Identifying Pupil's Cognitive Level in Fractions Using Bloom's Taxonomy

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Abstract

Fractions have a distinct new way of interpretation and do not represent absolute amount as the more familiar whole numbers and this will created problems among pupils. Pupil's cognitive level in fractions still at a very low level because there were many misconceptions occur among pupils in school nowadays. In this paper, Bloom's taxonomy is used to measure pupil's cognitive level and thinking skills in fractions. Fractions questions were built on according to the level of Bloom's taxonomy based on the cognitive domain. The lowest three levels of Bloom's taxonomy will be the most priority in this paper. The data were analyzed using SPSS and the frequencies of pupils who got the correct answer were recorded.

Keywords: Bloom's Taxonomy, fractions, cognitive load, cognitive domain.

1. Introduction

Pupils are consciously and unconsciously being exposed to fractions since the beginning of their schooling. In Malaysia, fractions were introduced during pupils were in Year 3 of primary school in Mathematics subject. Fractions are notoriously difficult and can pose many difficulties (Newton, 2008; Tanner 2008; Peck & Jencks, 1981; Steffe & Olive, 1991; Baroody & Hume, 1991; Charles & Nason, 2000). This was because fractions have a distinct new way of interpretation and do not represent absolute amount as the more familiar whole numbers. Hasemann (1981) also stated that fractions recognized to be a difficult topic because of the difficulties in describing fractions.

According to the difficulties of fractions, researchers are bombarded with the demand for identifying the cognitive level in learning fractions among primary school pupils in Malaysia. The pupil's cognitive level was identified using Bloom's taxonomy according to the cognitive domain. The cognitive domain represents the development of mental skills or knowledge (Asım ARI, 2011). This classification of the cognitive domain or category is a multi-tiered model of classifying thinking according to six cognitive levels of complexity (Krathwohl, 2002). The lowest three levels include: knowledge, comprehension, and application. The highest three levels are: analysis, synthesis, and evaluation as shown in **Figure 1** (Wang & Farmer, 2008; Halawi, Pires & McCarthy, 2009).

The lowest three levels had been the priority in this study. It is because, for the concept of fractions there exist many rules, and these are more complicated than whole numbers. Karen Tanner (2008) also through the conversations with pupils and previous teaching experiences was aware that many pupils struggle with understanding fraction concepts because they would have difficulty with reading, renaming, ordering, interpreting and applying common fractions, fraction computation and equivalent fractions although this concept was at lower levels of cognition.

2. Problem Observing

A simple study had been done to two of the primary school in Malaysia in order to observe the cognitive level of pupils from the Fractions classes.

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Questionnaires were distributed to 200 Standard 4 pupils that were chosen randomly from these two primary schools. It consists of subjective questions based on fractions topic that pupils must answer the questionnaires based on the knowledge that being teach by their teachers. These sets of questions were developed according to the Malaysian Standard 4 (ten years old) Mathematics syllabus and Bloom's taxonomy level.

There were four sets of questions about fractions consist of: name, write, and draw fractions in words and numerals, comparison of fractions, equivalent fractions, and simplify fractions. Each question in each set was developed according to the lowest three levels of Bloom's taxonomy. Pupil's feedback answers were analyzed. The numbers of pupils who can answer each question was obtained.

3. Result and Discussion

The first domain in the lowest levels is **knowledge**, which is defined to the recall of previously learn fractions. Pupils are required to remember facts, principles, and steps in a sequence, and other information in the same way in which the fractions was presented in class (Castle, 2003; Eber & Parker, 2007).

Table 1 shows the data obtained from the study. From the observation, only 84 out of 200 pupils get to answer it correctly for question 1. 116 of them having misunderstanding conception on their answer about naming, writing and drawing fractions in words and numerals. For question 2, only 68 pupils get to answer it correctly.

Pupils cannot represent ½ and ¼ in words. They cannot recognize fractions terms in words. For example, ¼ was translated as one quarter, but they cannot represent it because the word 'quarter' is not represent as numeral in words like fifths, sevenths and etc. Some pupils only can represent ¼ as one fourth because they understand what is fourth and the word fourth is represent as numeral in words.

These show that most of the pupils do not understand the basic concepts of fractions. The large percentage of pupils lacking basic fractions skills has troubled researchers for decades (Hecht, 1998; Mix, Levine & Huttenlocher, 1999; Yoshida & Sawano, 2002). This problem still plaguing pupils until now although the questions were in the knowledge level according to the above results.

