

Student performance using Blooms cognition levels : A case study

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Abstract— A course of engineering education can be designed with new innovative methods of teaching – learning process, assessment methods to enhance the thinking and analytical skills of students. Blooms taxonomy has made many academicians and educators conscious of the type of assessment they are adopting to assess their students. Performance of students is a very important aspect of effective teaching - learning.

Keywords—Course design, Blooms levels, course assessment , analytical skills, teaching-learning process

I. INTRODUCTION

Benjamin Bloom, in 1950s, created the six hierarchical cognitive levels to create innovative teaching- learning methods [1]. Blooms taxonomy has made many academicians and educators conscious of the type of assessment they are adopting to assess their students. Conventional test methods with assessment from the writing of tests with a predefined model are overshadowed by the new flexible innovative ways of assessing with a new scientific approach.

Students can be trained to read and think by giving a set of questions framed in an orderly manner, with different degree of difficulty. Teachers prepare test questions which can be used to train students instead of testing them. Blooms taxonomy assist teachers to set questions reflecting various cognition levels. As a result student's comfort and confident zone with respect to a course will expand accordingly. This also requires good effort from teachers to prepare the questionnaire.

Normally a great deal of class room teaching is used to test students through questioning. Teachers tend to ask short questions which requires short-term memory and is not long lasting. Survey taken from the existing literature shows that 80 to 90% of the questions asked by teachers during the class room teaching are literally knowledge based [2, 3, 6]. This approach will overshadow the creativity of students.

In this paper, a method to find the performance of students in a course using Blooms cognition levels is presented. Section I presents introduction to Blooms taxonomy. Section II presents a brief description of different levels of Blooms taxonomy. Section III presents various processes used for self assessing Section IV explains the assessment report at different difficulty levels of a typical course. Sections V discuss the scope for further improvement with conclusion.

II. BLOOMS TAXONOMY

Benjamin Bloom, an educator himself, developed a classification system referred to as Blooms taxonomy to assist teachers in recognizing various cognition levels in teaching-learning methods [3].

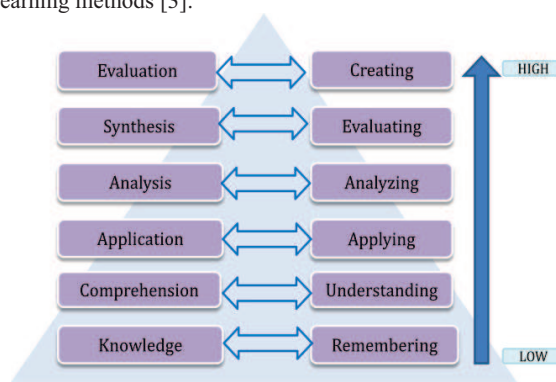


Figure1. Blooms taxonomy of learning

There are six cognition levels arranged in hierarchical form, moving from the lowest level of cognition (LOW) to the highest level of cognition (HIGH). They are,

Knowledge - It is the lowest level and it requires students to recall information. Most of the teachers ask knowledge based questions. Knowledge questions are framed using the action verbs like *know, explain, what, name, where, list, define and when*.

Comprehension - the question which are framed using the action verbs like *discuss, compare, describe, outline and use* fall into this level of thinking. This type of questions requires students to go beyond recall and expect them to combine the data together. Students answering this type of questions need not use any creative thinking.

Application - Questions at this level expects students to use their knowledge to apply in order to arrive at the answer. Some of the action verbs used to frame application questions are *manipulate, apply, employ, demonstrate, choose and interpret*.

Analysis - The questions are framed using the action verbs like *analyze, conclude, draw, simplify, distinguish, survey* etc. Analysis questions require students to break the questions into

component parts in order to come to the conclusions. Creative thinking with a good reflex plays an important role to some extent.

Synthesis - Synthesis questions require good thinking and creativity from students. Synthesis level is very useful in bringing out the original ideas from students to solve problems. Words commonly used to frame synthesis questions are, *construct, synthesize, design, create, formulate, produce, compose* etc.

