

# Classification of Examination Questions Difficulty Level Based on Bloom's Taxonomy

Salmah Fattah  
Lecturer  
Computer Science Program  
School of Engineering and  
Information Technology,  
Universiti Malaysia Sabah  
+6088320000  
salmahf@ums.edu.my

Siti Hasnah Tanalol  
Lecturer  
Computer Science Program  
School of Engineering and  
Information Technology,  
Universiti Malaysia Sabah  
+6088320000  
hasnah@ums.edu.my

Mazlina Mamat  
Lecturer  
Computer Engineering Program  
School of Engineering and  
Information Technology,  
Universiti Malaysia Sabah  
+6088320000  
mazlina@ums.edu.my

## ABSTRACT

*This paper presents the research ideas to develop a web application system that can be used by educator to design a good examination question paper. The research will employ human experts to establish the qualities that a good examination question paper must have by adopting the Bloom Taxonomy concepts into it. Here, the difficulty level of each question deposited in the question paper is determined from the keyword/s found in the question. To realize the ideas, a Question Bank is needed and will be used as reference for classifying the question difficulty level. The final product will be a web application system that contains Question Authoring Module, Question Retrieval Module, Question Analysis Module and Exam Paper Generation Module.*

## Keywords

Bloom's Taxonomy, Question Bank, classification, Web application

## 1. INTRODUCTION

Assessment plays an important part in the teaching-learning process at all levels of education. The main purpose of classroom assessment is to improve learning (Gronlund, 1968). Since assessment plays such an important and significant part in the future of students, there is no doubt that any assessment system will determine what students learn and the way in which they do this. Hence assessment will also determine the way in which we teach and what we teach. Education and assessment is related to each other. Without assessment, we have no other technique to know the significance or the effectiveness of learning experience to achieve the desired goal. Examination is one of the common methods to assess knowledge acceptance of the students. Based on the examination result, student's thoughts skills and behavioral can be developed.

Written examination is a conventional yet universal tool to evaluate the student's performance in education area. Whether or not the written examination able to assess the student's ability is very much depends on the questions deposited in the examination paper. A good examination paper must consist of

various difficulty levels to tolerate the different capability of students. This is consistent with the objective of examination to categorize the students into groups of good, average and weak. One way to achieve this is to apply some guidelines into it. Therefore, this paper tries to adopt Bloom's Taxonomy concept in designing the good examination question paper.

## 2. BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system of educational objectives based on the level of student understanding necessary for achievement or mastery. Educational researcher Benjamin Bloom and colleagues have suggested six different cognitive stages in learning from the simple recall or recognition of facts, as the lowest level, through increasingly more complex and abstract mental levels, to the highest order, which is classified as evaluation (Bloom, 1956; Bloom, Hastings & Madaus, 1971). There are six levels in the taxonomy as depicted in Figure 1, moving through the lowest order processes to the highest.

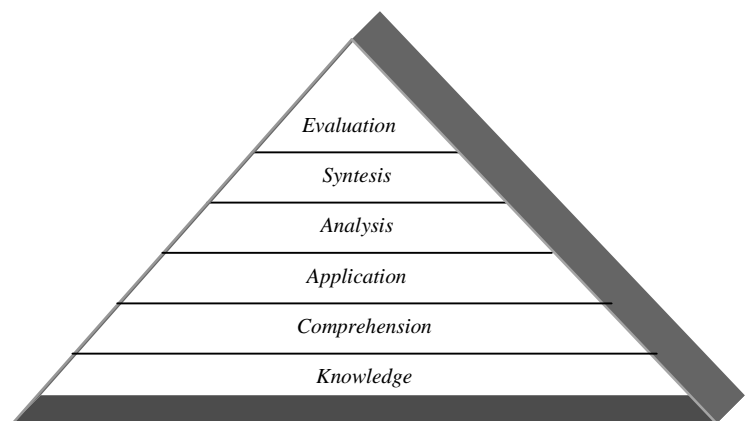


FIGURE 1: Bloom's Taxonomy Levels

The six developmental levels pertaining to the acquisition of knowledge and of intellectual analysis and skills are knowledge, comprehension, application, analysis, synthesis, and evaluation.

Verb and question examples that represent intellectual activity on each level are listed as follow:

1. **Knowledge:** arrange, define, duplicate, label, list, memorize, name, order, recognize, relate, recall, repeat, and reproduce state.

*Question verbs:* Define, list, state, identify, label, name, who? when? where? what?

2. **Comprehension:** classify, describe, discuss, explain, express, identify, indicate, locate, recognize, report, restate, review, select, translate,

*Question verbs:* Explain, predict, interpret, infer, summarize, convert, translate, give example, account for, paraphrase x?

3. **Application:** apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, write.

*Question verbs:* How could x be used to y? How would you show, make use of, modify, demonstrate, solve, or apply x to conditions y?

