# IMPACT OF ASSESSMENT TECHNIQUE ON LEARNING OUTCOMES: A CASE STUDY

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**Abstract**: In order to achieve excellence, it is important for the educational institutions to assess the outcomes of their graduate programmes. In general, the graduate programme outcomes are assessed through direct assessments such as internal tests, quizzes, projects, assignments etc. and indirect assessments such as exit survey. The Course Outcomes are assessed through direct and indirect assessment techniques such as course end surveys. The results through direct assessment are followed up with several actions such as remedial classes, tutorials etc. Feedback surveys from the students, recruiters and alumni are considered for the indirect assessment of Programme outcomes. In this paper, the methodology adopted for the assessment of Course Outcomes for Microcontrollers course are presented.

**Keywords**: Course End Survey, Microcontrollers, Self Study, Projects, Rubrics, CO Attainment.

## 1. Introduction

Student surveys are done by educational institutions to collect student feedback on the effectiveness of courses and classroom delivery. Also the attainment value of Course Outcomes (CO) are necessary to analyse the student learning level. Course outcomes can be measured by two methods: Direct and Indirect assessment. Direct assessment involves assessing the student performance based on the marks secured through tests, quizzes, laboratory performance, seminars etc. On the other hand indirect assessment can be carried out through various surveys, or co-curricular activities which are an extension of the formal learning experiences in a course.
In this paper, the impact of assessment technique on course deliverables is explained. The comparison of CO attainment is done for two successive academic years during which the self-study component was introduced. In the earlier course offerings, students were only undergoing theory and practical sessions.

## 2. Types of Survey

The various surveys that are carried out in a graduate program are course end survey, exit survey, alumni survey and employer's survey.

Course end survey is done at the end of every semester for every course. Exit survey is done after a student completes his/her graduate program about the entire learning experience throughout the program. Alumni survey is done after one year of graduation of a student. Employer's survey is obtained from the employer of students.
Course end survey gives feedback about the content, techniques involved in the course delivery, usefulness of the course and relevance to the present day applications. This also helps measuring the attainment of Course Outcomes defined for a particular course and thereby Program Outcomes can be measured.
The exit survey and alumni survey help in assessing the attainment of Program outcomes and in turn assessing the Program Educational Objectives defined for a particular program.
The surveys carried out constitute for indirect form of assessment of CO and in turn PO attainment. Fig.1. shows the tools adopted for CO assessment. Fig 2 shows the waterfall methodology for assessment of Program Outcomes/Graduate Attributes [4].

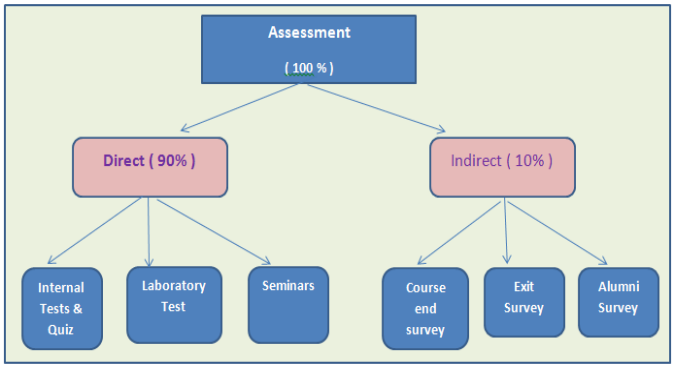


Fig.1. CO Assessment methods

## 3. About The Course

In this paper, a case study carried out for the Microcontroller course is explained.
In the present curriculum, Microcontroller is a core course that comprises of both theory and laboratory experiments for undergraduate students in second year [3].

