www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 3 Issue 5 May, 2014 Page No. 5610-5613

Improving Intellectual Skills of Students by Analyzing their Performance and Classifying them Based on Bloom's Taxonomy Using K-Means Clustering Algorithm

Ms. S. Sangeetha [(1)], Ms. M. Thiruvarutselvi [(2)]

[1] Assistant Professor, Department of Computer Applications
Bannari Amman Institute of Technology
Affiliated to Anna University, Chennai
Tamilnadu - 638401
sangeethabharani@gmail.com

[2] Assistant Professor, Department of Computer Applications
Bannari Amman Institute of Technology
Affiliated to Anna University, Chennai
Tamilnadu - 638401
thiruvarutselvimahesh@gmail.com(2)

Abstract: ***Teaching is the process of carrying out the activities which is effective in getting students to learn. The cognitive knowledge of every student in a classroom is not uniform. Some students are good at reasoning and some are not. This paper suggests aligning the questions in the question paper of periodical tests with Bloom's Taxonomy. Assess the answer script of each student and categorize them using K-Means Clustering algorithm under different levels of the Bloom's Taxonomy. This activity helps lecturer to get the reasoning strength of each student in a classroom. The lecturer can put more attention to improve intellectual skills of students having weak reasoning power. The aim of this paper is to improve the students' performance through enhancing their ability.***

Keywords

Bloom's Taxonomy, K-Means Clustering.

Introduction

The real objective of education is to gear students for life not simply for examinations. It is quite a bit of focus on teaching strategy. Students are to be treated as individuals with particular abilities, aspirations and concerns. Students learn in different ways. The abilities to perform certain tasks vary from student to student. Understanding that each student has unique strengths and weaknesses related to the ways in which they approach learning is an important component of effective education. Students who experience academic difficulties are identify and offer needy assistance. It is necessary to examine critically, synthesize and evaluate the student's knowledge across a broad range of subject concepts. The proposed system is built on the underlying the concepts of Bloom's taxonomy and integrated with K-Means clustering algorithm. This system helps teachers to assess the knowledge of the students in various aspects of the Bloom's taxonomy and to identify the learning weak point of the students. The teacher can follow different teaching strategy to improve the student's analytical and cognitive skills about the subject concepts based on the assessment. Professor Howard Newby's statement [7], "I would certainly want to assert the value to self-understanding in disciplines of debating the basis on which the discipline is conducted and what the students need in order to be able to participate in the community of scholars who practice it". (QAA, Benchmarking Academic Standards Conference, 17 May 2000) is pioneered in this system.

1. Bloom's Taxonomy

Bloom's Taxonomy was created in 1956 by the educational psychologist Dr Benjamin Bloom in order to

promote higher forms of thinking in education, such as analyzing and evaluating, rather than just remembering facts (rote learning) [1]. The students are to be assessed through different levels of Bloom's taxonomy. The levels of Bloom's taxonomy considered in the proposed system are Remember, Understand, Apply, Analyze, and Create. The Bloom's taxonomy levels which are considered are arranged in a hierarchical order as shown in Fig.1.

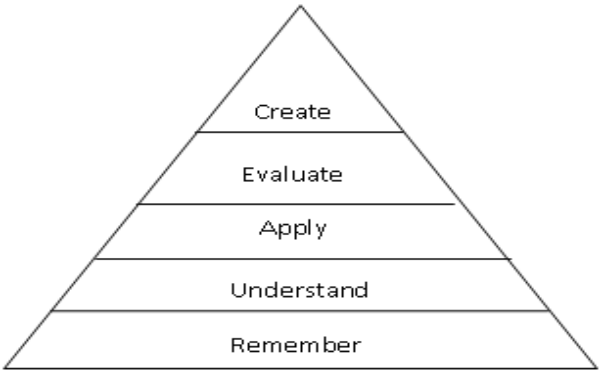

Fig.1: Bloom's Taxonomy Hierarchy

Remember: Recollecting the previous learned information, such as definitions, principles.

Understand: Comprehending the meaning, translation, interpolation, and interpretation of instructions and problems.

Apply: Using a concept in a new situation. Applies what was learned in the classroom into empirical situations in the work place.

Analyze: Troubleshooting a piece of equipment by using logical deduction. Recognize logical fallacies in reasoning.

Create: Integrates training from several sources to solve a problem.

By this hierarchy it could be revealed that a student is good in top most hierarchy create, surely that student is good in all the lower levels. But reversely, it is false. A student may be good at lower level but may not be good at higher levels of taxonomy. By practicing the Bloom's taxonomy in a classroom, students can equip themselves to analyze increasingly complex cases, to solve more difficult and realistic problems, and to undertake more demanding projects, and thereby acquire sophisticated skills in generating and testing hypotheses about underlying principles, and in applying theoretical expectations to particular instances.

