Cognitive Level of Nepalese Students:

A Meta-analysis of National Assessment of Student Achievement

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Abstract

This article is prepared by analyzing the available database: comparative study of the published report "The National Assessment of Student Achievement (NASA)" 2011 of grade 8 and 2012 of grade 3, 5 in Nepal. Large number (1,28,914) of randomly selected school students had participated in the assessment. Nepali and Mathematics in grade 3, Nepali, Mathematics and English in grade 5 and Nepali, Mathematics and Social Studies in grade 8 were assessed. As the eight reports of two big research volumes were compared, then analyses the role of meta-analysis. This article aims to explore the status of cognitive level wise achievement in different subjects and different grades in order to explain the extent of cognitive development of Nepalese students. Analysis of Variance (ANOVA) shows significant variation in achievement between the cognitive levels in all grades and subjects. Students are found able to recall the memorized facts and concepts and also respond to accomplish the problems of comprehension level. However, they have achieved low in application and higher ability requiring problems. Similar trend of high achievement in low cognitive domain in all subjects and all grades and vice versa is the major finding of this research.

Key words: Bloom's taxonomy, Cognitive ability, NASA results, Lower order skills, Higher order skills, National assessment.

Background

This article is based on meta analysis of two national assessments, 2011 and 2012. In 2011, grade 8 subjects viz three subjects : Nepali, Mathematics and Social study were assessed in 25 districts on sample basis. In the following year, NASA 2012 of grade 3 in Nepali and Mathematics, grade 5 Nepali, Mathematics and English was administrated. These assessments were large sample assessments, more than 48000 students in grade 8 and more than 80000 students in grade 3 and 5 were participated in the test. Such national assessments are considered reliable methods of identifying gaps and problems of school level educational system and reform the national level policy. In this regards, early grades assessment is considered more crucial because there can be possibility to intervene the weakness of the individual students and improve the latter school years of the low-performing students. (Kafle & Metsämuuronen, 2013).

In this article, analysis of data, extraction of findings from main report of those subject was done based on the cognitive level of questions if they are knowledge, comprehension, application, analysis, synthesis and evaluation level. Among those six levels, higher ability is a grouping level which comprises analysis, synthesis and evaluation which are the higher order skills defined by Benjamin Bloom categorized in 1956 which was created in 1948 (Bloom's Texonomy - Learn NC, 2015). Bloom's taxonomy is very useful and relevant to the planning and design of education and training courses, teaching and lesson plans, learning and development within every aspect of education (Hasan, Naomee, & Bilkis, 2013). NASA Unit have exactly followed Bloom's taxonomy while preparing the test items and analyzing them. In this context, this

report is trying to compare the ability shown by students of different grades 3, 5 and 8, which is still undone based on the NASA database and report.

Literature Review

Classroom assessment is necessary to facilitate learning. "Most efficient and effective student learning will result when classroom instruction and materials align with objectives or standards" (Bumen, 2007, p. 442). While analyzing National curriculum of Nepal, three types of fundamental contents are found – theoretical, practical and experimental (in science). Based on the type of cognitive skill required to developed, three major levels of content matters are identified by (Gettinger & Lyon, 1985, p. 13) namely (a) tasks that require knowledge of specific facts, (b) tasks that require comprehension of basic concepts and principles, and (c) tasks that require application of facts, concepts, and principles to novel problem-solving situations. Those three kinds of cognitive skills are also the level of skills aimed by National curriculum of Nepal which can be realized from the specification grid published from Curriculum Development Centre (CDC).

Figure 1: Bloom's Taxonomy and Cognitive level

Level	***Definition***
Knowledge:	*Recall and remember information.*
Comprehension:	*Understand the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words. Establish relationships between dates, principles, generalizations or values*
Application:	*Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the workplace. Facilitate transfer of knowledge to new or unique situations.*
Analysis:	*Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences.*
Synthesis:	*Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure. Originality and creativity.*
Evaluation:	*Make judgments about the value of ideas or materials.*

Source: Paul, R. (1985)

Those levels can be utilized for both teaching and evaluation in education field. In this context, Nepali teachers are not found aware of those levels while teaching and testing, which can be easily observed general class room practices and examination question papers. Most of the questions of teacher made tests are based on lower skills (knowledge, comprehension and application), out of that knowledge is the majority. It is assumed that if students are not given an opportunity to learn within the higher levels of cognition, it does not make sense to test them in that area" (Eber & Parker, 2007, p. 45; Furniss, 2015). Bloom (1956) defined those skills as hierarchical level because without lower level skill, it is difficult to develop higher order skill. Figure 1 illustrates the different cognitive levels under the order or Bloom's Taxonomy.

