

An Initiation towards implementing Outcome Based Approach in Engineering Education

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Abstract: The most important key aspect in Outcome-Based Education (OBE) is the assessment of the learning outcomes. In a learning outcomes context, assessment effectively means assessing student attainment of learning outcomes. At the initial stage of OBE implementation, the so called specific learning outcomes or also known as Course Outcomes (CO) for each course were drawn up based on the Program Outcome (PO) and other requirements. COs are the attributes, that the student is expected to have or obtained at the time he or she completing the course. A method to evaluate the achievement or attainment of the COs has been developed. The paper describes the analysis process of the CO and Attainment of CO for Logic Design, which is offered to 3rd Semester (2nd year) students of Computer Science and Engineering Department. It also describes the background of the method, how the method is used, and the results produced. The method utilizes data obtained from student marks in internal tests and final university exam. The findings will then be further used for improving the teaching learning process.

Keywords: Course Outcome, Data Structures, Outcome Based Education, Program Outcome

I. INTRODUCTION

Accreditation is a formal recognition of an educational program by an external body on the basis of an assessment of quality. It is a process of quality assurance and improvement, whereby a program in an institution is critically appraised to verify that the institution or the program continues to meet and exceed the norms and standards prescribed by the appropriate designated agency. Academic programs assessment and evaluation is becoming an important process in providing improved education to students through modified curriculum and instruction. Thomas A. Angelo [2] stated that "Assessment is an ongoing process aimed at understanding and improving student learning. It involves making our expectations explicit and public; setting appropriate criteria and high standards for learning quality; systematically gathering, analyzing, and interpreting evidence to determine how well performance matches those expectations and standards; and using the resulting information to document, explain, and improve performance. When it is embedded effectively within larger institutional systems, assessment can help us focus our collective attention, examine our assumptions, and create a shared academic culture dedicated to assuring and improving the quality of higher education".

II. IMPORTANCE AND SIGNIFICANCES OF ACCREDITATION

- 1) To attain international recognition of the degrees awarded.
- 2) To provide students a quality education which lead to a wide range of job opportunities and international mobility
- 3) To make the institute/department aware about strengths and weaknesses of the institution / program offered by it and encourage the institute to move continuously towards the improvement of quality of its program, and the pursuit of excellence.

- 4) To facilitate institutions for updating themselves in program curriculum, teaching and learning processes, faculty achievements, students’ knowledge/skills/abilities.
- 5) To excel among stakeholders (students, faculty, alumni, parents, recruiters, industries, government/Public Sectors, regulators, management, etc)

III. COURSE OUTCOMES

Course Outcomes (COs) are clear statements of what a student should be able to demonstrate upon completion of a course. They should be assessable and measurable knowledge, skills, abilities or attitudes that students attain by the end of the course. The course outcome defined for Data Structures is furnished in table (1).

Table(1): LOGIC DESIGN- Course Outcome

	Course Outcome
CO-1	To understand the operation of logic components like basic gates and universal gates and apply them for logic functions
CO-2	Simplify Boolean function using Karnaugh maps and Quine Mc-clusky method and implement functions with combinatorial circuits with NAND-NAND and NOR-NOR logic
CO-3	To understand different types of hazards. Analyze and design modular combinatorial logic circuits
CO-4	Ability to understand the Bi- stable elements like flip-flop and use its functionality to understand the sequential circuits and its applications
CO-5	Use the concepts of state and state transition for the analysis and design of sequential circuits.
CO-6	To understand different types of digital to Analog converters and Analog to digital converters.
CO-7	To learn a HDL language and implement the logical circuits using HDL.

IV. BLOOM'S TAXONOMY OF EDUCATIONAL OBJECTIVES

One of the most widely used ways of organizing levels of expertise is according to Bloom's Taxonomy of Educational Objectives. (Bloom et al., 1994; Gronlund, 1991; Krathwohl et al., 1956.) Bloom's Taxonomy uses a multi-tiered scale to express the level of expertise required to achieve each measurable student outcome. Organizing measurable student outcomes in this way will allow us to select appropriate classroom assessment techniques for the course.