2. Question Paper Alignment

The questions in the question paper are to be aligned in the order starting from lower level to higher level of the Bloom's Taxonomy. When a student's skillset is to be examined about a particular concept of a subject, a teacher can assess the student by setting a question that consists of all the levels of Bloom's taxonomy. A question is to be set with the options 1.a, 1.b, 1.c, 1.d, 1.e. The options of the questions are align in the way that the first option of a question 1.a belongs to the level of remember. Second option 1.b belongs to the level of understand. Likely third option 1.c belongs to the level apply, fourth option 1.d belongs to the level analysis, and fifth option 1.e belongs to the level create. Each option of a question should be assigned certain weightage of marks. The range of options (1.a, 1.b, 1.c, 1.d, 1.e) of a question tests a student how good he remembers the principles of the concept to be examined, understands the usability of the concept, the real time situation to which the concept can be applied, analyzing the merits or demerits on applying the concept to the real time situation, creating a new application by using the concept respectively. The question option 1.b could be answerable only if 1.a is answerable by a student. Likely 1.c can be if he could be answered 1.b. This alignment is to be followed throughout all the levels.

3. Clustering

Clustering is an exercise of grouping a set of objects in a way that objects in the same group are more similar to each other than to the objects in other groups [5]. This paper uses the clustering technique to group the students under the different categories of Bloom's Taxonomy. The K-Means algorithm is used to determine the distance between the clusters and add the student (object) to appropriate cluster. The K clusters are created for each level in the taxonomy, where K=3. The clusters are named poor, average, and good. Based on the marks obtained by a student against the weightage mark assigned to a question options pertain to the taxonomy's level, the students are grouped to any one of the clusters. These three clusters are built for all the levels of the taxonomy and students are grouped to one cluster at each level.

4. Model

The proposed model helps teacher to group the students in a class with three clusters. One cluster consists of students who are good in remember, one of the levels considered in Bloom's taxonomy. Likely second cluster consists of students who are average in remember. Third cluster consists of students who are poor in remember. The students grouped in cluster named good may be good in higher levels of taxonomy. The students grouped in cluster named poor would not be good in higher levels. The proposed model helps teacher to identify the students' weakness in certain level and pay much attention on the students grouped under cluster poor by giving certain kind of exercises to train them and to improve their performance. This is followed for all the higher levels of the taxonomy which are considered. A periodical assessment test1 is conducted for the subject Database Management System to a class of 20 students. The question paper is framed as proposed in this paper. A question is devised into five options range from a to e. Each option in the question paper is assigned equal weightage with 10 marks. Marks obtained by the students in the assessment test1 are tabulated and it is shown in Table 1. The data mark associated to each student is plotted on a graph as shown in Figure 2 which reveals the overall performance of the students in the class. Based on the student's performance they are classified in appropriate cluster. The student's weakness is identified and they are put in exercise to meet the objective. The students are clustered under the three stated clusters poor, average, and good. Figure 3 shows the result of the clustering algorithm applied to the remember level of the taxonomy. Likely the same is exercised to all higher levels understand, apply,

evaluate, and create and the results are shown in Figure 4, Figure 5, Figure 6, and Figure 7 respectively. The X axis of the Figures 3 to 7 represents the student number. The result is obtained by setting a threshold value to each cluster. The mark obtained by a student at each level is compared against the

Qp. No. / Student No.	Q1. OP. a	Q1. OP. b	Q1. OP. c	Q1. OP. d	Q1. OP. e
1	6	8	5	3	1
2	8	9	8	9	9
3	5	6	4	4	3
4	9	7	8	5	2
5	2	3	2	3	2
6	7	8	7	9	7
7	3	4	5	2	3
8	9	8	5	5	5
9	10	9	8	7	8
10	8	8	7	8	7
11	2	3	1	3	1
12	6	5	5	4	6
13	7	8	6	5	5
14	5	6	6	5	4
15	6	6	5	6	6
16	3	4	5	2	2
17	9	8	7	5	5
18	2	4	3	5	5
19	6	7	7	8	6
20	7	8	5	6	5

fixed threshold value of the respective level. The distance between the mark obtained and the threshold value is computed and grouped to the cluster which has minimum distance value. From the result obtained, it is easier to analyze the students' performance at each level of the taxonomy. It is easier to point out a student identified by the student number, example student numbered 1 who is average in remember, good at understand, average in apply, poor in evaluate, and poor in create. Though the student numbered 1 is good in understand, his performance at next higher levels are not satisfactory. This helps the teacher to give necessary training to the students based on their weakness in order to improve their ability where being short of.

