Automating the Process of Direct Assessment in Technical Education and Improvement in Teaching and Learning Process

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Abstract

Course outcome assessment can be defined as attainment to check the performance of the student during the study of each course throughout particular semester [3].This paper discusses the technique used for automating the process of Direct Assessment of the course outcomes in Technical Education [1]. It also provides the analysis of the students whose targets are not achieved and provides various ways to improve it. Improvement in teaching & learning process is being done based on assessment of course outcomes of each student [2]. Course Outcomes helps in identifying the knowledge gained by the student for that particular course. Course outcomes can assessed by various teaching methodologies like class room teaching, practical experiments, seminars etc. Each course is designed with specific course outcomes and each course outcome is mapped to the program outcome. There are in total of 12 program outcomes. The attainment of course outcomes is measured by assessing student's performance using MS Excel software [10].

This paper also explains course outcome assessment method with direct and indirect assessment tools. Detailed calculations are being done for direct and indirect assessment methods. The results of course outcomes attainment are used for improving the overall teaching learning process and also helps in attainment of program outcomes[8].

Keywords: Course outcomes (COs), Programme Outcomes (POs), Mapping, Linking, Outcome based Education (OBE), Outcome Based Assessment, Data Analysis.

1. Introduction

Course objective: A course objective describes the contents or modules that will covered by faculty member in a course in a particular semester [11].

Course outcome: Course Outcomes are designed for each and every course. It helps in identifying what knowledge will gained by the student in that particular course [11].

Course outcome assessment and calculations are based on a learning theory called Outcome Based Education (OBE). Outcome-based education makes students demonstrate that they "know and are able to do" whatever the required outcomes are [12].

Program Outcomes (POs): POs are statements that showcase knowledge and skills an engineering program should have. POs deals with the competencies and expertise a graduate will possess after completion of the 4 year program [13]. There are around 12 program outcomes as listed below:

1. Engineering knowledge

2. Problem analysis

3. Design/development of solutions

4. Conduct investigations of complex problems

5. Modern tool usage

6. The engineer and society

7. Environment and sustainability

8. Ethics

9. Individual and team work

10. Communication

11. Project management and finance

12. Lifelong learning

Program Outcomes are attained with the help of course outcomes which are already for designed by university for each and every course. Each course has minimum 4 to 5 Course Outcomes that states results that will be achieved by the course after the end of the semester [13].

If required, COs can be modified by consulting with the head of department, faculty members who are expertise in that particular course.

For e.g., a course such as Database Management Systems might have the following course outcomes set by the university [14].

1. Understand the fundamentals of database systems

2. Design and draw ER and EER diagram for the real life problem.

3. Convert conceptual model to relational model and formulate relational algebra queries.

4. Design and querying database using SQL.

5. Analyze and apply concepts of normalization to relational database design.

6. Understand the concept of transaction, concurrency and recovery.

CO Attainment

1. The questions in the term test examinations (both term test 1 & 2), assignments, experiments, mini project (if applicable for that course) are mapped against COs of that particular course [13].

2. Day to day evaluation is being done to calculate the attainment of each CO by taking the average of % attainment [13].

3. Finally, the attainment for each CO is also calculated by taking average of the CO attainments from Term test marks and Assignments [13].

4. The assessment is carried out by senior and experienced faculty members along with student's academic performance throughout the semester [13].

5. The external examiner assessment is also considered as assessment tool for project work which is performed as Mini Project in a particular semester [13].

6. At the end of each course, the course exit survey/feedback is collected from the students for the CO attainment under indirect CO assessment [13]

2. Related Work

Performance of student is calculated and analysed using Microsoft Excel application [1]. Much work has been done in analysis of course outcomes in MS Excel software. However, there has not been much attempt in automating the entire process to solve this problem.

A. Analysis of Course Outcomes of HVE-A tool for Assessment of Programme Outcomes [1]

The paper describes about the technique used for the calculation of the course outcome attainment in one of the course in Electronics engineering department. It provides detailed analysis of the students whose targets are not achieved against pre-defined Course Outcomes. It also provides the means to improvement by modifying the COs. Further, the analysis is also used to calculate the attainment of programme outcomes [1].

B. Defining Course Outcomes for Digital Switching Systems: An Example [2]

This paper discusses the technique used for improvement in teaching-learning process for 'Digital Switching Systems' [2]. Improvement in teaching-learning process is done by modifying the course outcomes [2].

C. Course Outcome Assessment and Improvement on Weak Student [3]

The paper describes the process of calculating the course outcome attainment of an individual student against pre-defined target. It also suggests different activities that can be served as content beyond syllabus [3].

D. Automated analysis of exam questions according to bloom's taxonomy [4]

This paper proposes automated analysis using Natural Language Processing (NLP) techniques. NLP techniques help in identifying important verbs and keywords. Using NLP techniques, rules may be formed which may improve the accuracy of the result [4].

E. Method for estimation of Attainment of Program outcome through Course outcome for Outcome based Education [5]

The paper discusses how CO-PO assessment is done. It is tabulated using MS Excel software. Strongly, moderately or Average [5] are the parameters used for estimated mapping of CO against PO.

