1	50 % STUDENTS GET MORE THAN 70% MARK	1
LEVEL 2	50 % STUDENTS GET MORE THAN 75% MARK	2
LEVEL 3	50 % STUDENTS GET MORE THAN 80% MARK	3

Now the score [3-0] obtained for each CO, is classified as Slightly (S), Moderately (M), and Substantially (SU) using fuzzy membership functions. Each input is fuzzified using triangular membership functions and is aggregated using set of fuzzy rules and max-min composition. The Aggregated fuzzy value is converted to a crisp value using the defuzzification method 'Centroid'. The Mamdani Fuzzy inference system is modelled in Matlab R2016a. It has been evaluated on 5 sections of calculus classes and the observation is summarized in Figure 6. A sample rule viewer and fuzzification of course outcomes are shown in Figure 7 and Figure 8.



	CO1	CO2	CO3	CO4	CO5	OUTPUT	REMARKS
A	1.5	2	2	1.5	1.5	1.5	SATISFACTORY
B	1.75	1.75	2	2	1.5	2.5	EXCELLENT
C	2.25	2.25	2	2	1.5	2.62	EXCELLENT
D	1.5	1.5	2	2	1.5	1.5	SATISFACTORY
E	1.25	1.25	1.7	2	1.5	2	GOOD

Figure 6: The course outcome attainment and its output value from 5 different sections