Table 1: Marks Obtained by Students

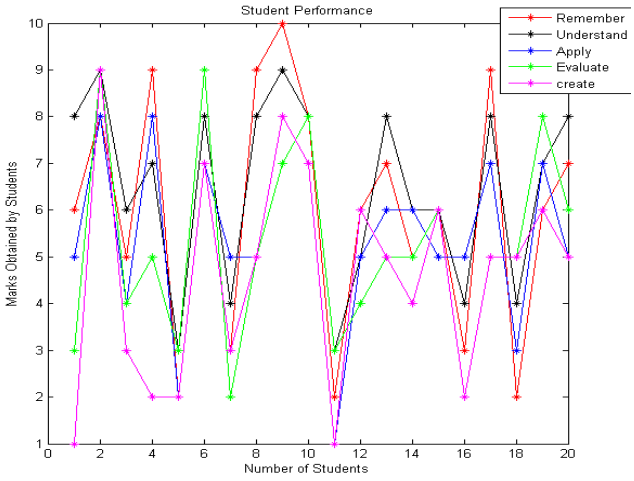

Figure 2: Student's Performance Graph

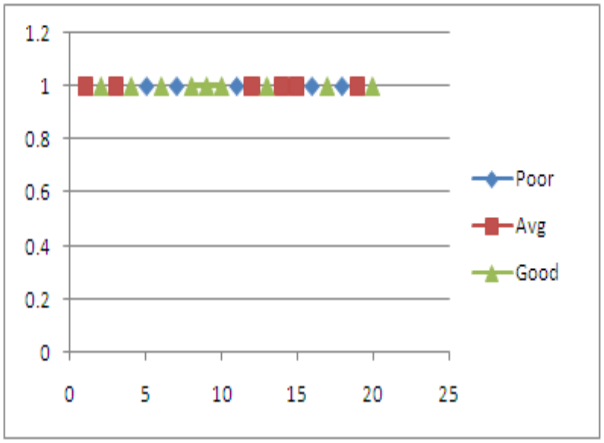

Figure 3: Students Clustered at Remember Level

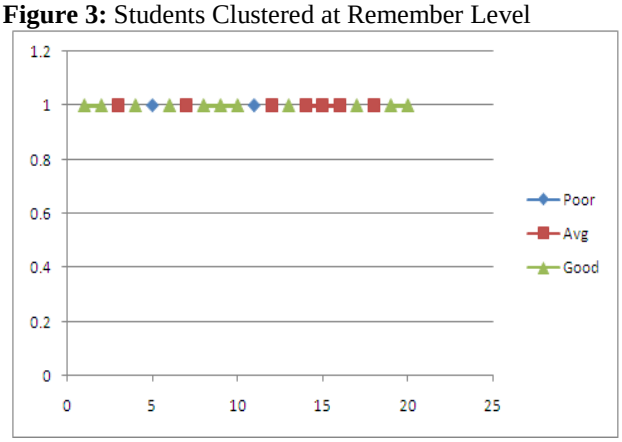

Figure 4: Students Clustered at Understand Level

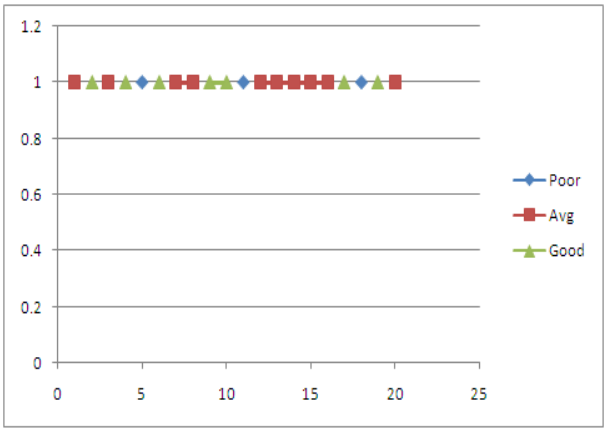

Figure 5: Students Clustered at Apply Level

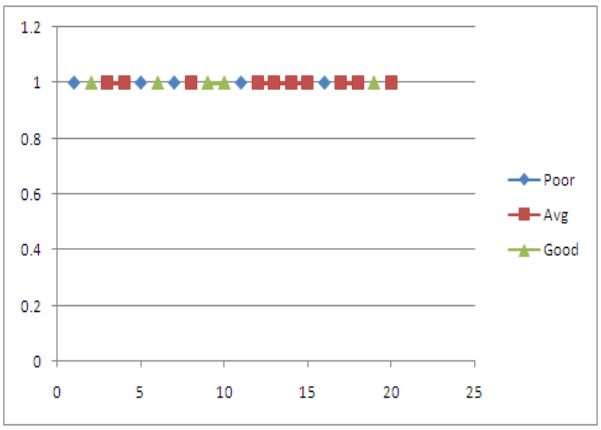

Figure 6: Students Clustered at Evaluate Level

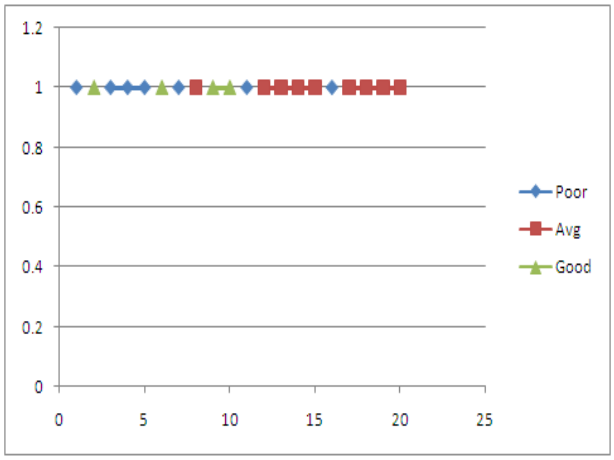

Figure 7: Students Clustered at Create Level

5. Result

The performance of the class of twenty students in a periodical test 1 is observed that certain percentage of students are good in the listed levels of the taxonomy and it is depicted in Figure 8.

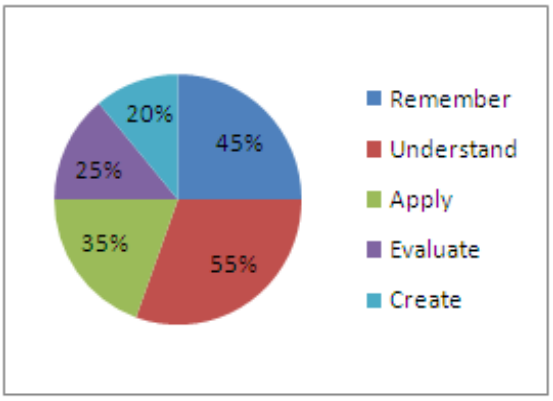

Figure 8: Overall Class Performance

Identifying their weakness and they are trained as per their need. After the adequate training given to them by following the Bloom's taxonomy, it is observed that their performance is considerably improved in all the categories of the taxonomy considered.

6. Conclusion

At the level of a sequence of subjects, such as a major, where the systematic development of knowledge transfer skills is an objective and the demands for knowledge transfer skills might become increasingly sophisticated across the sequence of subjects learned by students, for example, beginning with small design, analysis of the design, helps students to reach a high level of achievement in writing, generic research activities, problem-solving by having in-depth knowledge of their specialist discipline(s). Moreover, when this system is exercised by a teacher in his classroom, the students can be sculptured with a strong sense of intellectual integrity. Students can become critical and creative thinkers with a set of flexible and transferable skills for different types of employment.

