Course Outcomes Attainment Analysis using Automated Tool - IONCUDOS

Pragati Sawant

Department of Information Technology
Rajarambapu Institute of Technology
Sakharale, Maharashtra
pragati.sawant@ritindia.edu

Abstract: In recent years the shift towards outcome-based education (OBE) has become one of the most important trends in engineering education. Along with technology transformations, outcome-based education plays an important role in reforming the engineering education. We, at Rajarambapu Institute of Technology sensitize these reforms and encourage the implementation of OBE for every course at our institute. For better accuracy the institute has also adopted a standardized automated/computerized system - IONCUDOS for the implementation of OBE. It begins with defining the course outcomes for each course. And then assessing these course outcomes to check whether they are attained or not at the end of the course. This paper examines the attainment of course outcomes for Discrete Mathematics course offered to the second year of engineering at the department of Information Technology, Rajarambapu Institute of Technology (RIT), Sakharale, Maharashtra. The course outcome attainment analysis incorporates two methods: 1) Direct method and 2) Indirect method. The observations of this analysis are then used for continuous quality improvement of the education at RIT.

Keywords: Course Outcomes Attainment, Outcome-based education, IONCUDOS, Discrete Mathematics, Technology Transformations.

1. Introduction

The Discrete Mathematics course provides the mathematical basis for applications in computer science. The aim of this course is to understand the use of discrete mathematical structures that are backbones of computer science. It covers various concepts like mathematical logic, set theory, relation and functions, Lattices, Boolean algebra and graph theory. This course is compulsory for all the students in the second year of B. Tech.

This paper gives outline about how the attainment of course outcomes is calculated at our department of Information Technology.

The important aspect of Outcome-Based Education (OBE) is the evaluation of course outcomes. This evaluation is largely depending on the student learning. Having a firm belief in Mantra:"We are teaching, are they learning?" the evaluation schemes are decided. It incorporates direct as well as indirect methods to check the student learning.

Direct Method analyses student performance in various examinations and tests which are conducted throughout the semester. Marks obtained by students in these exams are then used to determine the student learning index. In this method student learning will be evaluated by course coordinator.

Indirect Method involves course exit survey which is taken at the end of the course. Here students themselves evaluate their learning.

The attainment of course outcomes is calculated using both the methods separately and then these methods are used jointly to determine the attainment.

2. OBE Framework

It is a stepwise approach. The process of implementation of OBE for each course at RIT is as follows:

1. Define course outcomes using appropriate action verbs.
2. Decide Assessment strategies/components to achieve the course outcomes defined in first step.
   Direct Methods
   Indirect Methods
3. Measure the achievement (find the attainment of course outcomes using standard procedure)

We have adopted automated tool-IONCUDOS for better accuracy. It is also helpful to maintain uniformity of the reports and procedures followed to calculate and represent the attainment.

OBE implementation begins with defining the course outcomes for the course and mapping them with the program outcomes of the department. Fig1. Shows the snapshot of mapping report on IONCUDOS.

H represents high correlation between course outcome and program outcome where as L represents low correlation.

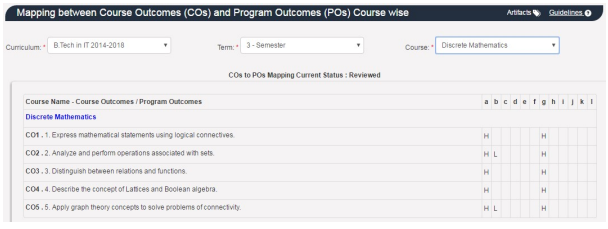


Fig1. Snapshot of CO-PO Mapping

3. Teaching & Evaluation Scheme for DM

The Table 1 depicts Teaching and evaluation scheme for discrete Mathematics course which is governed by OBE framework. It shows the lecture hours, Tutorial hours, practical hours, credits assigned to the course, and minimum requirements for earning the credits.

