Blooms Taxonomy– Application in Exam Papers Assessment

S. Ilango Sivaraman[1] and Dinesh Krishna[2]

[1,2]Caledonian College of Engineering, Muscat, Oman

Abstract– **Testing the students' cognitive level is the prime objective of any assessment system. However, it is perhaps necessary to review and introduce steps in the examination paper design to ensure that the student is tested for the different cognitive levels of learning. Blooms Taxonomy named after Benjamin Bloom classifies the different layers of learning processes that a student goes through when the learning objectives are set for them in a teaching program. In an educational environment where an array of programs and modules are taught by different teachers with differing learning objectives, the consistency of assessment across all modules also become a major task. Essentially, this is the prevailing learning and teaching atmosphere in Caledonian College of Engineering, Sultanate of Oman. This paper explores the elements of Blooms Taxonomy in examination assessment system in this college. Further, the methodology adopted by the assessment office of the College, in testing the students' cognition levels (applying Blooms Taxonomy principles) and the questions for mapping the cognitive levels are illustrated. It is also felt that the application of Blooms Taxonomy system has enabled the teachers to set examination papers that are well balanced, testing the different cognitive skills without a tilt towards a tough or easy paper perception.**

I. INTRODUCTION

This paper is written based on the experience gained while introducing the principles of Blooms Taxonomy in our college (Caledonian College of Engineering, Muscat, Oman) assessment system in the year 2012-13.

In the first year it was introduced as a trial method for setting the questions papers and necessary guide lines were given to all the teaching staff members involved. The systems effectiveness is reviewed after the first year and with full cooperation from all the staff members, Blooms Taxonomy system was introduced as a part of the regular feature in the assessment methods of exam/test questions.

At present, the system is applicable across all our department programs – The College has three Engineering departments and two supporting departments the details are given below in Table 1.

Table 1: Programs and Modules

S. No	Department	Programs (Affiliation)	Number of Modules
1	Built and Natural Environment	Civil Engineering(GCU)/ Construction Engineering(GCU)/ Measurement and Cost Engineering(GCU)	17 13 09
2	Electrical and Computer Engineering	Computer Engineering(GCU)/ Electrical Power Engineering(GCU)/ Electronic and Instrumentation(GCU)/ Telecommunication(GCU)	16 07 15 10
3	Mechanical and Industrial Engineering	Computer Aided Mechanical Engineering(GCU)/ Mechatronics(GCU)/ Process Operations and MaintenanceGCU)/ Chemical Engineering(VITU)	18 12 12 32
4	Mathematical and Statistics	(Supporting modules for all above programs)	11
5	Educational and Professional Development	(Supporting modules for all above programs.)	03

The college is in affiliation with Glasgow Caledonian University (GCU) for many programs and with Vellore Institute of Technology (VITU) for a couple of programs.

Besides the undergraduate programs mentioned, the college also has two post graduate programs, i.e., Process Engineering with VITU and Maintenance Management with GCU. For all these programs, at the exam stage, the Blooms Taxonomy principles are followed while setting the question papers.

II. BLOOMS TAXONOMY

The system of Bloom Taxonomy was conceptualized and proposed in the year 1956 by Benjamin Bloom, leading a team of educators. It was a framework, classifying educational goals and objectives. (Forehand, 2011). In 2000-01 one of the original team members, David Krathwohl, and a student of Bloom's, Lorin Anderson, spearheaded an effort to revise the original cognitive taxonomy.The ideas for our application in the assesment is taken from the revised Blooms taxonomy.

Understanding that "taxonomy" and "classification" are synonymous helps dispel uneasiness with the term. Bloom's Taxonomy is a multi-tiered model of classifying thinking according to six cognitive levels of complexity((Forehandy.M., 2010).Here the classification is about academic understanding/classification of thought process in learning and teaching.

As per the author((Athanassiou, 2003), the taxonomy refers to a six level classification system, that uses observed student behavior to infer the level of cognitive achievement. The author goes on to say that emprical evaluation of student achievement can be processed by its application.

Blooms taxonomy can be applied in the following specific areas according to the author (Giesen, 2014):

1. Write and revise learning objectives
2. Plan curriculam
3. Identify simple to most difficult skills
4. Effectively align objectives to assessment techbiques and standards
5. Incorporate knowledge to be learned
6. Facilitate questioning

Caledonian College of Engineering has incorporated Blooms Taxonomoy in assessment systems in 2012-13(point number 4 above). As per their assessment office,the reasons for adopting Blooms Taxonomy stem from the following reasons:

1. Blooms Taxonomy system makes the teaching staff to think about the type of questions before they are put in black and white.
2. This brings about a clarity when questions are formulated by the staff members.
3. It is possible that the question paper is termed as tough or easy by the students.Blooms Taxonomy assists the staff to bring out a balance while setting the question paper.
4. Consistancy is also observed across all module question papers when Blooms taxonomy is introduced in the assessment system.