Definitions of the different levels of thinking skills in Bloom’s taxonomy

- 1. Remember** – recalling relevant terminology, specific facts, or different procedures related to information and/or course topics. At this level, a student can remember something, but may not really understand it.
- 2. Understand** – the ability to grasp the meaning of information (facts, definitions, concepts, etc.) that has been presented.
- 3. Apply** – being able to use previously learned information in different situations or in problem solving.
- 4. Analyze** – the ability to break information down into its component parts. Analysis also refers to the process of examining information in order to make conclusions regarding cause and effect, interpreting motives, making inferences, or finding evidence to support statements / arguments.
- 5. Evaluate** – being able to judge the value of information and/or sources of information based on personal values or opinions.

6. Create – the ability to creatively or uniquely apply prior knowledge and/or skills to produce new and original thoughts, ideas, processes, etc. At this level, students are involved in creating their own thoughts and ideas

Table(2): Cognitive Level of CO

	Course Outcome	Cognitive Level
CO-1	To understand the operation of logic components like basic gates and universal gates and apply them for logic functions	Understand
CO-2	Simplify Boolean function using Karnaugh maps and Quine Mc-clusky method and implement functions with combinatorial circuits with NAND-NAND and NOR-NOR logic	Apply
CO-3	To understand different types of hazards. Analyze and design modular combinatorial logic circuits	Analyze
CO-4	Ability to understand the Bi- stable elements like flip-flop and use its functionality to understand the sequential circuits and its applications	Understand
CO-5	Use the concepts of state and state transition for the analysis and design of sequential circuits.	Apply
CO-6	To understand different types of digital to analog converters and analog to digital converters.	Understand
CO-7	To learn a HDL language and implement the logical circuits using HDL.	Understand and Apply

V. WHAT IS ASSESSMENT?

According to Palomba and Banta (1999) assessment involves the systematic collection, review, and use of evidence or information related to student learning. Assessment helps faculty understand how well their students understand course topics/lessons. Assessment exercises are often anonymous. This anonymity allows students to respond freely, rather than trying to get the “right” answer or look good. Assessment exercises attempt to gauge students’ understanding in order to see what areas need to be re-addressed in order to increase the students’ learning.

In other words, assessment is the process of investigating (1) What students are learning and (2) how well they are learning it in relation to the stated expected learning outcomes for the course. This process also involves providing feedback to the students about their learning and providing new learning opportunities/strategies to increase student learning

Course learning outcomes are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course. In other words, learning outcomes identify what the learner will know and be able to do by the end of a course.

Course learning outcomes should be stated in clear, specific, and measurable terms, describe what the learner can accomplish as a result of completing a course, focus on what the learner will be able to do as a result of taking the course, describe what the learner can draw from the knowledge, skills, and experiences acquired in a course. In addition, they should be aligned with the program learning outcomes and represent the minimum requirements to complete a course

VI. ATTAINMENT OF COURSE OUTCOME

The next step is to provide a data-backed quantitative measurement of how well students are achieving each course's learning outcomes. The process used to get these measurements should be

easy to implement and not time consuming to instructors. It is not acceptable to determine a student's achievements of course learning outcomes on the basis of the final grade obtained in the course alone.

Attainment of the COs can be measured directly and indirectly.

Direct: attainment basically displays the student's knowledge and skills from their performance. It can be determined from the performance of the students in all the relevant assessment instruments – like internal assessments, assignments, quiz and final university examination. These methods provide a sampling of what students know and/or can do and provide strong evidence of student learning.

Indirect methods such as surveys and interviews ask the stakeholders to reflect on student's learning. They assess opinions or thoughts about the graduate's knowledge or skills. Indirect measures can provide information about graduate's perception of their learning and how this learning is valued by different stakeholders. Indirect attainment here is determined from course exit surveys.

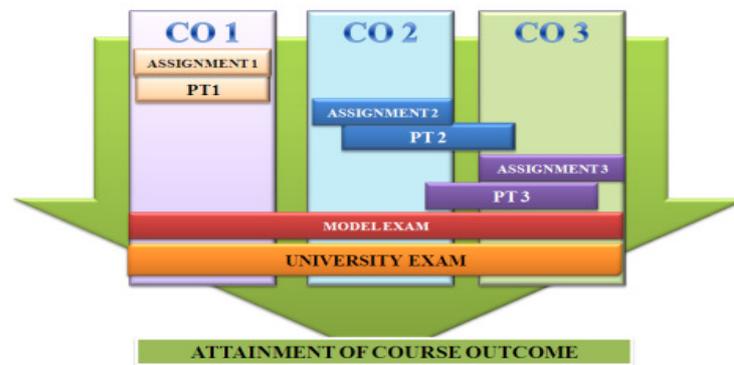
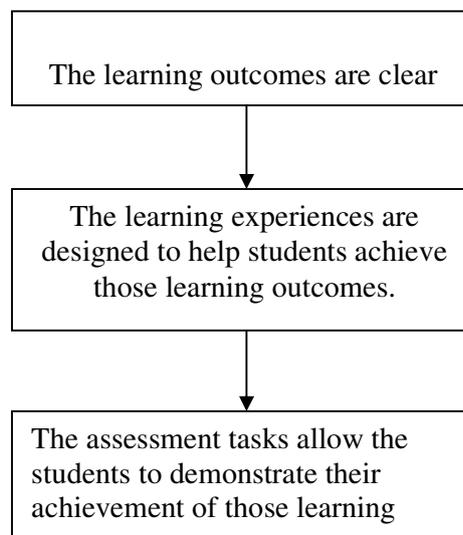


