



## INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATION AND MANAGEMENT

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**THE APPLICATION OF REVISED BLOOM'S TAXONOMY FOR JAVA PROGRAMMING ASSESSMENT**

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**ABSTRACT**

Learning of Java programming is a challenge for undergraduate students, particularly with application and analysis levels. A study has been conducted in this regard to analyse the learning difficulties of Java programming in six cognitive levels of Revised Bloom's Taxonomy (RBT); Remember, Understand, Apply, analyse, evaluate and create. Multiple Choice Questions (MCQs) have been constructed according to RBT from the subject of programming paradigm of undergraduate Computer Science and Engineering (CSE), affiliated colleges of Anna University, Chennai. 220 responses were received from four engineering colleges. We analyzed the answers provided by the students. The results show that the higher order skills (analyse level) is harder than the lower order skills (Remember, understand and apply) of Revised Bloom's taxonomy. Further, students feel that the concurrent programming (init-v) of Java is more difficult to learn when compare to the Object Oriented Programming (OOP) -fundamentals (unit-I), OOP-Inheritance (unit-II), Event driven Programming (unit-III) and generic programming (unit-IV).

**KEYWORDS**

Assessment, Java Programming, Revised Bloom's Taxonomy.

**INTRODUCTION**

Bloom's taxonomy was first described as a hierarchical model for the cognitive domain (Bloom et al, 1956). Anderson and others revised the major categories in Bloom's Taxonomy to suit the emerging educational institutional needs of the new century (Anderson et al, 2001). The revised Bloom's Taxonomy maintained the original ideas of Bloom, being the levels of cognition, but made changes within the categories, expanding them and explaining them better in the context of general education. In our study, we use the Revised Bloom's Taxonomy as we are classifying programming ability and find that it is capable of explaining the ability or skills required by students to answer each multiple-choice question (MCQ). The six thinking levels in revised version of Taxonomy is *Remember, Understand, Apply, Analyse, Evaluate and Create* Bloom's taxonomy has been applied to the education domain of computer science for course design and evaluation (Scott 2003), structuring assessments (Lister et al, 2003) and comparing the cognitive difficulty level of computer science courses (Oliver et al, 2004). Assessment of learning outcomes for Java programming course can be improved effectively through proper application of taxonomy. This study aims at applying the Revised Bloom's Taxonomy for Java programming assessment and find out the deficiency of students learning on various levels of taxonomy and unit wise as well.

**RELATED WORK**

Applying the taxonomy in summative assessment is a difficult task (Thompson et al, 2008). A number of studies have applied Bloom's Taxonomy to programming tasks. Scott explained some links between programming questions and Bloom's Taxonomy when he demonstrated how the taxonomy works in programming tests and provided some sample questions for each category of the taxonomy (Scott, 2003). Oliver and others claimed that their Programming 1 course rated as 3.9 applying Bloom's Taxonomy, but, in their analysis, only assignments were rated according to the Bloom's Taxonomy (Oliver et al.2004). There was no evaluation made of examination questions based on Bloom's Taxonomy as due to the course designed, there is no final examination for Programming.

Lister & Leaney identified the weak, middle and strong programming students in their study based on criterion-referenced grading (grades which were assigned according to criteria, irrespective of the resultant grade distribution). Different treatments, depending on the level within the taxonomy, were applied in order to obtain the various different grades. They proposed a scale based on the students' performances to determine their progression to the semester. Furthermore, the study concluded that multiple-choice questions should not be seen as being too easy in the exam, since one third to one half of the class failed to achieve the 70% pass figure on their first attempt. However, they still believe that multiple-choice questions can provide a solid test of a student's knowledge and comprehension (Lister & Leaney 2003).

Nurul Naslia Khairuddin and others outline software engineering assessment using Bloom's Taxonomy, sample multiple choice questions are given and categorized according to the relevant Bloom's Taxonomy levels (Nurul Naslia Khairuddin et al, 2008). Shusaida shuhidan and others found that it is very difficult to classify questions on the final exam paper using Bloom's Taxonomy It is hard to distinguish between the categories as the original Bloom's Taxonomy was written to suit the education field generally (Shusaida shuhidan et al, 2009). Further they recommended the two additional measures as we have seen that there exist questions which are low level in complexity as determined by the instructors, but the novices found them very difficult to solve. In a study, Satu Alaoutinen and Kari Smdander shows that the scale using Revised Bloom's Taxonomy for students self assessment in a programming course gives a quite good general picture of students knowledge level (Satu Alaoutinen et al, 2010).