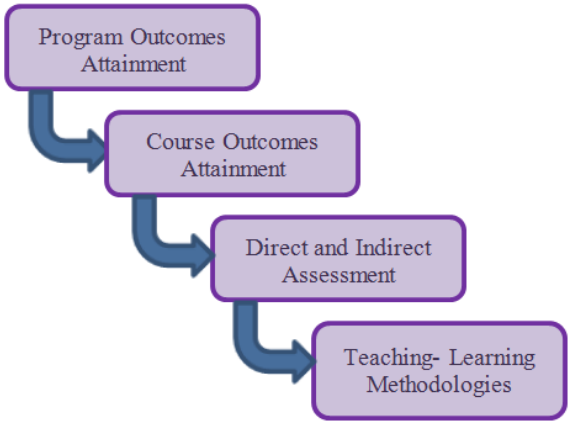


Fig. 2: Waterfall diagram for assessment of Program Outcomes

This course is basically taught with theory classes and conducting laboratory experiments. After the knowledge of the advantages of Project Based Learning (PBL), Self-Study component was introduced at the institutional level, which emphasizes on gaining additional knowledge through various other forms of teaching and learning methodologies [1][2][5][6][7].

The course structure for the microcontroller course is given in Table. 1

**Table 1: L-T-P-S for Microcontroller course**

| | Lecture (L) | Tutorial (T) | Practical (P) | Self-Study (S) |
|---|---|---|---|---|
| Hours | 39 | 0 | 13 | 26 |
| Credits | 3 | 0 | 1 | 2 |

As per the above table, thirty nine contact hours is dedicated for theory classes with a credit value of 3. Thirteen lab sessions are held for a credit value of 1. A self –study component of 2 credit value is also incorporated in the course curriculum, which involves carrying out a survey or case study, executing a project etc. The outcome of self study will be resulting in paper/ poster publications by the students.

## 4. About Self Study

In the Self Study component introduced in this course, students will get hands on experience of the implementation of the concepts thought in the theory classes. The students are free to carry out project or survey or case study on application of the microcontroller. This will enhance the practical knowledge of the students.

For the self - study component of the course, students have been divided into various sub-batches, with the batch size not exceeding 5. The students were given options of carrying out i) mini project using Microcontrollers (8051/ 8052/ Arduino boards). ii) Extensive Survey on different Microcontrollers iii) Case study on Applications of Microcontrollers. At the end of the self study, student s will have the ability to understand the architecture of microcontrollers, develop, analyze and execute the code in assembly/ C language to design and implement their projects. The Assessment of the self study involves three phases. The Table[2] gives the details of the evaluation pattern.

**Table 2: Evaluation pattern for Self Study.**

| Phase | Parameters for evaluation | Weightage of Marks |
|---|---|---|
| Phase 1 | Abstract submission and First Presentation | 05 |
| Phase 2 | 50% progress of the project | 05 |
| Phase 3 | Final Presentation for Case study and survey, Project presentation with demo | 05 |
| | | Total = 15 |

The time frame given for the self-study component is 14 weeks. The evaluation of a student is based on the rubrics given in the table 3 [3]. The rubrics presented here is for the evaluation of the group which has opted to carry out a project as a part of the self-study. For evaluations of case studies and surveys, a different rubric is used.

Figure 3a, 3b, 3c, 3d showcase few of the projects developed by the students during the course.