F. Linking Program Outcomes to the Courses Outcomes: A Top-down Approach [6]

The paper uses set theory analysis between the program and the courses outcomes sets to

examine the level of details that can be used when mapping program outcomes to courses outcomes. Each program outcome is analyzed to determine the components that make that outcome. Each course outcome can be mapped to only one program outcome thus, eliminating the need for the weights matrix. This paper also ensures that attainment of program outcomes can be calculated by mapping them against courses outcomes [6].

G. Discrete Mathematics Assessment Using Learning Objectives Based on Bloom's Taxonomy [7]

This paper gives grades according to Bloom's taxonomy for Discrete Mathematics course. Learning objectives were developed for each topic in the course and the lower-level objectives were mapped to lower levels of Bloom's taxonomy keywords and the higher-level objectives were mapped to higher levels of Bloom's taxonomy keywords [7].

H. Assessment of Course Outcomes (COs) in University Affiliated Engineering Programs [8]

This paper explains the importance of Course Outcomes in assessment of CO-PO mapping. Detail explanation of calculation of Direct and Indirect assessment techniques have been explained in this paper. Finally, the calculation results are used by faculty

members for improvement in teaching learning process [8].

I. Limitations and Improvement in the Assessment of Course Outcomes [9]

The paper explains how the course outcomes can be modified and new techniques can be adopted for improvement in teaching and learning process. It also shows the attainment of individual student for CO in each course. This helps in finding weak and bright students in each subject. This helps faculties in introducing new techniques of teaching-learning process such as Quizzes, conducting workshops and seminars. Extra remedial classes and makeup lectures can also be conducted for weak students [9].

3. Methodology

Direct and Indirect assessment is currently being done with the help of MS Excel Software. Direct assessments of students are evaluated through Term test results, Lab Experiments and Assignments. For each learning objective, an Excel sheet is created.

Sample excel sheets for calculation of Term test marks, Assignment marks and Experiment marks for each course outcome attainment are shown below in Table 1, 2 & 3 respectively.

Table 1 shows CO attainment calculation for Term test marks. For term test, average marks scored in each CO is calculated (CO1 and CO2).

A. Sample Excel sheet for Term test CO calculation

ROLL NO	NAME OF STUDENT	SUM CO1	Q1.A	SUM CO2	Q1B	Q1C	Q1D	Q1E	Q2A	Q3B
CO40	Ganjave Akash Dashrath	0		7	1	2	1	0	3	
CO41	Hakim Amaan Iqbalahmed	1	1	6	1	1	2	2		
CO42	Jadhav Harmeetsingh Harpreetsingh	1	1	6	1	2	2	1		
CO43	Jadhav Sumit Nitin	0	0	6	1	2	2	1		
CO44	Jewargi Namrata Narayan	2	2	3	1	1	0		1	
CO45	Khan Ibrahim Abdul Karim	2	2	5	2	1	2			
CO46	Patil Abhishek Deepak	2	2	4	2	1	1			
CO47	Prajapati Shubham Ramvadh	2	2	3	1	1	1			
CO48	Sachdev Bhavneetshing Pradeepsingh	1	1	10	2	2	2	1	2	1
CO49	Sahu Pragati Manoj	2	2	13	2	2	2	2	5	
CO50	Salkar Apurva Sanjay	2	2	6	2	2	1	1		
CO51	Sayed Kamran Ahmed Faiz	0		9	1	2	2		4	
CO52	Sawant Bhagyesh	2	2	7	2	2	2	0		1
CO53	Amir Maji	2	2	4	1	1	2			
CO54	Nikhil Sonawane	2	2	1						1
CO55	Amey Aredekar	2	2	0						
	Average	1.589286		7.696429						
	Average result	72.64151		53.77358						

Table 1 STUDENTS TERM TEST MARKS FOR CO ATTAINMENTCALCULATION

B. Sample Excel sheet for Experiments CO calculation

Roll No	NAME OF THE STUDENT	Exp 1	Exp 2	Exp 9	SUM CO5	Exp 3	Exp 4	SUM CO1/CO3	Exp 5	SUM CO4	Exp 6	Exp 7	Exp 8	SUM CO2
57	TAMSE PRAJKTA	14	14	13	41	14	14	28	13	13	14	15	14	43
59	TANK SIMRAN BALBINDER	15	14	12	41	13	14	27	14	14	13	13	14	40
60	THANEKAR GANANJAY SAN	15	14	12	41	13	14	27	14	14	13	13	14	40
61	TIWARI ABHISHEK	12	13	13	38	12	13	25	13	13	12	13	12	37
62	TOMAR VINAY VIJAY	14	14	14	42	13	14	27	15	15	14	14	13	41
63	VAISHYA SHUBHAM				0			0		0				0
64	VAITY RAHUL RAJENDRA	15	14	12	41	13	14	27	14	14	13	13	14	40
65	VARGHESE VINNIE	15	14	12	41	13	14	27	14	14	13	13	14	40
66	WAGHMARE KAJAL DILIP	12	13	13	38	12	13	25	13	13	12	13	12	37
67	WAST SACHCHID MILAN	14	14	14	42	13	14	27	15	15	14	14	13	41
68	YADAV DARSHAN	14	14	13	41	14	14	28	13	13	14	15	14	43
69	AHAN GUPTA	15	14	12	41	13	14	27	14	14	13	13	14	40
70	KHEDEKAR SHUBHAM	15	14	12	41	13	14	27	14	14	13	13	14	40
					CO5	100	CO1/CO3	100	CO4	100			CO2	100