The second domain in the lowest levels is **comprehension** which refers to the understanding of learned fractions. Pupils must show their ability to grasp or construct meaning from fractions by explaining, interpreting, translating to a new form or symbol system, and extrapolating (Castle, 2003; Krathwohl, 2002).

Only 84 and 36 pupils as shown in **Table 1** got the correct answer for comprehension level in question 3 and question 4. Once the pupils cannot answer the lowest level questions it is hard for them to continue to the next level (Eber & Parker, 2007). Almost less than half pupils can answer the question in comprehension level under comparison of fractions, equivalent fractions and simplifying fractions.

Pupils did not know the procedures for simplifying fractions and how to divide the given fractions to the simplest form. Some pupils simplify the given fractions but not in the simplest form. Overall, it shows that pupils facing problem with the existed learning process which causing a lack understanding even the basic concepts of fractions.

The last stage in the lowest level was **application** which refers to the ability to use learned fractions, or to implement fractions in new and concrete situations (Krathwohl, 2002; Castle, 2003). From the observation, only 34 and 5 out of 200 pupils get to answer it correctly in comparison of fractions for question 7 and 8.

Pupils who can write and draw fractions correctly were not necessarily able to compare the fractions in correct techniques. Usually pupils used the wrong concepts in comparing the fractions. They must grasp the basic concept of fractions before they go to the highest level of questions.

4. Conclusion

Pupil's cognitive level in fractions was still low although the questions were in the lowest levels. As teachers, they are having to constantly evaluate how well their pupil is progressing to determine when it is time to move on or when reinforcement is required. The most important levels were the lowest levels because once pupils mastering the lowest levels they can answer any questions from the highest levels (Eber & Parker, 2007). While using Bloom's taxonomy in the classroom, teachers must make sure that their pupils had passed the lowest level before entering the highest levels. So that pupil's cognitive level will reach to the highest levels.

5. References

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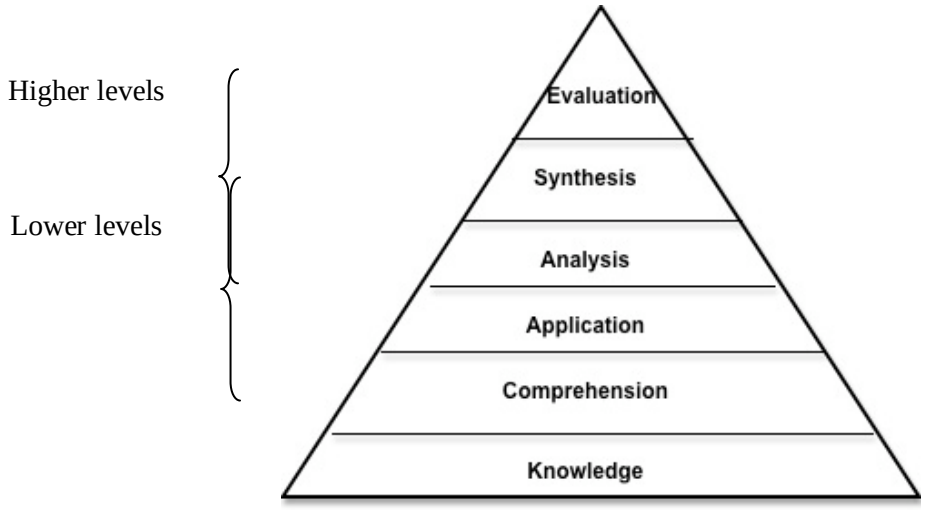

Figure 1. Bloom's Taxonomy of the cognitive domain (Bloom, 1956).

Table 1. Number of pupils that got the correct answer for each lowest levels of Bloom's taxonomy

Sets of questions / Category/Level	Name, write, and draw Fractions in words and numerals	Comparison of Fractions	Equivalent Fractions	Simplify fractions
	Percentages of pupils			
Knowledge	Q1- 84 Q2- 68	-	-	-
Comprehension	Q3- 84 Q4- 36	Q5- 58 Q6- 18	Q9-45 Q10-18	Q11- 27 Q12- 16
Application	-	Q7- 34 Q8- 5	-	-