Table 1: Teaching and Evaluation Scheme

Teaching Scheme				Evaluation Scheme			
L	T	P	Credits	Scheme	Theory (Marks %)		
					Max	Min for Passing	
3	1	--	4	ISE	20	40%	40%
				MSE	30		
				ESE	50	40%	

4. Assessment of the Course:

Evaluation of this course is based on: In semester evaluation **(ISE), Mid** semester evaluation **(MSE),** and End semester examination **(ESE).** The weightage for these components are shown in the table2 below:

Table2: Assessment of the course

ISE	MSE	ESE
20 %	30%	50%

In order to pass the course for B Tech program, students are required to obtain 40% marks in Aggregate. They need to secure minimum 40% marks in **ISE & MSE** to become eligible for ESE and minimum 40 % marks separately in ESE.

A. In- Semester Evaluation (ISE)

This evaluation scheme is designed by the course instructor as a part of course plan and intimated to the student at the beginning of the course. It needs to have minimum two components having the 10% weightage each.
The following two components were included in the ISE of Discrete Mathematics course:

1) *Online Quiz*: It is of 20 minutes duration conducted for 20 marks and involves GATE based questions. The marks obtained by student will be converted to 10.

2) *Problem Solving Test*: It is of 30 minutes duration conducted for 25 marks and tests the problem solving ability of students. The marks obtained by student will be converted to 10.

B. Mid Semester examination (MSE)

It is of 2 hours duration conducted for 50 marks and based on the 1st three units of the syllabus. The marks obtained by student will be converted to 30.
email address is compulsory for the corresponding author.

C. End Semester examination (ESE)

It is of 3 hours duration conducted for 100 mars and based on the whole syllabs. It is conducted after after the end of instructions for the semester. The marks obtained by stdent will be converted to 50.

5. Methodology

The methods adopted to calculate the course outcome attainment gives equal importance and responsibility to students and teachers for attaining the course outcomes defined for the course. Involving students in identifying their learning index boosts the student centered teaching. It makes students responsible for their own learning. Two methods are used:

A. Direct Method

It will have 80% weightage in determining course outcome attainment. The evaluation is done by teacher. It will be calculated based on several other components.

B. Indirect Method

It will have 20% weightage in determining course outcome attainment. The evaluation is done by student.

6. Data Analysis

The Data of MSE and ESE is analysed to find the course outcome attainment.

A. MSE Data Analysis

Fig 2 shows the snapshot of MSE Data Analysis Report.

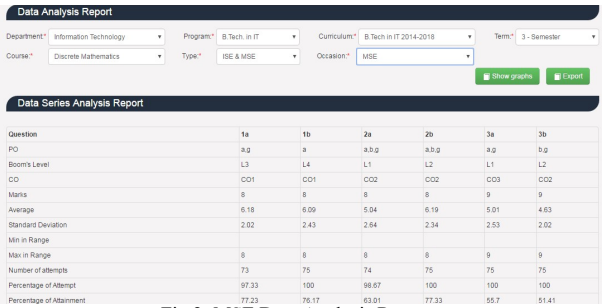
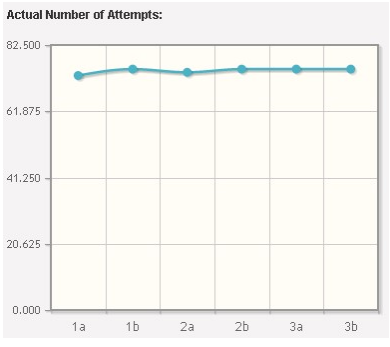


Fig 2. MSE Data Analysis Report

Fig 3 shows the snapshot of graph of actual number of attempts for MSE.



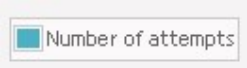
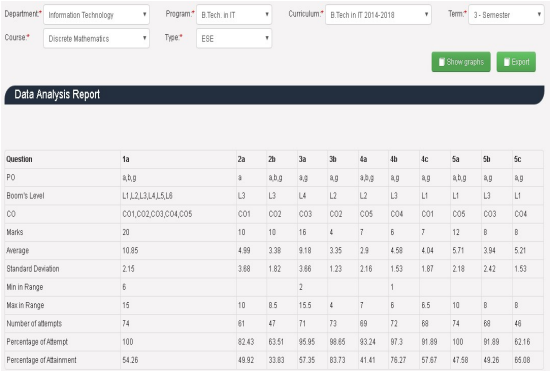


Fig 3. MSE-Actual no. Of Attempts

B. ESE Data Analysis

Fig 4 shows the snapshot of ESE Data Analysis Report.