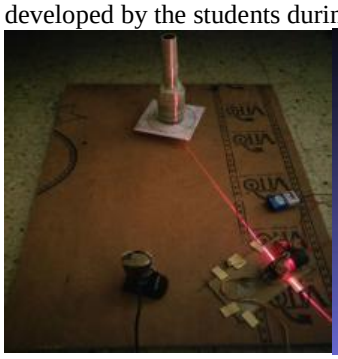

Fig. 3a

Fig. 3b

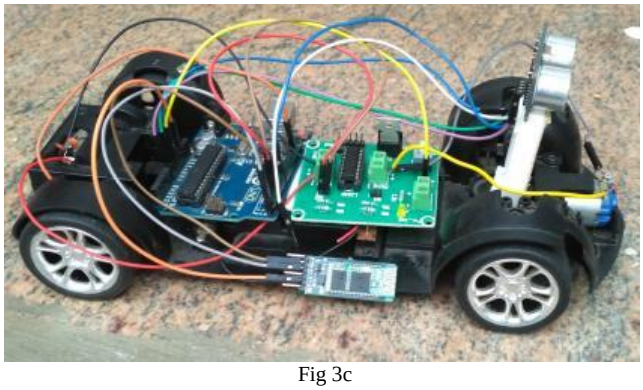

Fig 3c

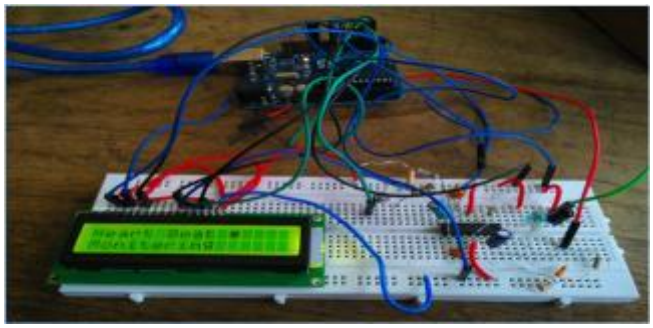

Fig 3d

**TABLE 3: RUBRICS ADOPTED FOR STUDENT EVALUATION**

| **RATING→ ATTRIBUTE↓** | **Poor ( rating 1)** | **Fair (rating 2)** | **Good (rating 3)** | **Excellent (rating 4)** |
|---|---|---|---|---|
| Relevance to the subject | Not at all relevant. | Fairly Relevant, but not completely related to the subject. | Relevant but not able to justify. | Relevant and able to justify and use of the concepts of theory is well defined. |
| Method of execution | Method selected is outdated/ not in use. | Method selected has some limitations. | Method selected is good but not convincing. | Best method of execution selected and comparison done with other methods available. |
| Selection of components | Unable to describe and classify components available to be used for specific purpose. | Able to describe and classify components available but unable to use and apply them. | Able to compare or evaluate results obtained using more than one component. | Able to combine, compare or evaluate results obtained using more than one component. |
| Practical skill | Unable to identify and solve problems in complex situations found. | Unable to identify and solve problems in complex situations found with marginal justifying judgment | Able to identify and solve problems in complex situations and make good justifying judgment. | Able to clearly identify and aptly solve problems in complex situations and develops complete and innovative solution to meet varying requirements while making excellent justifying judgment. |
| Analysis and Discussion | Discussion of results is inappropriate and shows lack of comprehension of scientific concepts. | Discussion of results does not identify appropriate concepts, needs significant work and / or shows a weak grasp of concepts. | Discussion of results needs some refinement but shows a reasonably strong grasp of the scientific concepts. | Discussion of results shows a strong grasp of the scientific concepts. |
| Application in the real world | Does not find any application. | Idea finds application but with modifications. | Finds application with little modification. | Totally applicable to the present world. |
| Report writing | Purpose of work with relevant background information missing. Report is poorly organized. | Purpose of work with relevant background information missing. Report is still reasonably well organized. | Purpose of work with relevant background information available but not completely provided. The report is still well organized. | Purpose of work with relevant background information sufficiently provided and the report is very well organized. |
| Cost Effectiveness | Cost is too high. | Cost is high but still could be reduced. | Cost is reasonable and selection of components / hardware is good. | Cost is cheap with best selection of components / hardware available. |
| Team work | Unable to work and refuses to interact with others | Able to work but with less interaction with others. | Able to work and interacts with others. | Enjoys work and always motivates other group members. |

## 5. CO Assessment Technique

CO attainment is obtained by direct and indirect methods. In direct method the attainment is obtained through the student performance in tests, quizzes and laboratory performance. In indirect method the assessment is obtained by considering the course end survey results.

Course end survey was conducted by using an online software called Survey Monkey. Survey Monkey is an online survey development cloud-based software. Survey Monkey provides data collection, data analysis, brand management, and consumer marketing [8].