References

[1] Biggs J., "The reflective institution: Assuring and enhancing the quality of teaching and learning", The International Journal of Higher Education and Educational Planning, vol. 41, no. 3, pp. 221-238, 2001.

[2] Bloom B.S. 1956, "Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain", New York: David McKay Co Inc.

[3] Chris Rust, Margaret Price, and Berry O'donovan, "Improving Students' Learning by Developing their Understanding of Assessment Criteria and Processes Assessment & Evaluation in Higher Education", Vol. 28, no. 2, 2003.

[4] David R. Krathwohl, Benjamin S. Bloom and Bertram B. Masia, "Taxonomy of Educational Objectives Book 2/Affective Domain", Longman Pub Group.

[5] Jiawei Han, Micheline Kamber, and Jian Pei, "Data Mining: Concepts and Techniques", Third Edition. Morgan Kaufmann, 2012.

[6] Karl O. Jones, Janice Harland, Juliet M.V. Reid, "Relationship between Examination Questions and Bloom's Taxonomy", 39th ASEE/IEEE Frontiers in Education Conference, October 18 - 21, 2009.

[7] McMillan J.H., "Classroom Assessment: Principles and Practice for Effective Instruction", Third Edition, Boston Pearson, 2004.

Author Profile

S. Sangeetha received MCA degree in 2006. In 2006 started career as an Assistant Professor in Bannari Amman Institute of Technology. Area of specialization is Data mining.

M. Thiruvarutselvi received MCA degree in 2006. In 2006 started career as an Assistant Professor in Bannari Amman Institute of Technology. Area of specialization is Data mining.