Question	1a	2a	2b	3a	3b	4a	4b	4c	5a	5b	5c
PO	a,b,g	a	a,b,g	a,g	a,g	a,b,g	a,g	a,g	a,b,g	a,g	a,g
Boom's Level	L1,L2,L3,L4,L5,L6	L3	L3	L4	L2	L2	L3	L1	L1	L3	L1
CO	CO1,CO2,CO3,CO4,CO5	CO1	CO2	CO3	CO2	CO5	CO4	CO1	CO5	CO3	CO4
Marks	20	10	10	16	4	7	6	7	12	8	8
Average	10.85	4.99	3.38	9.18	3.35	2.9	4.58	4.04	5.71	3.94	5.21
Standard Deviation	2.16	3.68	1.82	3.66	1.23	2.16	1.53	1.87	2.18	2.42	1.53
Min in Range	6			2			1				
Max in Range	15	10	8.5	15.5	4	7	6	6.5	10	8	8
Number of attempts	74	61	47	71	73	69	72	68	74	68	46
Percentage of Attempt	100	82.43	63.51	95.95	98.65	93.24	97.3	91.89	100	91.89	62.16
Percentage of Attainment	54.26	49.92	33.83	57.35	83.73	41.41	76.27	57.67	47.58	49.26	65.08

Fig 4. ESE Data Analysis Report

Fig 5 shows the snapshot of graph of actual number of attempts for ESE.

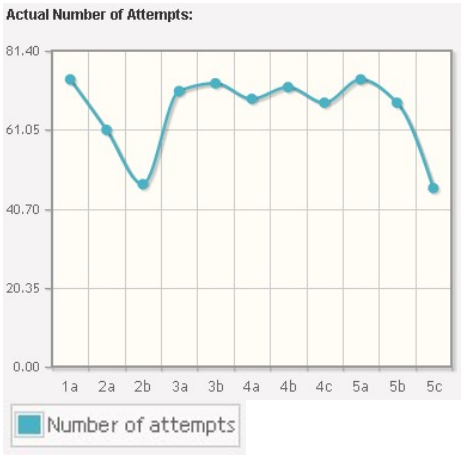


Fig 5. ESE- Actual no. Of Attempts

7. Course Outcome Attainment Analysis

The evaluation of course outcomes is performed using two approaches.

A. Direct Method

This method involves evaluation of course outcomes using various examinations which are conducted from beginning of the course till the end of the course. In this section the CO attainment is analysed for MSE and ESE examinations based on the marks secured by the students.

1) MSE Attainment

The marks secured by students in every question of Mid Semester Examination are considered to determine the attainment of corresponding CO. Fig 6 shows the snapshot of Percentage of Attainment vs. Percentage of Attempt for MSE. It has been observed that the attainment of CO depends on two parameters attempt and complexity of the question.