**METHODOLOGY**

Our data source is the answer to questions on the subject 'Programming Paradigm' of undergraduate students of CSE branch in affiliated colleges of Anna University, Chennai. Tool consist a total of 80 marks for 80 questions, all of which are MCQs. The time allocated to complete the paper was 3 hours plus an extra 15 minutes of reading time. On this basis the expected, estimated time to answer each multiple choice questions is approximately three to four minutes. In total there were 220 submissions received from the students. We analyzed the answers of the 80 questions. In each multiple-choice question there is only one correct answer and three incorrect answers, denoted as distracters. In the remainder of this section we present descriptions of our approaches to construct test questions according to Revised Bloom's Taxonomy.

**METHODOLOGY FOR MCQ CONSTRUCTION**

We outline the Revised Bloom’s Taxonomy upon which we have based our categorization of the multiple-choice questions (Table 1). In terms of cognitive complexity, Remembering is the lowest level category and relates to memorizing information and being able to recall definitions. As the scale of complexity moves up, the cognitive factor increases, meaning that greater use is being made of the students’ mental capabilities. Creating is the highest level of cognition and relates to the creating, developing and writing of ideas and abstractions. The Applying level 3 is the one where we believe most of the programming code questions from our test paper have been pitched.

**TABLE 1: REVISED BLOOM’S TAXONOMY**

Skill	Sample prompts	Purpose	Level
Remembering	<i>recognize, list, describe, identify, retrieve, name</i>	memorize and recall facts	LOWER
Understanding	<i>describe, explain, estimate, predict</i>	understand and interpret meaning	
Applying	<i>implement, carry out, use, apply, show, solve</i>	apply knowledge to new situations	
Analyzing	<i>compare, organize, cite differences, deconstruct</i>	break down or examine information	HIGHER
Evaluating	<i>check, critique, judge hypotheses, conclude, explain</i>	judge or decide according to a set of criteria	
Creating	<i>design, construct, plan, produce</i>	combine elements into a new pattern or product	

We discussed primarily the construction of 80 multiple choice questions, by applying Revised Bloom’s Taxonomy for given five units and analyse this with students’ level of learning difficulty of Java Programming.

**METHODOLOGY FOR APPLICATION OF REVISED BLOOM’S TAXONOMY TO MCQ**

We examined the Multiple Choice Questions and distracters, constructed them according to Revised Bloom’s Taxonomy outlined in the previous section, and present these results in Table 2. We delimit that the content of the multiple-choice questions may be constructed into three lower levels of Revised Bloom’s Taxonomy: Remember, Understand, Apply and one Higher level of Revised Bloom’s Taxonomy: Analyse. Since this is an undergraduate programming course, we would expect that the test instrument should test performance at the lower level skills. The questions are equally taken for all the five units of the subject and four Taxonomy levels. 20 questions from each level (20x4=80 questions).

The construction of MCQ to various cognitive levels is done based on cognitive-level-keyword mapping (Renumol V G, 2001). Revised Bloom’s Taxonomy in cognitive domain provides a set of keywords for each cognitive level. Remember the syntax, package are comes under *Remember* level. Ability to understand the concept, flow of execution, interprets the given code for *Understand* level. Ability to use the syntax, concepts in unfamiliar situation comes for *Apply* level. Checking the ability of logical thinking comes under *Analyse* level.