III. METHODOLOGY

The method of forming the question paper emanates from the six cognitive levels of thinking proposed in Blooms Taxonomy:

Table 2: Cognitive levels of thinking

The cognitive processes dimension — categories, cognitive processes (and alternative names) Lower order thinking skills ⟶ Higher order thinking skills					
Remember	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
recognizing (identifying) recalling	interpreting clarifying, paraphrasing representing, translating illustrating classifying categorizing summarizing concluding, , interpolating, predicting comparing explaining	executing carrying out implementing using	differentiating discriminating, distinguishing, focusing, selecting organizing finding coherence, integrating, outlining, parsing, structuring attributing deconstructing	checking coordinating, detecting, monitoring, testing critiquing judging	generating hypothesizing planning designing producing construct

A training work shop is organized by the College on Blooms Taxonomy and the staff is advised about the six cognition levels and the verbs that can be used to test each of these cognition levels. The verbs that can be used in framing the questions are given in Table 2.

For instance, if the questions, use the verbs like 'Identify' or 'interpret 'it is meant to test the students' knowledge covering their remembrance or understanding skills. To test the students' application and analyzing skills, the verbs that can be possibly used are suggested in the table above. The evaluating and creating skills can be tested using the verbs given in the corresponding columns of the Table 2.

Thus the table illustrates the verbs usage in questions and its corresponding implications, as per Blooms Taxonomy. Therefore, the teaching staff is advised of the different cognition levels and possible tools (verbs) that can be used to test the students' knowledge of the subject.

It was also recommended to the staff members that they can arrive at a balance by setting a question paper that tests both lower order thinking skills as well as higher order thinking skills of the students. Further the assessment office introduced following model (LO/IO/HO) for the staff to apply the concepts while setting the question papers.

LO – LOCQ – Lower order cognitive questions – covering questions for testing the ***remembering and understanding*** of the concepts by the students.

IO – IOCQ – Intermediate order cognitive questions- Covering questions that test the ***applying and analyzing*** skills of students

HO – HOCQ-Higher order cognitive questions-To test the ***evaluating and creating*** abilities of the students with respect to their knowledge.

IV. ILLUSTRATING THE APPLICATION

In the following Table 3, examples of the application of Blooms Taxonomy in setting a few typical questions are given:

Table 3: Classification examples

S. No	Question	Classification as per Blooms Taxonomy	Marks
1(a)	Define Ohm's law	LO(LOCQ)	
(b)	What is the Root Mean Square value of an alternating current	LO(LOCQ)	The marks are apportioned based on the total marks allotted for a question
(c)	Classify the soils based on the data given	IO((IOCQ)	
(d)	Design a pneumatic circuit for the application described	HO(HOCQ)	

Table 4: Balancing the exam paper

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution recommended	20-30%	40-50%	30-40%

(Note: In the example above questions are from different disciplines of Engineering Programs and are mixed).

It is observed that the staff generally gives a blend of LO/IO/HO questions in the paper so that the students get an evenly balanced paper in the exam.

The author (Piontek, 2008),in a publication by The University of Michigan,mentions that the students should feel that the asessment paper is fair and meaningful and the assessment data, reflecting the students achievement, should support this fact.Application of Blooms Taxonomy, is one of the instruments to achieve this objective.

In the process of setting the question papers with the components of LO/IO and HO, the staff is also advised to provide details of total marks distribution among the LO/IO/HO questions of the paper. The following table shows as an example, the percentage marks distribution in a possible case. The question of balancing the marks distribution among LO/IO/HO is normally left to the staff, setting the question paper.

In this method, it is believed, that the questions test the students' analyzing, designing and critical thinking skills in addition to their basic understanding of the topic.

In an article on 'Assessment for learning' the author (Brown, 2004-05) points out that the assessment criteria need to be clear, explicit, framed in language that is meaningful to staff and students and available. This has to be consistent at all levels of the years of study. The assessment office of the college feels that after introduction of Blooms Taxonomy, the teaching staff has a guide post while preparing the exam papers.

V. CONCLUSIONS

It is necessary to mention here that application of Blooms Taxonomy should cover the learning outcomes of the module being tested. This is emphatically stated by the author (Nusche, 2008) that learning outcomes should form the basis for any type of assessment.

The distribution of marks over LO/IO/HO classification also depends on the level (year of study) for which the question paper is being set. In addition, the type of module (analytical/theoretical) also plays a role in the appropriate distribution of the questions across the different cognition levels.

It must also be mentioned here that the Blooms Taxonomy principles serve as guide lines to the staff framing the question paper but it is largely left to them to bring out a balanced paper as the final outcome.

It is fair to conclude here by saying that the comments from the external examiners have become more positive on the question papers sent to them for review, after the introduction of Blooms Taxonomy in the college.

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