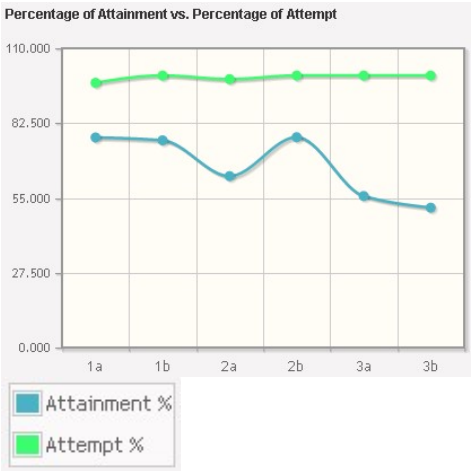
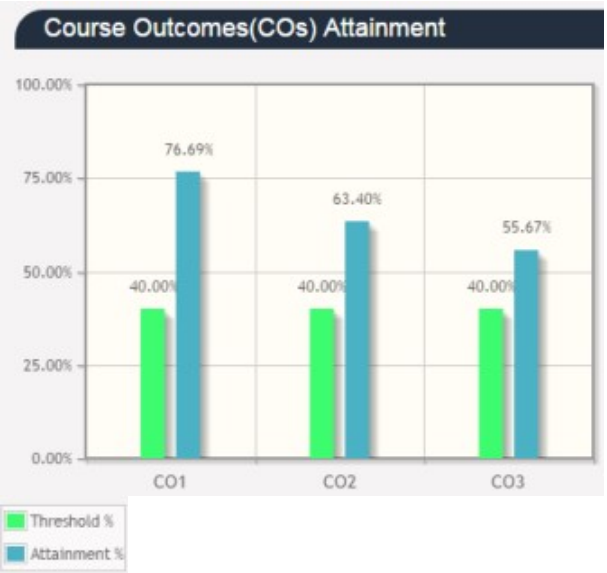


Fig 6. MSE- Percentage of Attainment vs. Percentage of Attempt



Course Outcomes	Max Marks	Average of Secured Marks	Threshold %	Attainment %
CO1	16.00	12.27	40.00%	76.69%
CO2	25.00	15.85	40.00%	63.40%
CO3	9.00	5.01	40.00%	55.67%

Fig 7. MSE- CO Attainment

The above fig 7. depicts the individual COs planned marks distribution and average of secured marks distribution as in the MSE question paper. The respective CO attainment is calculated using the following formula:

Individual CO Attainment % =

(Average of Secured Marks/ Max Marks) * 100

2) ESE Attainment

The marks secured by students in every question of End Semester Examination are considered to determine the attainment of corresponding CO in ESE. Fig 8 shows the snapshot of Percentage of Attainment vs. Percentage of Attempt for ESE. It has been observed that as the attainment of CO depends on two parameters attempt and complexity of the question.

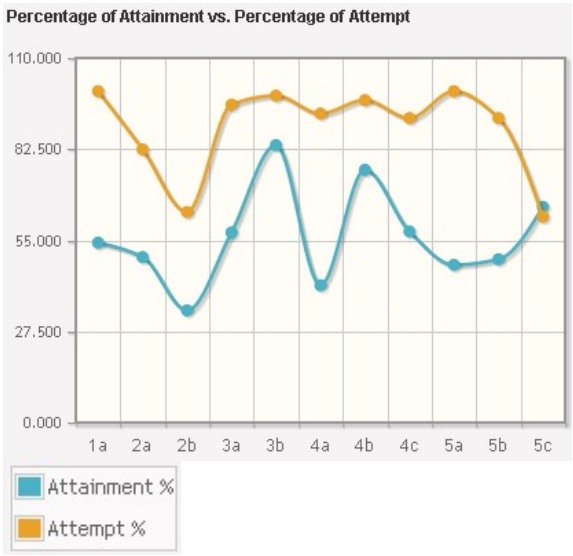
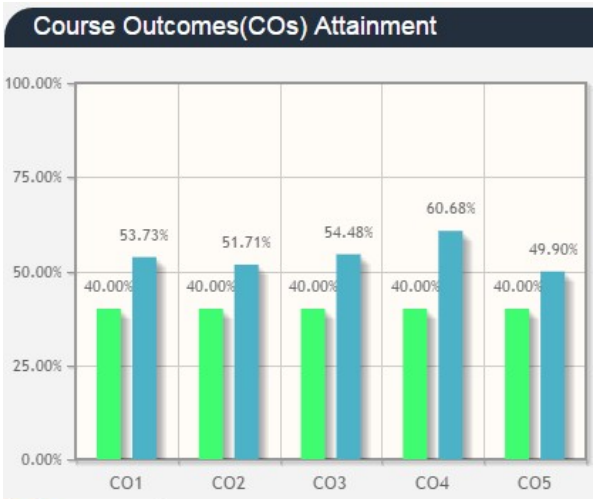