4. **Analysis:** analyze, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test.

*Question verbs:* Differentiate, compare / contrast, distinguish x from y, how does x affect or relate to y? why? how? What piece of x is missing / needed?

5. **Synthesis:** arrange, assemble, collect, compose, construct, create, design, develop, formulate, manage, organize, plan, prepare, propose, set up, write.

*Question verbs:* Design, construct, develop, formulate, imagine, create, change, write a short story and label the following elements:

6. **Evaluation:** appraise, argue, assess, attach, choose, compare, defend estimate, judge, predict, rate, core, select, support, value, evaluate.

*Question verbs:* Justify, appraise, evaluate, judge x according to given criteria. Which option would be better / preferable to party y?

As an Instructional Developer, this taxonomy will help us write assessment questions and excellent course. According to Bloom, et al. (1956), as teachers we tend to ask questions in the "knowledge" category 80% to 90% of the time. These questions are not bad, but using them all the time is. Try to utilize higher order level of questions. These questions require much more "brain power" and a more extensive and elaborate answer.

Susan Edington and Cathy Hunt (1996) discovered that testing should starts with planning out the objectives to be tested-preferably at different levels of Bloom's taxonomy of cognition. Test questions should also be written for different levels of cognition. As a rule, include some questions from all six categories of Bloom's Taxonomy, but make sure no more than 40% are knowledge oriented.

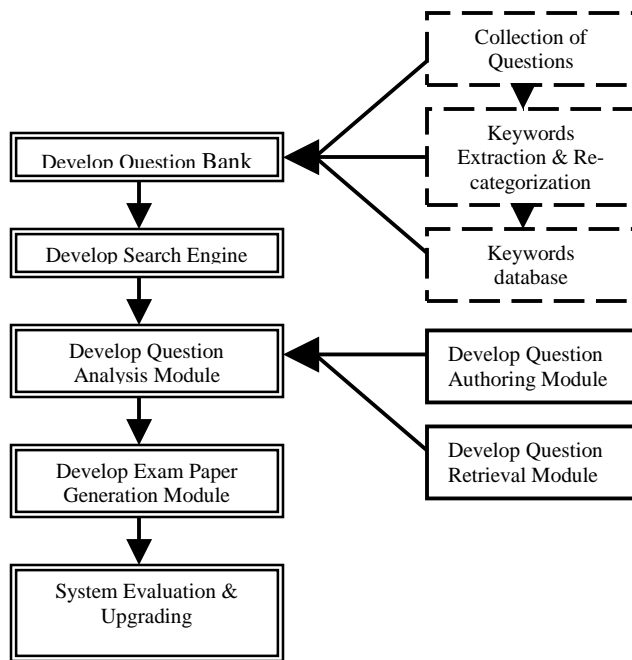
Teachers should not worry too much about the fine distinctions between the six levels as defined by Bloom. For example, comprehension and application are commonly treated as synonymous as it is the ability to apply what is learned that indicates comprehension (Phye, 1997). Most classroom testing theorists and classroom teachers today pay the most attention to the distinction between the knowledge level and all the rest of the levels. According to Phye (1997) also, most teachers, except at introductory stages of brand new areas, prefer to teach and measure to objectives that are above the knowledge level.

### 3. METHODOLOGY

Based on Bloom Taxonomy, each question must have at least one verb (keyword), where this keyword will determine the difficulty level of the question. In accordance, Bloom classified the keywords into six difficulty levels as described in the previous section. Using these concepts, this research will manipulate Bloom Taxonomy as principle to design a good examination question paper.

To start, this research will focus on the Multimedia subject taught in Computer Science discipline. In view of the fact that every subject has its own quality, the keywords categories proposed by Bloom cannot be completely adopted in Multimedia subject. For that reason, all the listed keywords in Bloom's taxonomy must be examined and adjusted to suite Multimedia subject. This exercise will be facilitates by the Multimedia and Bloom Taxonomy experts. The experts will study the Multimedia sample questions, extracting the keywords and re-categorize them to six difficulty levels as proposed by Bloom. Based on the outcomes, a database consisting of keywords, arranged according to the six difficulty levels will be developed. Besides extracting and re-categorizing the keywords, rules/guidelines to design a good examination question paper will also be developed by the experts.

This research aims to develop a system, which is able to find keyword/s in the new draft question, compare it with the keyword stored in the database and specify the difficulty level of the question. This process is applied to every question in the draft examination question paper. The outcomes then, will be used by the system to make overall conclusion on the drafted examination question paper. Figure 2 explains the flow of the system development.



**FIGURE 2: The System Development Flow**

### 3.1 Text Mining

In order to extract the keywords from the questions, text mining technique will be used to identify and extract information and keywords from textual content in the exam paper. The process will involve the preprocessing of the collection of questions, text categorization, keywords extraction and the storage of the intermediate verbs of Bloom's Taxonomy.