While there is a recognized demand to have higher-order thinking practice in the classroom, there is also a recognized instructional struggle with bringing higher-order thinking to life in the classroom" (Marimuthu, Michael, Muthusamy, & Veeravagu, 2010; Furniss, 2015). Educationists are found agreed in a point that students achieving high score in higher order skill means mastery of the educational objectives and vice versa.

Data and Methods

Grade eight assessments were the first large scale National Assessment where 48,682 students participated in NASA 2011 which comprises 16,033 in Mathematics, 16,350 in Nepali and 16,299 in Social Study. In the consecutive test (NASA, 2012), 13714 students participated in Mathematics, 13971 in Nepali and 1379 in English from grade 5. Similarly from grade 3, 19,252 students participated in Mathematics and 19,501 participated in Nepali. Hence, this article is based on the data of 1,28,914 students altogether from the randomly selected from all sampled 50 districts (25 in NASA 2011 and 28 in NASA 2012, Kathmandu, Lalitpur and Bhaktapur were repeated).

All subjects assessed had three versions V1, V2, V3. Items were categorized in to four categories knowledge, comprehension, application and higher ability. In all subjects, items were developed based on the learning objectives defined by National curriculum set by Curriculum Development Centre (CDC) in all subjects. Special attention was taken so that text book problems were avoided in the test to measure developed ability of the students, not to see how much they know textbook. Pre-tested and final revised items were reliable enough (Cronbach alpha >0.88) in all subjects. All the tests as whole was constructed based on Bloom's taxonomy of hierarchical cognitive levels (Bloom *et al.,* 1956; Metfesser, Michael, & Kirsner, 1969), that is, *knowledge*, *comprehension*, *application*, and *higher ability* (reasoning/problem solving). The achievement of the students on the hierarchical levels is shown in Tables and figures.

Based on the category, all versions and items were calibrated with International TIMSS (Math and Science), PISA (Nepal grade 8) and PERLS (Nepali and English grade 3 and 5) parameters (beta parameters ie, difficulty level in terms of standard normal score -3 to 3). Versions were equated and scores were converted into the percentage of maximum score of each version. Each version equated score of each level was supposed 100% and based on that score Mean score was compared by using Analysis of Variance (ANOVA).

Results and Discussion

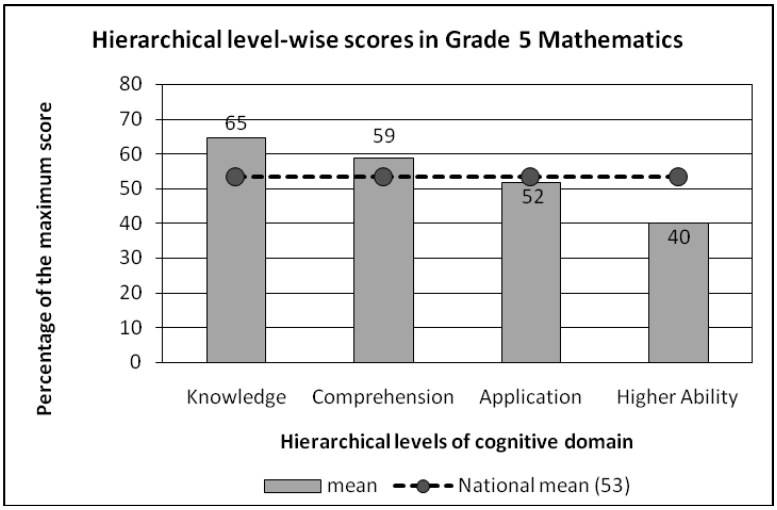
Results from all eight tests containing each test – three sets of questions were equated to make the results comparable. Based on the equated score, different cognitive levels were compared against the achievement score. Achievement scores were statistically significant in each subject based on cognitive level at 95% confidence, so is not stated individually in each subtopics below.

Cognitive level wise achievement

Considering whole mathematics curriculum of grade 3, geometry, numeracy, arithmetic, algebra, sets and algebra were sub-categories made to assess, which covered total contents. There were sufficient items in knowledge, comprehension and application, however, only one item was found at higher skill. So, application and higher ability items in grade 3 mathematics were grouped in a single set during the Item Response Theory (IRT) modeling.