**TABLE 2: REVISED BLOOM’S TAXONOMY AND THE NUMBER OF MCQ IN EACH LEVEL**

Level	Category	Unit-I	Unit-II	Unit-III	Unit-IV	Unit-V	Total no. of question on each level
6	Create	-	-	-	-	-	-
5	Evaluate	-	-	-	-	-	-
4	Analyse	4	4	4	4	4	20
3	Apply	4	4	4	4	4	20
2	Understand	4	4	4	4	4	20
1	Remember	4	4	4	4	4	20
<b>Total no. of questions on each unit</b>		16	16	16	16	16	80

**STUDENTS’ LEVEL OF DIFFICULTY**

In the test paper construction, it is considered that the level of difficulty faced by the students. According to the nature of multiple-choice questions, they have four possible responses (A, B, C or D), only one correct answer and three distracters. Constructed MCQ in two levels, one is easy which consist of vary easy and easy, another one is difficult which consist of difficult and very difficult.

**ANALYSIS AND DISCUSSION**

The Percentage of marks secured by students in Programming paradigm subject on unit wise and the level of Revised Bloom’s Taxonomy is presented in bar chart in Fig.1.

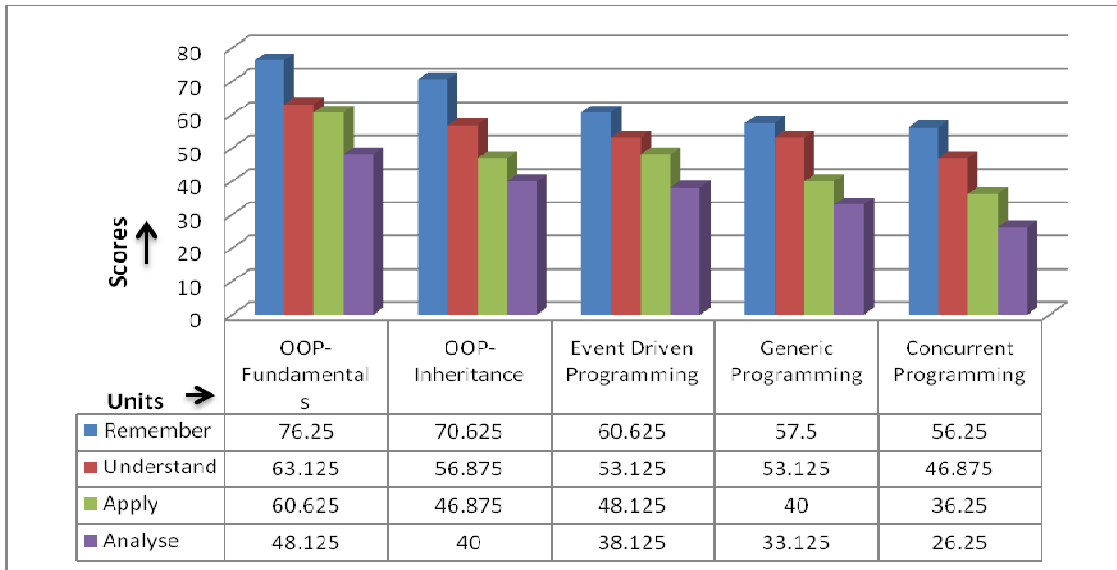
*The least performance of students is:*

- Analyzing the concurrent programming (26.25%)
- Analyzing the generic programming (33.13%)
- Applying the concurrent programming (36.25%)

*The highest performance of students is:*

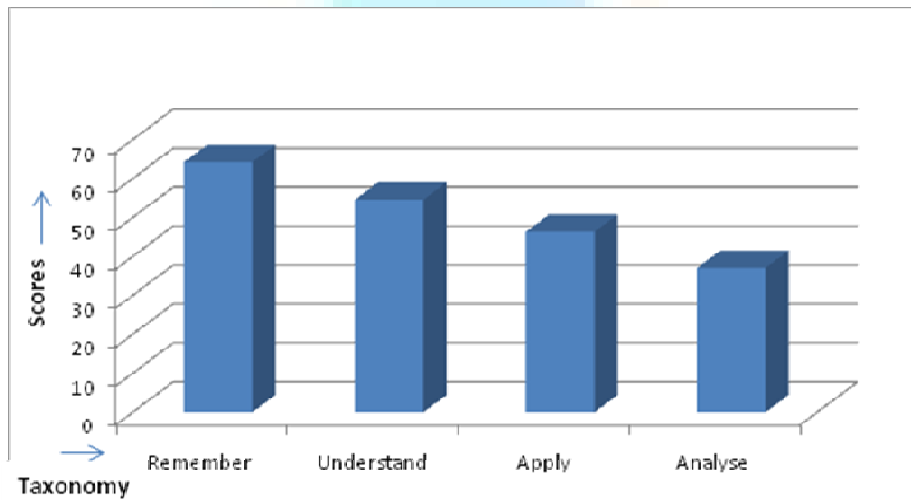
- Remembering the OOP-Fundamentals (76.25%)
- Remembering the OOP-Inheritance (70.63%)
- Understanding the OOP-fundamentals (63.13%)

