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# The Use of Bloom's Taxonomy to Inform Students' Cognitive Levels

Siti Nursaila Alias; Faridah Ibrahim

School of Distance Education, Universiti Sains Malaysia, Pulau Pinang

Email: eylaa86@gmail.com

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## *Abstract*

To improve students' conceptual understanding depends on the question types asked by the teachers. This paper investigates to examine form four students' cognitive levels in Newton's Law based on Bloom's Taxonomy. The study sample consisted of 189 science stream students from three secondary schools in Kuala Kangsar, Perak. Researcher implemented Newton's Law questions as instrument to determine the three cognitive levels of the respondent which namely Knowledge, Comprehension and Application. The paper-pencil test was developed and administered on the subject. The data were collected and analyzed using the Statistical Packages for Social Science for Windows release 21 (SPSS Software). The findings show that the mean of the Knowledge, Comprehension and Application level is moderate.

***Keywords:*** Bloom's taxonomy; Newton's Law questions; cognitive levels

## *Introduction*

Physics is known as a difficult subject to comprehend by many students (Angell, *et al*., 2008; Osborne & Collins, 2001; Mazur, 1996; McDermott, 1993). In Force and Motion topic, one of the difficult topics was Newton's Law. Student's achievement in Force and Motion topic is poor (Phang & Noor Izyan, 2012; Thornton, 1998). Most challenging thing for the teacher was the students' prior knowledge, which they might use their own opinions to understand and explain concepts and phenomenas of force based on their daily experiences (Thornton, 1998; Anderson, 1986; Fisher, 1985; Gilbert & Watts, 1983; Helm, 1980).

Bloom's Taxonomy can be used to classify cognitive thought and associated behaviors in six hierarchical levels. The levels identified in Bloom's Taxonomy for classifying objectives and questions were based on the type of cognitive processes required to fulfill the objective or answer a particular question. Classification of objectives and questions were fundamental in guiding student learning. Although Bloom's taxonomy is not the only possible way to classify thinking levels, it is widely known and used in education, and therefore provides a good starting point for teaching higher-order thinking and studying its development. Nonetheless, Bloom's taxonomy was used to move students beyond the stages

of simple recall and literal comprehension (Marzano, 2001). Lower order questions (knowledge, comprehension and application level) were those that were used in imparting the basic or factual knowledge, which must be matched with student's current understanding.

Thus, Newton's Law questions were used extensively to test students' understanding in Newton's Law from three selected secondary school in Kuala Kangsar, Perak. This study intends to analyze students' ability in answering Newton's Law questions at different levels of thinking. The purpose of this study is to determine the students' cognitive levels in answering Newton's Law.

## *Methodology*

### *The Subjects*

A total of 189 science stream students in Kuala Kangsar, Perak participated in this research. They were from similar academic backgrounds and have been exposed to answer Newton's Law questions.

### *The Instrument*

A paper-pencil test was developed by the researcher and administered to 189 form four physics students. The paper-pencil test was constructed after reviewing the study courses in order to ensure that the test questions were related to subject matter which had been part of the students' instruction. The paper-pencil test was designed and it consisted of 13 open-ended questions. The test scores were collected and analyzed. The mean of the cognitive levels were analyzed quantitatively.

## *Results*

The students' performance in the test varies according to the levels of thinking process. Students performed better in questions with low level thinking process (knowledge, comprehension and application) compared to high order questions. Based on Table 1, the mean for Knowledge level was 2.37 and standard deviation was 0.504. For Comprehension level, mean was 2.12 and standard deviation was 0.666. Mean for Application level was 2.26 and standard deviation was 0.620.

Table 1 Means and Standard Deviations for Cognitive Level

| Cognitive Level | Mean | Standard Deviation |
|---|---|---|
| Knowledge | 2.37 | 0.504 |
| Comprehension | 2.12 | 0.666 |
| Application | 2.26 | 0.620 |

The findings indicate that the level of thinking processes advocated by Bloom taxonomy has influenced the achievement of the students in Newton's Law. It seems that all of them faced with the same difficulties when answering lower level questions especially questions at level 1, 2 and 3 (knowledge, comprehension and application). Knowledge level is the first level in Bloom's Taxonomy and certain knowledge was found to be very difficult. The findings concluded that the mean values of the Knowledge, Comprehension and Application level is moderate.