Table 2 STUDENTS EXPERIMENT MARKS FOR CO ATTAINMENTCALCULATION

In Table 1, Q1A is mapped against CO1. Q1B, Q1C, Q1D, Q2A and Q3B are mapped against CO2.

In last row, percentage of total number of students scoring more than average marks is calculated. Formulas have to enter every time for each objective calculation. Also the name of students has to be repeated in each sheet for each objective calculation (for term test, experiments and assignments).

In table 2, Experiments 1,2 and 9 are mapped with CO5, Experiments 3 & 4 are mapped with CO3 and CO1, Experiment 5 is mapped with CO4Experiments 6,7 and 8 are mapped with CO2. Marks for each experiment are given out of 15 marks. In last row percentage of total number of students scoring more than average marks is calculated.

C. Sample Excel sheet for Assignments CO calculation

Roll No	NAME OF THE STUDENT	ASSIGNMENT 1	SUM CO1	SUM CO2	SUM CO3	SUM CO4	ASSIGNMENT 2	SUM CO5
62	TOMAR VINAY VIJAY	8	8	8	8	8	8	4
63	VAISHYA SHUBHAM	0	0	0	0	0		0
64	VAITY RAHUL RAJENDRA	6	6	6	6	6	9	5
65	VARGHESE VINNIE	7	7	7	7	7	8	4
66	WAGHMARE KAJAL DILIP	9	9	9	9	9	7	4
67	WAST SACHCHID MILAN	9	9	9	9	9	9	5
68	YADAV DARSHAN	8	8	8	8	8	9	5
69	AHAN GUPTA	8	8	8	8	8	9	5
70	KHEDEKAR SHUBHAM	6	6	6	6	6	8	4
			93.22034	93.22034	93.22034	93.22034		100

Table 3 STUDENTS ASSIGNMENT MARKS FOR CO ATTAINMENTCALCULATION

In table 3, similar calculations are done for calculation of COs for assignment marks. Assignment 1 is mapped to CO1, CO2, CO3 and CO4 and Assignment 2 is mapped/linked to CO5.In last row, percentage of total number of students scoring more than average marks is calculated.

4. Proposed System

The data which is entered manually can be automated with the help of an application. This application will help faculties to enter details only once in case of entering students list in each and every sheet.

The application will first ask the faculties to enter subject name and year, students list will be entered. This list will be then used for all learning objective calculations such as for Term test, Assignments, Experiments and even for Course exit survey too. All the formulas will be available in the application itself. Final output will be CO attained for each student for each CO will be shown. This application will also be useful in finding bright and weak students for each CO attainment. It will also help in modification of COs.

A. *Working of Automation tool*:

Step1: Login the system using ID and Password

There will be two logins:

Admin: He will update formulas, student list, and division at the start of every semester. Admin will also maintain and update the login details of each staff.

Staff: He will enter marks and get the attainments calculated.

From Step2, all steps are for staff login.

Step2: Select branch, year, subject name and division.

Step3: Select direct assessment.

Step4: Select the learning objective for calculation.

It will be Term test, Assignment or Experiment attainment calculation.

Step5: Enter the marks for each student.

- ➢ Click on CALCULATE ATTAINMENT button to calculate overall attainment for each course outcome.
- ➢ Click on WEAK STUDENTS button to display weak students list for each course outcome.

Step6: Take corrective actions for improvement in teaching-learning process.

Improvement can be either modification of COs or conducting Quiz, Seminars, Workshops for weak students.

Step7: Logout the system.

5. Conclusion and Future Work

This automated application will help staff members to enter the details of students in user friendly manner. Also all the calculation part will be taken care by software itself. This

application will definitely save time and accurate output will be provided. It will also help in finding the weak and bright students in a very quick time. This application not only will find weak and bright students but also it will help in finding the Course Outcomes in which he/she is found to be weaker and brighter. These students will further be provided with remedial classes, extra assignments, PPT presentation related to topic that particular CO, Quizzes which will help in strengthening that particular weak CO. It will help faculties to see clearly where students need improvement. Lastly this application will also help faculties that in a particular course which COs and which modules are most important from exam point of view. Such modules will be covered in deeply to cope up with program outcomes.

Currently all the data will be stored in database; future work can be done in transferring the whole data to excel sheet with the help of coding in any programming language. This will need the database connectivity between excel and database. Excel sheet can be maintained for record purpose. Also, currently techniques are planned only for direct assessment, future work can be done for calculation of indirect assessment (course exit survey) too.

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