All hierarchy level wise achievement score are presented in table 1. For the visualization and representation of all subjects, achievement score of grade 5 Mathematics is presented in figure 1

Figure 1 Achievement in different cognitive levels on grade five Mathematics



Source: NASA report, 2012

In grade 5, mean achievement in Knowledge level items was 65%, Comprehension 59% and Application 52% higher ability 40% which **is** shown in figure 1. The horizontal line represents the national mean (54%) of this subject. Remarkably high a number of students were able to solve only couple of practical problems, that is, 5 out of 26 marks of the application type of items (12% of the students). 40% of the students could gain just one mark out of 5 in the tasks requiring the higher cognitive abilities and 20% of the students did not solve any of these tasks. This scenario is quite similar in all grades and all subjects in those national assessments.

In the similar manner, cognitive level wise achievement score is tabulated in table below

Table 1: Cognitive level wise achievement mean score

Grade	Year	Subject	Cognitive level			
			Knowledge	comprehension	Application	Higher ability
Grade 3	2012	Nepali	72	65	56	37
Grade 5	2012	Nepali	71	63	61	47
Grade 5	2012	English	64	50	49	35
Grade 8	2011	Nepali	74	54	46	42
Grade 8	2011	Social Study	52	66	40	34
Grade 8	2011	Math	68	55	38	21

The table shows that as the cognitive level becomes higher, achievement level decreases accordingly. This problem is more serious in Mathematics. In Mathematics grade 8, there is highest achievement (68%) in recall type problems where as only 21% achievement in higher

ability problems. This is a wide gap in learning.

Subject and Cognitive level wise comparison of achievement

Mathematics dataset and results show that achievement of student based on different cognitive level differs grade wise which is illustrated in figure 2.

Figure 2: Cognitive level wise achievement in Mathematics

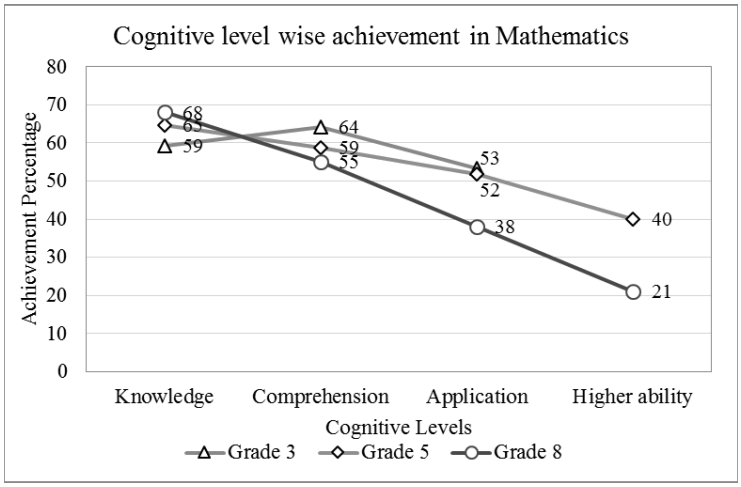
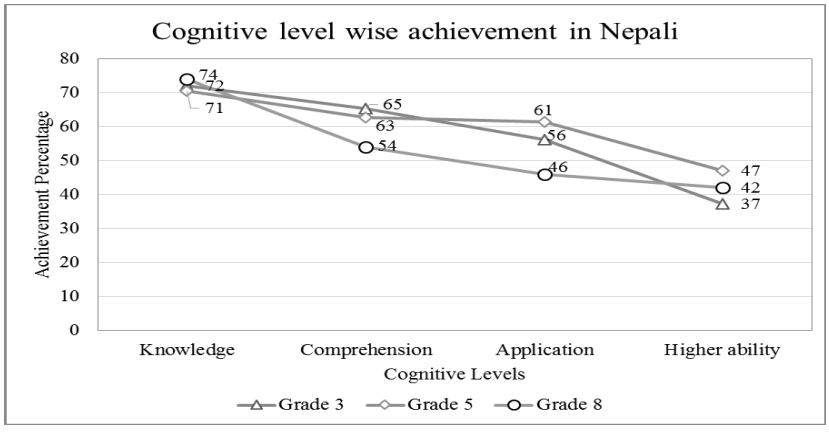


Figure 2 hints that cognitive ability of students differs grade wise. As the grade increases, higher order skills are decreasing. This does not necessarily show that higher grade students do not have higher skill than lower grades. However, it reveals that as the grades are higher, curriculum demands higher skills. Both teacher and students have sufficient time to exercise and discuss more in lower grades. In higher grades, content weightage is heavier, and hence there is less time to discuss rather than doing routine exercise and practicing for the examination and memorizing (Kafle & Metsämuuronen, 2013).