FIG.1: PERFORMANCE OF STUDENTS ON TEST OF JAVA PROGRAMMING: TAXONOMY AND UNIT WISE



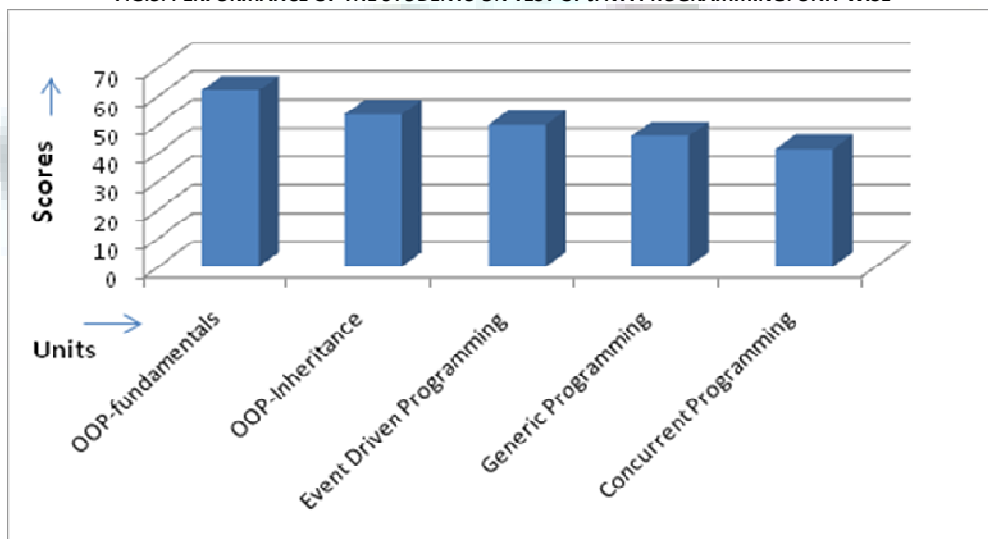
The performance of students in programming paradigm subject according to Revised Bloom’s Taxonomy is shown in fig.2. The students’ performance is decrease when moving to the next level of taxonomy, which indicates the emerging need of concentration on teaching and learning of programming paradigm subject.

FIG.2: PERFORMANCE OF THE STUDENTS ON TEST OF JAVA PROGRAMMING: TAXONOMY WISE



Unit wise performance of students in learning of Java programming has shown in Fig.3. Subsequence of students’ performance on taxonomy wise, here Students’ performance is decrease when moving to the next unit of the subject. This point out to give attention on teaching and learning process of Java programming.

FIG.3: PERFORMANCE OF THE STUDENTS ON TEST OF JAVA PROGRAMMING: UNIT WISE





The analysis of various data revealed that the students have the lack in all four levels of Revised Bloom's Taxonomy. Primarily with the analyse level of Revised Bloom's Taxonomy is difficult for learning of Java programming. Also, the concurrent programming is considered difficult unit to learn.

## CONCLUSION

In order to apply the Revised Bloom's Taxonomy and to analyse the learning difficulties of Java Programming, this paper analyzed the answers of MCQ from a group of undergraduate engineering students. This study shows that the students have difficulties on all levels (taken only first four; Remember, understand, apply, analyse) of Revised Bloom's Taxonomy, particularly in the applying and analyzing level, also it reports that the concurrent programming (unit-v) is difficult unit compare to other units. Further, it shows the analyse level of concurrent programming is most difficult of Programming paradigm subject.

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