The process of conducting the survey is explained in the flowchart (Fig.4) given below:

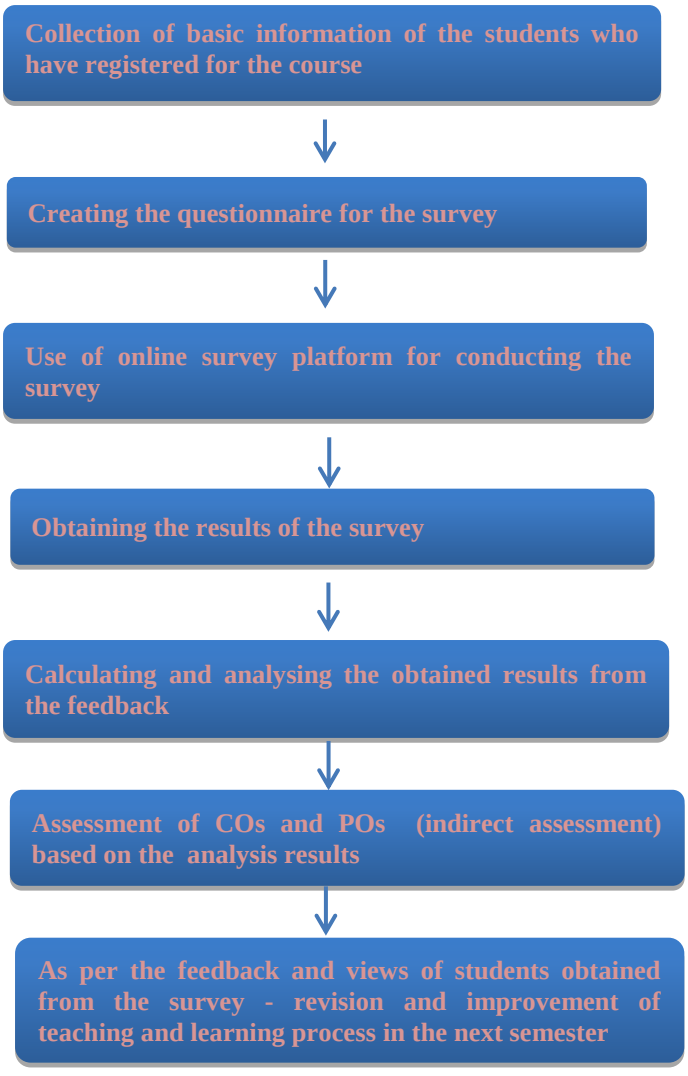


Fig. 4: Flowchart for steps of conducting survey

The questionnaire given for conducting course end survey is as given in the Table 4. The questionnaire basically consists of the questions that give the level of understanding of the course pertaining to the Course Outcomes defined for microcontroller course.

**Table 4. Course End Survey Questionnaire**

CO1: I am able to Understand and explain computer based and memory based architecture, microcontroller, pipelining, addressing modes, data types in Embedded C, basics of serial communication, timer configuration and interrupt handling

| | A | | B | | C | | D | Z |
|---|---|---|---|---|---|---|---|---|
| Excellent | 17 | Very Good | 25 | Good | 10 | Fair | 3 | 55 |

CO2: I am able to calculate instruction execution time, delay, baud rate, and write assembly and C Code identify the timer mode, serial communication mode and interrupt priorities

| | A | | B | | C | | D | Z |
|---|---|---|---|---|---|---|---|---|
| Excellent | 16 | Very Good | 24 | Good | 12 | Fair | 3 | 55 |

CO3: I am able to Debug/ analyze the code in assembly as well as Embedded C

| | A | | B | | C | | D | Z |
|---|---|---|---|---|---|---|---|---|
| Excellent | 14 | Very Good | 22 | Good | 14 | Fair | 5 | 55 |

CO4: I am able to Identify the IDE to conduct experiments by simulating, debugging and executing the assembly and Embedded C code

| | A | | B | | C | | D | Z |
|---|---|---|---|---|---|---|---|---|
| Excellent | 11 | Very Good | 26 | Good | 12 | Fair | 6 | 55 |

CO5: I have the knowledge of different applications of Microcontrollers for health, safety, environment and society

| | A | | B | | C | | D | Z |
|---|---|---|---|---|---|---|---|---|
| Excellent | 15 | Very Good | 20 | Good | 15 | Fair | 5 | 55 |

CO6: I am able to work as an individual and as a team-member to design, formulate and implement experiments using microcontroller through conduction of an Open-Ended experiments

| | A | | B | | C | | D | Z |
|---|---|---|---|---|---|---|---|---|
| Excellent | 16 | Very Good | 27 | Good | 9 | Fair | 3 | 55 |