Evaluation - Evaluation type of questions requires decision making and problem solving skill of students. Since these questions have multiple solutions individual ideas or judgment has more weight. This is highest cognition level. These types of questions are framed using the words like *assess, justify, evaluate, criticize, value and judge* etc.

Introduction of Blooms cognition levels in teaching-learning processes is for teachers to create effective learning objectives and learning outcomes. The action verbs used in the learning objectives and outcomes indicate the learning level of students. This practice brings out some of the hidden talents of course instructors who can give a scientific meaning to the classroom teaching by providing innovative course dependent teaching activities instead of making the course learner-centric. This will also help course instructors to take corrective measures to improve the delivery mechanisms of their course. This will train the students to withstand the competency in their profession and the real world.

III. TEACHING-LEARNING PROCESSES

Blooms taxonomy allows teacher select appropriate teaching – learning activities for a course.

A teacher can construct and organize the teaching [4] considering the following points:

- Curriculum content knowledge
- Assessment tools to be used for a selected course
- Basic pedagogical knowledge
- Awareness of the strengths and weakness of learners
- Knowledge about the classroom management
- Knowledge about the educational values and purposes.

The teaching and learning processes to improve the cognition levels adopted in the department are as given below. They are,

A. Question paper process

A common process to prepare the test question paper is adopted by authors in the department. This is to assist the teachers to recognize the levels of complexity of various questions. This also helped the teachers to show creativity in question paper setting. This process is adopted in the department to ensure all the teachers set test question papers in a scientific way fixing the levels of complexity based on Blooms taxonomy [3].

Blooms taxonomy levels need to be indicated against each test question. Blooms levels are marked as L1 to L6, with L1 for knowledge and L6 for Evaluation.

Minimum three Blooms levels to be used to frame questions. Choice of questions restricted to same level of Blooms taxonomy. Question papers were reviewed by the department academic audit committee to ensure the usage of Blooms levels by all teachers. All the teachers taking the same course for different sections are advised to maintain the common degree of difficulty. This is to maintain uniform platform for all students across the three sections.

Finally, teachers are motivated to use high cognition levels to frame questions to understand the thinking skills of the students. This process brought a lot of quality awareness among all the teachers and also the creativity of setting challenging questions.

The process to review the question papers to ensure the usage of Blooms taxonomy levels and also to provide common test paper pattern for each course is practiced in the department. The outcome of this experiment to observe the performance levels in the department resulted in following changes.

- Teachers think differently and creatively.
- Teachers exhibit pedagogical skills in teaching-learning activities.
- Quality enhancement awareness among teachers.
- A healthy competition among the teachers handling the same course for different sections.
- Students got the benefit of answering questions at increased cognition level.

The integrated course namely „Op-amps and Linear ICs’, a 4th semester, Electronics and Communication engineering course is taken as a case study for the present discussion. The course has a laboratory component attached to it. The test questions prepared to assess students of this course mapped to the six Blooms taxonomy levels L1 to L6. The mapping of the assessment tools of the course to Blooms level is as shown in the figure.2.

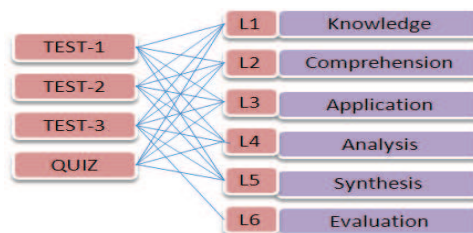


Figure 2: Test question paper mapped to Blooms

The course analysis shows the percentage of students exhibiting the various skills.

B. Internal marks auditing process

A typical course is considered here to present the methodology followed in the department. The required inputs to perform the analysis are,

- Test performance scores
- Excel spread sheet with Blooms levels against each question
- The marks allotted for each question at different Blooms levels as shown in the table 1.
- The table-1 shows that different cognition levels with marks allotted in each test.

Table-1: Levels in each test						
	L1	L2	L3	L4	L5	L6
T1	4	16	5	5	10	-
T2	8	6	11	5	10	-
T3	4	10	10	5	5	6

The steps followed to complete the analysis are,

1. The performance of students are entered in excel sheet with levels marked against each question / subquestion.
2. The test paper is divided into components based on the Bloom's levels.
3. The performance at each level in each test is calculated and average of the three is taken.
4. The overall performance of students at each level is calculated by taking the average of the three performances.