Fig. 1. Attainment of Course Outcome

One of the keys to successful learning is the aligned curriculum: this means that learning outcomes are clear, learning experiences are designed to assist student achievement of those outcomes, and carefully designed assessment tasks allow students to demonstrate achievement of those outcomes. This concept is illustrated in Table 3



Table(3): Achievement of Outcomes

RUBRICS: A rubric is an assessment tool that clearly indicates marking criteria. It can be used for marking assignments, class participation, or overall grades. When provided with the assignment, a rubric establishes expectations. It is an authentic assessment tool which is growing in popularity due to its usefulness in assessing complex and subjective criteria.

Advantages of using rubrics in assessment include:

- allowing assessment to be objective and consistent
- allowing the instructor to clarify his/her criteria in specific terms
- clearly showing the student how their work will be evaluated and what is expected
- providing useful feedback regarding the effectiveness of the instruction
- provide benchmarks against which to measure and document progress

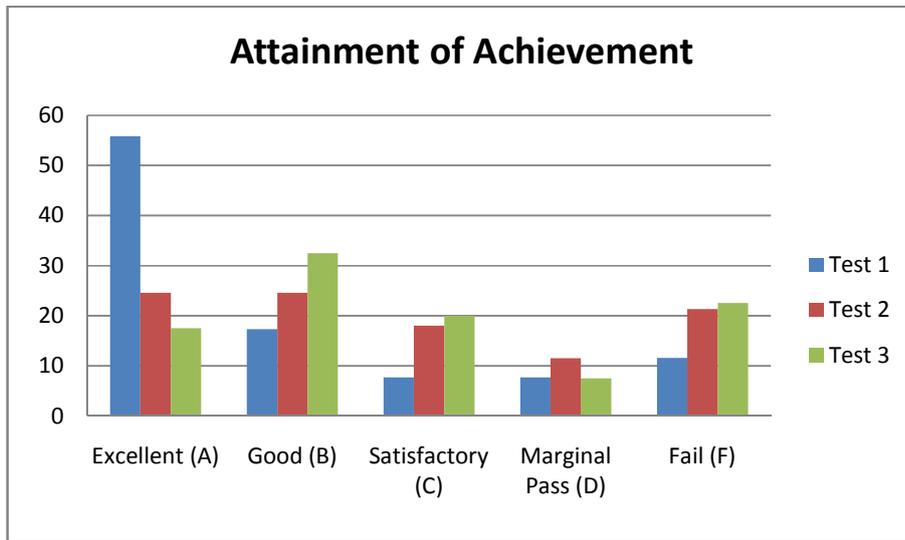
Table(4): Assessment rubrics that was adopted for direct attainment is depicted in below table

Level of Achievement	Elaboration on Course Grading Description	Bench Mark Set (out of 25)
Excellent (A)	The student's performance is outstanding in almost all the intended course learning outcomes.	23 to 25
Good (B)	The student's performance is good in most of the intended course learning outcomes.	20 to 22
Satisfactory (C)	The student's performance is satisfactory. It largely meets the intended course learning outcomes.	17 to 19
Marginal Pass (D)	The student's performance is barely satisfactory. It marginally meets the intended course learning outcomes.	15 to 16
Fail (F)	The student's performance is inadequate. It fails to meet many of the intended course learning outcomes.	Less than 15

In Logic Design course the direct attainment is based on 3 internal tests that were conducted during the course of the semester.