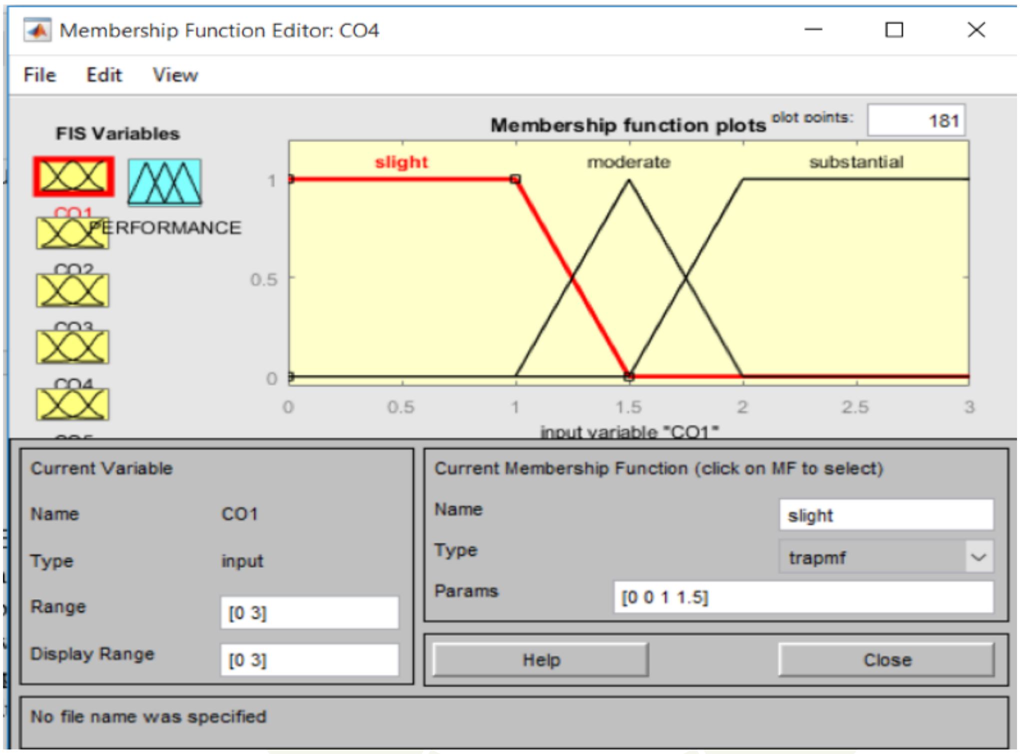


Figure 7: The fuzzification of course outcome

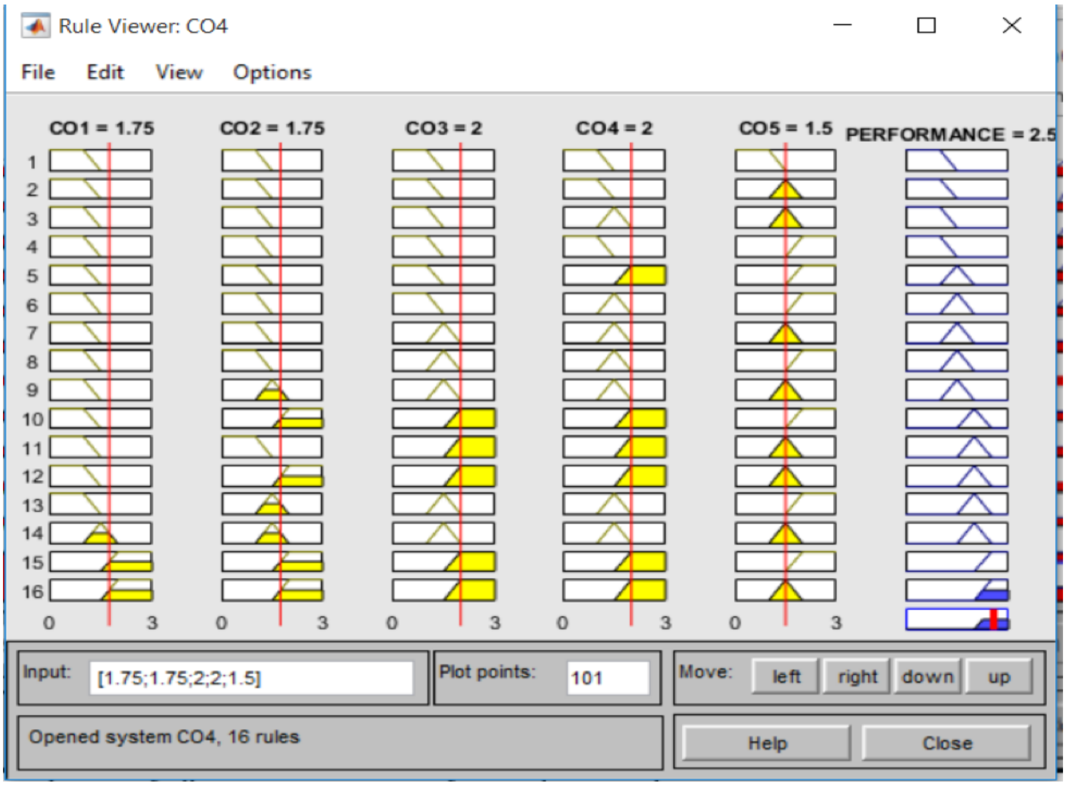


Figure 8: Rule viewer of all course outcome of a random section

Conclusion and Recommendations

In this paper, a model based on student centered approach is proposed for the effective delivery of course content. It starts with student's previous knowledge and confirm the total involvement of students throughout the teaching learning process. The involvement is achieved through summarization, visualization and demonstration. Finally, student's performance is measured using Mamdani Fuzzy model, which takes into consideration each and every parameter in the activities and hence it gives an accurate measure for the student's attainment of knowledge and skill. It is observed that the method works well to change the passive learning to active learning by ensuring the students active involvement. Once students are actively engaged in the learning process, quality delivery is easily attained. The role of the teacher is only a facilitator to help the students to attain the target. In short, involving students in the teaching process and motivate student centered approach where the teacher would act as a facilitator while the learner would be reacting to the rich learning environment will cultivate a healthy educational environment. This is a general approach that can be applied to any subject with suitable tool.

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Annexure 1

COURSEOUTCOME ATTAINMENT COMPUTATION- SECTION : 8

SEM : II — 2016-2017 — SUB: CALCULUS-1

TARGET			
LEVEL	INTERNAL		
	% OF STUDENTS		% OF MARKS
LEVEL 1	50	GETS >=	70
LEVEL 2	50	GETS >=	75
LEVEL 3	50	GETS >=	80

CO ATTAINMENT					
CO	CO1	CO2	CO3	CO4	CO5
SCORE	2.25	2.25	2	2	1.5
LEVEL OF ATTAINMENT	SU	SU	M	M	S

SU- Substantial, M- Moderate, S- Slight

			ACTIVITIES					
			quiz	Midterm	selfstudy	Assignment	Final	
Roll No	Student Name / Max mark		15	25	5	5	50	
1			13.5	22	5	5	39	
2			13.5	25	4.5	5	45	
3			14	18	5	4.5	28.5	
4			12	19	4.5	4.5	33.5	
5			13	20	4.5	4.5	42.5	
6			12.5	15.5	4.5	4.5	23.5	
7			14.5	23.5	5	5	45.5	
8			14	24	5	5	44.5	
9			12.5	17	5	4.5	31	
10			10.5	12.5	4.5	4.5	14	
11			14	23	5	5	33	
12			11.5	20	5	5	39	
13			12.5	21.5	5	5	35.5	
14			15	19	5	5	32	
15			14	21	5	5	31	
16			12.5	13.5	5	4	27.5	
17			13.5	14	5	5	29	
18			13.5	21.5	4.5	4.5	32	
19			12.5	16	5	5	28.5	
20			14.5	22	5	5	35	
21			14	19	5	5	41.5	
	NO OF STDENTS GOT LEVEL1	70	21	15	21	21	9	
	NO OF STDENTS GOT LEVEL2	75	20	14	21	21	7	
	NO OF STDENTS GOT LEVEL3	80	19	11	21	21	5	
	No of students excluding abs		21	21	21	21	21	
	LEVEL ATTAINMENT level 1		Y	Y	Y	Y	N	
	level2		Y	Y	Y	Y	N	
	level3		Y	Y	Y	Y	N	
	CO1		3	3		3	0	2.25
	CO2		3	3		3	0	2.25
	CO3		3			3	0	2
	CO4				3	3	0	2
	CO5					3	0	1.5

INSTRUCTIONS	
1)	Set the proper target in E9:E12,G9:G12
2)	It calculates CO score based on set target
3)	Put 'ABS' for Absent