Figure 3 Cognitive level wise Achievements in Mathematics



Nepali language dataset also reflects the similar pattern like in Mathematics - students were performing best in knowledge level items where as poorest in the higher ability. Overall, scenario of performance in Nepali is alike in all grades, as the cognitive level increases achievement decreases. Difference in Nepali than in Mathematics is that students are able to show better performance in higher order skill compared to Mathematics. Similar pattern can be seen in Social study and English language too.

Conclusion

In Mathematics, students are able to do basic calculations associating with knowledge level and comprehension level. They are weaker in application level of items and are weak in reasoning, problem solving, plotting, proving theory or formula, and in constructing shapes and figures. In Nepali, students performed well when called upon to recognize the correct answer, in recalling simple facts from the texts, fundamental thinking, the basic interpretation of a paragraph, tables, charts, and in logical thinking that required only a few steps. However they are much weaker in producing fluent texts or letters, and in preparing synthesis and abstracts from a text. In Nepali, the students did attempt open-ended tasks but the skills were not high enough for the highest skills. In Social Studies, students are good in recognizing the correct answer, in very fundamental knowledge/content, in true or false questions, matching texts, and in the selection of words for gap fill activities. They are much weaker in reasoning, problem solving, and in constructing arguments.

If students are not given an opportunity to learn within the higher levels of cognition, it does not make sense to test them in that area (Eber & Parker, 2007, p. 45; Furniss, 2015). Bloom (1956) defined those skills as hierarchical level because without lower level skill, it is difficult to develop higher order skill. While there is a recognized demand to have higher-order thinking practice in the classroom, there is also a recognized instructional struggle with bringing higher-order thinking to life in the classroom" (Marimuthu, Michael, Muthusamy, & Veeravagu, 2010; Furniss, 2015). This means that Nepalese teachers don't use higher order questioning while teaching in the classroom situation. They don't engage students in applying learnt knowledge and skills in practical situations, discuss critically, reason the situations, solve the problems themselves, show creativity. From the results of all eight tests, it can be concluded that achievement of students decreases as the level of cognitive domain goes to higher order, meaning that students are very good in recognizing the facts, remember the facts. Also, they are good enough in comprehending and solving simple problems in all subjects. As they come to the application level items, they are showing lower performance, meaning that they are weak in applying learnt knowledge and skills in new situation, not able to solve the problems involving more than one step, draw the pictures and label it, write paragraphs on a given topic, write application, describe pictures etc. based on the specific subject matter. Lowest performance in higher ability items shows the most weak performance in creative types of items, logical answering situation, give reason, prove, justify, etc. in all grades and all subject. This does not reflect only the ability developed by students, but also the performance and way of teaching by the teachers

Implication and way forwards

Overall, meta-analysis of the eight tests reflects that the achievement of students decreases

as the level of cognitive domain goes to higher order, meaning that students are very good in recognizing the facts, remember the facts. Also, they are good enough in comprehending and solving simple problems in all subjects. As they come to the application level items, they are showing lower performance, meaning that they are weak in applying learnt knowledge and skills in new situation, not able to solve the problems involving more than one step, draw the pictures and label it, write paragraphs on a given topic, write application, describe pictures etc. based on the specific subject matter well. Lowest performance in higher ability items shows the weakest performance in creative types of items, logical answering situation, give reason. Following general ways can be implemented to gear up those weaknesses.

1. A reform in teaching and learning process is necessary to improve the quality of education so that achievement in all order skills can be geared up.
2. Quality input in learning experience is required in the class room. For this teachers should focus in providing activity based learning, developing creativity and individual performance.
3. More focus should be given in asking higher order thinking requiring questions and discussion.
4. Students should be involved in project work, group work, field observation to learn themselves and make their own ideas towards environment and learnt matters.
5. Teacher training should focus the practical and daily life aspect of content matter which they are teaching.
6. Curriculum content and text books should be revised from the prospective of higher order skill development.

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