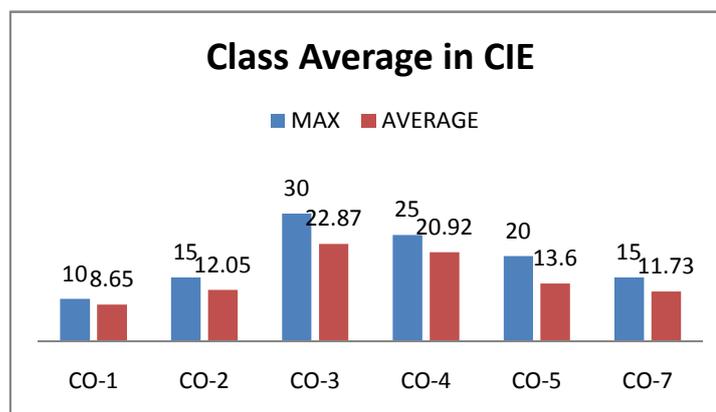
Table(5): Attainment of Achievement (%age)

Level of Achievement / Test	Test 1	Test 2	Test 3
Excellent (A)	55.77	24.59	17.50
Good (B)	17.31	24.59	32.50
Satisfactory (C)	7.69	18.03	20.00
Marginal Pass (D)	7.69	11.48	7.50
Fail (F)	11.54	21.31	22.50



Table(6): Class Average in CIE

CO	T1(25)	T2(25)	T3(25)	CIE Class Average
CO-1	8.65 / 10			8.65 / 10
CO-2	12.05 / 15			12.05 / 15
CO-3		22.87 / 30		22.87 / 30
CO-4			20.92 / 25	20.92 / 25
CO-5			13.60 / 20	13.60 / 20
CO-6				-
CO-7	3.93 / 5	3.36 / 5	4.44 / 5	11.73 / 15

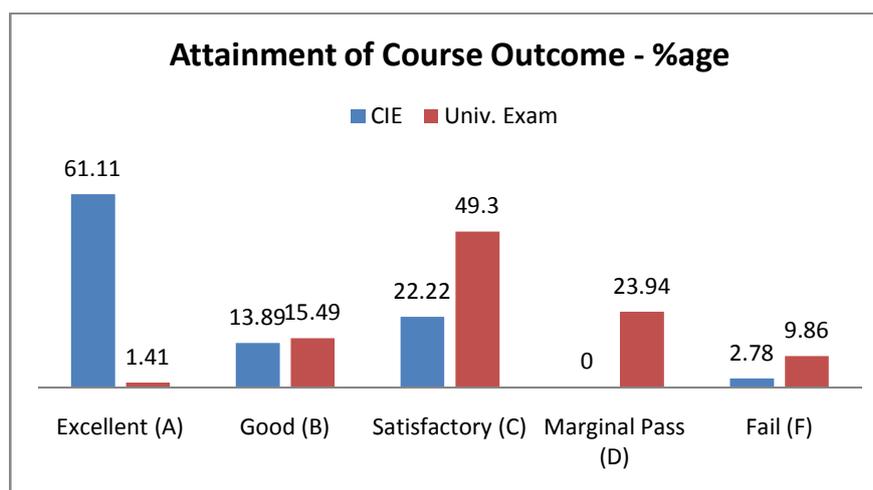


Mapping of LD University Question paper

Sub question	1	2	3	4	5	6	7	8
A	CO1	CO2	CO3	CO4	CO4	CO4	CO5	CO6
B	CO1	CO2	CO3	CO4	CO4	CO5	CO5	CO6
C	CO1	CO3	CO3	CO7	CO7	CO5	CO5	CO6
D			CO3	CO1				

Table(7): Attainment of Course Outcome – University exam v/s CIE (%age)

Level of Achievement / Test	Bench Mark Set (out of 100)	CIE	Univ. Exam
Excellent (A)	>= 80	61.11	1.41
Good (B)	65 to 79	13.89	15.49
Satisfactory (C)	50 to 64	22.22	49.30
Marginal Pass (D)	36 to 49	0	23.94
Fail (F)	Less than 35	2.78	9.86



VII. CONCLUSION

Assessment of educational objectives and learning outcomes involves the systematic and on-going gathering and use of information about student learning for the purpose of improvement. The result of assessment would be a coherent curriculum in which all courses have well-defined and interconnected roles in achieving the program mission. The above paper explains a method of measuring Course Outcomes by using Rubrics. We have provided a description of the full assessment cycle for course learning outcomes. From this result, the attainment of each course outcome for the course can be further reviewed and analysed. Action plan to improve any weakness can be identified and implemented in the following semester.

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