C. Internal marks analysis :

Table-2 shows the analysis result in each test and the average performance of students at different levels of Blooms taxonomy.

The cut-off to analyse the performance is fixed at 60% by the program coordinator. This cut-off is based on the parameters like input ranks of the program, the average performance in lower semesters and also the lateral entries at 3rd semester. The cut-off will be increased by analyzing the performance of students. The academic audit committee performs the analysis and submits a report to the course instructor through program coordinator. From the table-2 it is observed that the performance is below the cut-off at synthesis (L5) and evaluation (L6) levels. This analysis will help the course instructor to identify weak points in his/her teaching and

Table-2: Analysis report						
% of students performance at various levels						
Performance	L1	L2	L3	L4	L5	L6
T1	71.50	57.10	49.20	48.10	48.70	-
T2	73.20	51.60	75.10	58.20	53.10	-
T3	79.40	81.80	67.50	88.20	47.50	34.60
Average Performance of the class	74.70	63.50	63.93	64.83	49.77	34.60

take corrective measures to overcome these after each test. This is a continuous process in the department. The analysis reports also reveal the strengths and weakness of students.

Observations from the analysis:

1. L6 the highest cognition level is used only in the test-3. The performance of students in that component of test-3 cannot be compared. Only 34.6% of students could attend to that question.

2. L1 level questions reflect knowledge based questions and about 74.7 % of students are comfortable. This shows that students have gained knowledge.

3. L2 level questions reflect comprehension. 63.5% have students have gone up in the ladder of cognition levels. About 10% of students are finding it difficult to understand the knowledge they have gained.

4. L3 and L4 level questions reflect application and analysis skill from the students. It is found that about 63 to 64 % of students can comfortable answer this type of questions.

5. L5- synthesis type of questions where it requires creativity and constructive ideas from students. It is to be observed that about 50% of the students can go up to this level while remaining 50% of class find it difficult to answer this type of questions showing that they lack this skill set.

The performance analysis can be used to study the learning and thinking behavior of students [3-6]. The questions framed with different degree of difficulty enable the teacher to test the learning capability of students. The outcome of this method is,

- Analytical strength of students in a given class can be well understood.
- A scientific way to identify number of academically weak students in the course.
- Academically weak students can be trained to overcome their weakness.
- The teacher can organize the learning to improve the skills of all the students.
- Teachers can find innovative ideas to meet the learning level of all students to complete learning process.
- Performance feedback after each test or quiz will give them enough time to correct and revise their learning leading to the improved learning.
- The entire teaching – learning is transformed to a more meaningful bidirectional process from a conventional monotonous unidirectional process.

IV. CONCLUSION

This paper details the procedure for understanding the learning behavior of the students of the program to meet the attainment of program outcomes through course outcomes. This methodology can be aptly applied to all the courses.

The above experiment is a first step taken by the authors to understand the learning behavior of students in the program. The authors are motivating the other teachers and students to understand the goals of education and contribution to the

societal needs by good practices. This has resulted in teaching creativity among the teachers resulting in a conducive environment in the department.

The faculty are working together to develop new innovative ways to make teaching – learning very interesting. Innovative teaching - learning methods are designed to meet the students of all learning levels. Academically weak students are counseled to overcome their weakness using various measures taken in the department. Outcome based education has made faculty to develop creative ways of teaching –learning methods to analyze the student performance in different learning environments. The teachers are motivated to exhibit good teaching practices for continuous improvement of the program.

The method discussed in this paper is one course handled by authors in second year level. However the method is followed throughout the department with slight changes in the analysis approach. The introduction of Bloom's levels in regular teaching – learning process will give flexibility to teachers to train students at different difficulty levels. This will certainly improve the curriculum design and its development resulting in an overall continuous improvement.

ACKNOWLEDGMENT

Authors wish to express their gratitude to the Management, Principal, Vice Principal and Dean (Academic) of BMS College of Engineering, Bangalore for the encouragement and valuable suggestions extended towards the proposed method of finding the Program outcome attainment and in bringing out this paper.

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