The calculation of assessment of CO's based on the Course End Survey is given below:

Y= [{(X1*A)+(X2*B)+ (X3*C) +(X4*D)} / (Z*5)]

Where,

X1= Weightage for rating Excellent (5)
X2= Weightage for rating Very good (4)
X3= Weightage for rating Good (3)
X4= Weightage for rating fair (1)
Y = Attainment Value mapping to respective CO's
Z= Total number of students taken the survey
A= No .of students who have rated Excellent
B= No .of students who have rated Very good
C= No .of students who have rated good
D= No .of students who have rated Fair

Here weighted average method is used for calculation of CO attainment. The weighted average method offers benefits over normal averaging which are[8]:

(i) It allows the final average number to reflect the relative importance of each number that is being averaged.

(ii) It accounts for uneven data and the final value reflects more balanced and equal interpretation of the data.

For the microcontroller course, the attainment of CO's (percentage) as per Course End Survey is shown in Fig 3.

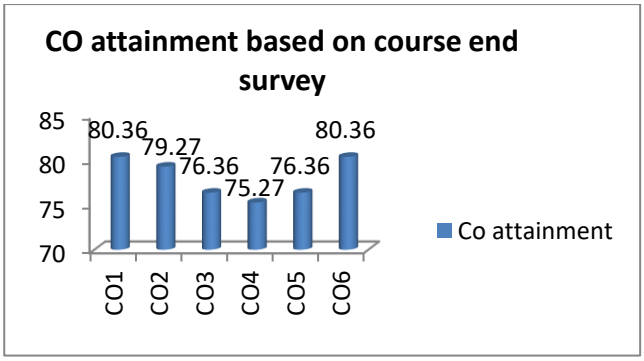


Fig 3: CO Attainment based on Course End Survey

Overall CO attainment for the microcontroller course is given in the Table 5.

**Table 5: Overall CO Attainment**

| CO # | Direct Assessment | Weighted Average 90% | Indirect Assessment | Weighted Average 10% | Total attainment | CO attained ? |
|---|---|---|---|---|---|---|
| CO1 | 0.7832 | 70.4 | 80.36 | 8.36 | 78.76 | YES |
| CO2 | 0.6623 | 59.6 | 79.27 | 7.92 | 67.52 | NO |
| CO3 | 0.7687 | 69.1 | 76.36 | 7.36 | 76.46 | YES |
| CO4 | 0.8721 | 78.7 | 75.27 | 7.52 | 86.22 | YES |
| CO5 | 0.9512 | 85.6 | 76.36 | 7.36 | 92.96 | YES |
| CO6 | 0.9512 | 85.6 | 80.36 | 8.36 | 93.96 | YES |

## 6. Results

Upon Calculating the CO attainment of the microcontroller course, it is observed that the attainment has considerably increased when compared to the previous years attainment. The Table[6] summarizes the CO attainment for Current Academic Year (CAY: 2017) and Previous Year i.e. Current Academic Year minus one (CAYM1: 2016). In CAY the impact of Course End Survey is also given weightage while calculating the overall CO attainment where as in the CAYm1 only student performance is considered for the attainment calculations. Although the Self-Study component was implemented for both academic years considered, the attainment does not account for course end survey in the previous year. Whereas it is accounted for in the current academic year.

**Table 6: Comparison of attainment of CO's**

| CO# | Target set | Attainment: CAYm1 | Attainment: CAY |
|---|---|---|---|
| CO1 | 75% | 0.7832 | 0.8513 |
| CO2 | 75% | 0.6623 | 0.8340 |
| CO3 | 75% | 0.7687 | 0.8445 |
| CO4 | 75% | 0.8721 | 1.0000 |
| CO5 | 75% | 0.9512 | 1.0000 |
| CO6 | 75% | 0.9512 | 1.0000 |

## 7.Conclusion

The attainment of Course Outcomes define the understanding level of students and the effectiveness of the Teaching Learning process adopted. It is evident from the calculations that the attainment has increased in the current acadamic year when compared with the previous acadamic year. This paper summarizes the effectiveness of the new Teaching-Learning method adopted and the method of calculation of attainment of the Course Outcomes.

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