Fig 8. ESE- Percentage of Attainment vs. Percentage of Attempt



Course Outcomes	Max Marks	Average of Secured Marks	Threshold %	Attainment %
CO1	37.00	19.88	40.00%	53.73%
CO2	34.00	17.58	40.00%	51.71%
CO3	44.00	23.97	40.00%	54.48%
CO4	34.00	20.63	40.00%	60.68%
CO5	39.00	19.46	40.00%	49.90%

Fig 9. ESE- CO Attainment

The above fig 9. depicts the individual COs planned marks distribution and average of secured marks distribution as in the ESE question paper. The respective CO attainment is calculated using the following formula:

Individual CO Attainment % =
(Average of Secured Marks/ Max Marks) * 100

B. Indirect Method

This method involves evaluation of course outcomes using Course Exit Survey.

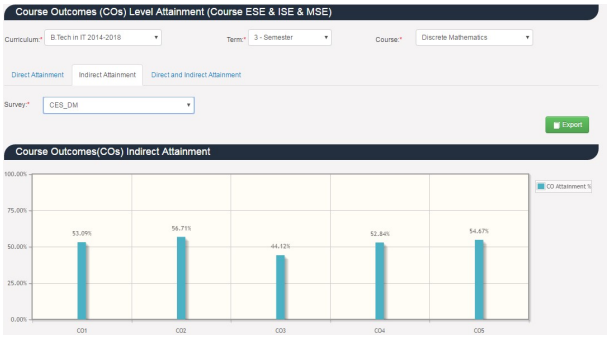


Fig. 10 In-direct CO Attainment

C. Hybrid Method

This method involves evaluation of course outcomes using the combination of direct and indirect methods.

Fig 11 shows the snapshot of Course Outcome Attainment using hybrid method. The graph says that attainment of each CO is greater than 60%.

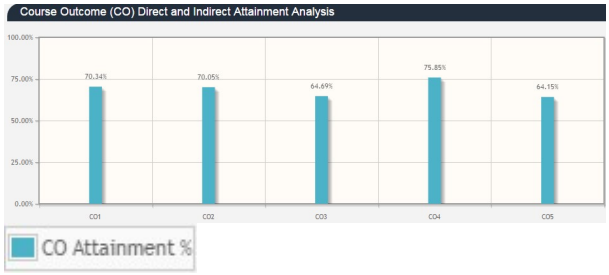


Fig. 11 Direct and indirect Attainment Analysis of Course Outcomes

Overall CO Attainment is calculated by assigning the 80% weightage to the direct method and 20% weightage to the indirect method. Fig. 12 shows the snapshot of overall CO Attainment for the Discrete Maths course

COs Code	Actual Direct Attainment %	Actual Indirect Attainment %	Direct Attainment Weightage %	Indirect Attainment Weightage %	Afetr Weightage Direct Attainment %	After Weightage Indirect Attainment %	Overall Attainment %
CO1	74.65	53.09	80.00	20.00	59.72	10.62	70.34
CO2	73.39	56.71	80.00	20.00	58.71	11.34	70.05
CO3	69.84	44.12	80.00	20.00	55.87	8.82	64.69
CO4	81.60	52.84	80.00	20.00	65.28	10.57	75.85
CO5	66.53	54.67	80.00	20.00	53.22	10.93	64.15

Fig. 12 Overall Co Attainment Analysis

7. Conclusions

This methodology gives equal importance and responsibility to students and teachers for attaining the course outcomes defined for a particular course. It is

observed that a single method is not enough to determine the attainment of course outcomes. When both the methods are used jointly then attainment of course outcomes is high. This methodology of involving students in identifying their learning index boosts the student centered teaching. It makes students responsible for their own learning. This study will help faculties from other institutes to find the course outcome attainment for their own course and improve the teaching learning process.

References

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Note: The live demonstration of this tool will be given at the time of presentation. The separate document is also attached which gives the clear view of all the snapshots added in this paper.