Course Outcomes Attainment Analysis using Automated Tool - IONCUDOS

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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.
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 whereas L represents low correlation.
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

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Evaluation Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>L T P Credits</td>
<td>Scheme Theory (Marks %)</td>
</tr>
<tr>
<td>3 1 -- 4</td>
<td>ISE 20 40%</td>
</tr>
<tr>
<td></td>
<td>MSE 30 40%</td>
</tr>
<tr>
<td></td>
<td>ESE 50 40%</td>
</tr>
</tbody>
</table>

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:

Table 2: Assessment of the course

<table>
<thead>
<tr>
<th>ISE</th>
<th>MSE</th>
<th>ESE</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>30%</td>
<td>50%</td>
</tr>
</tbody>
</table>

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.

C. End Semester examination (ESE)

It is of 3 hours duration conducted for 100 marks and based on the whole syllabus. It is conducted after after the end of instructions for the semester. The marks obtained by student 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.

B. ESE Data Analysis

Fig 3 shows the snapshot of graph of actual number of attempts for MSE.
B. ESE Data Analysis

Fig 4 shows the snapshot of ESE Data Analysis Report.

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

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](image)

![Fig 7. MSE- CO Attainment](image)

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 % =

\[
\frac{(\text{Average of Secured Marks})}{\text{Max Marks}} \times 100
\]

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.

![Percentage of Attainment vs. Percentage of Attempt](Fig 8. ESE- Percentage of Attainment vs. Percentage of Attempt)

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 % = \( \frac{\text{Average of Secured Marks}}{\text{Max Marks}} \times 100 \)

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

![In-direct CO Attainment](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%.

![Direct and indirect Attainment Analysis of Course Outcomes](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.

![Overall Co Attainment Analysis](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

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.