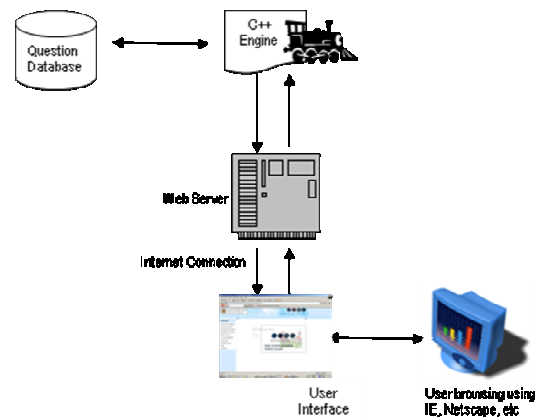
## 4. SYSTEM OVERVIEW

### 4.1 The Development Platform

The system will be developed on a Window-based system using Macromedia Dreamweaver MX and C++. The Dreamweaver MX comes with all the tools required to develop the interface and C++ as the engine to generate the difficulty level of examination question based on Bloom's Taxonomy. The system development will undergo several phases to implement its core modules that including Question Authoring, Question Retrieval, Exam Paper Generation and Exam Question Analysis.

### 4.2 System Architecture

The architecture of the system is based on the client-server computing. The system consists of several components including Database, Engine, Web Server and User interface. Figure 3 illustrated the relationships among the components.



**FIGURE 3: The System Architecture**

#### 4.2.1 Database

The files of database are part of overall system that enables to efficiently store, search, sort and retrieve data. The system uses MySQL database system and SQL (Structured Query Language). This database will store the examination questions, level of difficulties and keywords based on Bloom's Taxonomy.

#### 4.2.2 Engine

The engine will be written in C++. The function of this engine is to categorize the questions which will be retrieved from the Question Bank in the database. The categories are based on the first three level of Bloom's Taxonomy; knowledge, comprehension and application. The engine will retrieve the questions from the Question Bank and compare them with the keyword that kept in the database. The classification process will be done using an imperative rule. This imperative rule tells the system how to behave:

if keyword1+keyword2+keyword3

set question to Level 2

The question's classification is described by a set of rules. A solution for the classification is found by automatically selecting and applying appropriate rules.

#### 4.3 Web Server

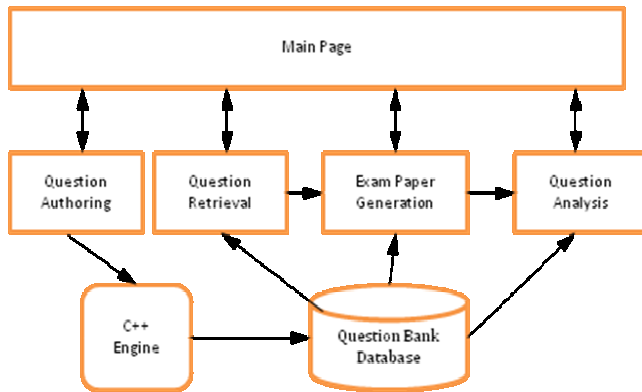
For this project, Apache web server is used to host the web system.

#### 4.4 User Interface

The user interface acts as a medium of communication between users and the system. As the system is a web-based application, the user interface is developed using PHP.

## 5. THE SYSTEM'S FLOW

The system's flow of processing is illustrated in Figure 4.



**FIGURE 4: The System's Flow**

### 5.1 Question Authoring

The user will enter the details of exam questions into the Question Bank. The classification process occurs when the user enter the questions. Using the engine, it will categorize the question based on the keyword provided from the Question Bank and update the information in the database.

### 5.2 Question Retrieval

Retrieval Module facilitates searching and retrieval services of examination question and answer from Questions Bank for lecturers. Besides, this module involved processes of retrieving question information such as the level of question and the status of question

### 5.3 Exam Paper Generation

This module helps the users in preparing the exam paper by selecting appropriate questions, and also providing sample answers. The exam paper produced is pre-formatted according to the exam paper format such as the course name, instruction, page number, and number of questions.

### 5.4 Question Analysis

Lastly, the Question Analysis Module facilitates lecturers to do analysis and generate reports based on questions categorisation in the form of charts. This information will be extracted from the database.

## 6. CONCLUSION

This paper discussed the idea to develop application software that able to classify the examination question difficulty level based on the Bloom's Taxonomy. The system will be able to display the overall presentation of the examination exam paper in terms of format and the distribution of question difficulty levels. Four modules that will be developed are; Question Authoring, Question Retrieval, Exam Paper Generation and Question Analysis. With the implementation of text mining and imperative rules, the question will be categorized according to the level of difficulty. The outcomes from this system can be used as guideline by the lecturer to design/revise the exam paper accordingly. Finally, the lecturer will be able to make analysis of the examination questions set and produce the exam paper based on the UMS format.

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