As a result, on one hand; success of students is rather low on Newton's Law questions. On the other hand, teachers thought that topic was difficult to understand as a lesson. So, researchers have found that the teaching strategy for Newton's Law was important in developing students' better understanding. Teachers generally ask lower-order and superficial questions to escape from various types of inquiries from students and make students perform well on examinations. Therefore, the cognitive challenge of exam questions can strongly influence students' study strategies (Gardiner, 1994; Scouller, 1998). If teacher primarily discusses facts and details in class but test at a higher cognitive level, students often perform poorly on examinations because they have not been given enough practice developing a deep conceptual understanding of the material. Similarly, if classroom activities focus on concepts requiring higher-order critical cognitive skills but lecturer test only on factual recall, therefore students quickly learn that they do not need to put forth the effort to learn the material at a high level.

## *Discussion*

### *Knowledge of Terminology*

In this level, students are required to recall facts pertaining to the topic that has been taught. Some students reported that they faced problem to recall some information, though they can easily absorbed something without understanding it. For instance, defining terms has become a difficult task for students. Abstract definitions in Newton's Law make it difficult to maintain the meaning in their mind. Most students often performed poorly in the examinations because they had problem in memorizing the correct answers. According Connel (1981), there are some students often using rote approach in the learning process, especially in science. Most of them only memorise the examples of the problem and how to solve it without a proper understanding of the relevant processes or relationships. This situation occurs because student is not able to link the past knowledge with the new learning based on mastery of concepts and a clear understanding. As a result, students cannot produce a pattern of good and effective learning strategies.

### *Grasping the Meaning*

Comprehension questions required students to process the prior knowledge in the mind in order to answer the questions. Students are required to rewrite and explain in a meaningful manner of something that they have learned. The key is that students had demonstrated the Newton's Law from a personal, rather than a formal externally driven one. They demand a higher level thinking and information processing compared to work with knowledge type of questions. At this level, students reveal an understanding of relationships and are able to alter and advance information above the way it was presented. The Bloom team recognised this as being more difficult than the first level. Students are weak in capturing this level because students still cannot be controlled with a good level of knowledge. At the level of understanding, students still dominate the behavior of the student interpreter cannot provide interpretation or meaning of any information, which is to interpret a diagram or explanation of the information received.

### *Solving Problem*

In the third level, students are required to think holistically about the concepts in a new situation. Questions in this area required students to use their existing knowledge and understanding to solve a new problem. Students can select relevant physics information from their own knowledge to apply their understanding in familiar and unfamiliar or novel physics situations. This level can be controlled to settle well when students are able to control the levels of lower level of knowledge and level of understanding. However, the findings of the study shows students are still weak and fail to dominate the stage well and students are unable to apply and understand the methods, theory, principle or abstraction used. In addition to the factors students did not achieve a good level of cognitive development is due to students' inability to understand or distinguish between a situation with other situations. Misinterpretations of generalisation in the interpretation of the question are one of the factors that enable students to achieve a good level.

### *Conclusion*

To solve these kinds of problems, the best way to introduce Newton's Law is by changing the strategy of teaching for enhancing higher order thinking (Alice, 2010). Teacher should be taught the concept explicitly to make sure students understand the critical features that define a particular concept and distinguish it from other concepts. Furthermore, when teaching abstract concepts, the use of concrete materials can reinforce learning for students. It can be helpful to move from concrete to abstract and back to concrete. If students were able to state an abstract concept in terms of everyday practical applications, then that person has understood the concept. Consequently, teachers should lead students through the process of connecting one concept to another and also putting concepts into a hierarchy from small to large. By doing these levels of thinking, students learn to see how many connections were possible, to connect to what they already know that helps them gain clarity and understanding. Students should be encouraged to engage in elaboration and explanation of facts and ideas rather than rote repetition. Teachers need to help them to relate new information to prior experience and talk about various future applications of what they were learning. A good question during teaching will provides an opportunity for students to express their ideas and thoughts (Wilen, 1986). Therefore, teachers can evaluate their students' understanding for this topic. All related teachers should prepare the questions together and they should pay more attention in choosing questions from various cognitive levels. When using the questioning technique, provide sufficient wait time for students to allow them to think critically and entertain thoughts. Finally, questions can be used to summarize and reinforce a class lesson. This will help students to transfer the information into the long-term memory. By using questioning technique during teaching process, it will develop students' cognitive skill.

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