

Evaluation Using the Cognitive Levels of Bloom's Taxonomy of Educational Objectives

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Abstract

Planning, teaching and assessment stages are used to achieve educational aims, where assessment is the crucial stage in determining students' conceptual development. Written examination is a conventional yet universal tool to evaluate the student's performance in a subject area. Teachers tend to ask questions in the 'knowledge' category 80% to 90% of the time. If this trend continues, the quality of education will go down. A good and reasonable examination paper must consist of various difficulty levels to accommodate the different capabilities of students. A teacher needs to develop a repertoire of questions that generate higher order thinking skills such as the following, 'What do you already know? What do you really think about this situation?'. If we can gradually adjust our way of teaching and questioning towards higher order cognitive skills, it will surely improve the quality of our questions. Using Bloom's Taxonomy to help design examinations and analyze the results could greatly improve the quality of assessment in education.

Key Words: *Evaluation, Bloom's Taxonomy, Cognitive Levels, Higher Order Thinking Skills, Examination Questions.*

What is Evaluation?

Evaluation is the process of ascertaining or judging the value or amount of something by careful appraisal. In education, it is

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a study designed to determine the effectiveness of instruction. The primary concern of evaluation is to bring about improvement in the teaching-learning process so that the learner develops his potential to the optimum level. Evaluation aims to make judgements and decisions about students' and teachers' effectiveness. It provides empirical evidences about the effectiveness of teaching strategies, tactics and aids and suggests modifications and improvements for remediation.

Need for evaluation in education

Some important aims of education are:

1. To provide students with lasting learning of concepts.
2. To prepare them for the demands of the knowledge economy and help them make substantial contributions.
3. To improve their knowledge and thinking skills such as critical thinking and problem solving ability, decision making skills, communication and collaboration skills, creativeness and intuitiveness, etc.

Experts have given four pillars of quality education, namely:

- 1) curriculum development & design,
- 2) classroom teaching-learning/curriculum transaction,
- 3) students' level of learning and learning styles, and
- 4) evaluation/assessment of learning outcomes.

These four pillars of education are closely interlinked with each other. In order to have a sound educational system, these areas need to be given equal attention and focus by educational administrators, curriculum planners, teachers and other concerned personnel. A regular and qualitative evaluation of various aspects of the educational system is needed. Then only the aims and objectives of education will be successfully achieved and the quality of education will be greatly improved.

Bloom's Taxonomy of Educational Objectives

Bloom's Taxonomy of Educational Objectives is a classification of learning objectives within education proposed in 1956 by a committee of educators headed by Benjamin Bloom, the famous American educationist. The word 'taxonomy' simply means 'classification of things arranged in a hierarchical order'. Bloom's Taxonomy is a hierarchy of skills that reflects the growing complexity and ability to use higher order thinking skills. Bloom's Taxonomy divides educational objectives into three domains: Cognitive (knowing/head), Affective (feeling/heart) and Psychomotor (doing/hands). Within the domains, learning at the higher levels is dependent on having attained prerequisite knowledge and skills at lower levels (Bloom, Engelhart, et al, 1956). The cognitive domain is considered to be the most important among the three domains in relation to education. A brief explanation of the cognitive domain and its different levels is provided in the following paragraph.

Cognitive Levels of Bloom's Taxonomy

The Cognitive domain in Bloom's taxonomy involves knowledge and the development of intellectual skills. Bloom's Taxonomy is a multi-tiered model of classifying thinking according to six cognitive levels of complexity, which are listed in order starting from the simplest behavior to the most complex. These levels are knowledge, comprehension, application, analysis, synthesis and evaluation (Don Clark, 2010). The categories can be thought of as degrees of difficulties, that is, the first ones must normally be mastered before the next ones can take place. The six cognitive levels are briefly explained as follows:

1. **Knowledge** - Remembering or recalling of previously learned material.
2. **Comprehension** - Grasping or understanding the meaning of informational materials.

3. **Application** - Use of previously learned information in new and concrete situations to solve problems.
4. **Analysis** - Breaking down of informational materials into their component parts, examining such information to develop divergent conclusions, making inferences, and finding evidence to support generalizations.
5. **Synthesis** - Creatively or divergently applying prior knowledge and skills to produce a new or original whole.
6. **Evaluation** - Judging the value of material based on personal values or opinions, resulting in an end product with a given purpose.

Evaluation using the Cognitive Levels of Bloom's Taxonomy

Out of necessity, teachers must measure their students' abilities. Evaluation of the effectiveness or results of teaching is a very important task. It is the crucial stage in determining whether students' conceptual development has reached Higher Order Cognitive Skills or not. Improving students' conceptual understanding depends on the question types asked in examinations by the teachers. A good assessment system will determine what and how students learn as well as what and how we teach. The art of skilful questioning is an effective key to promoting higher-order thinking skills of students

Higher-order thinking is an instructional strategy supported by research. Often referred to as critical thinking skills, it is more than simple recall of facts or information retrieval but rather a function of the interaction between cognitive strategies, meta-cognition, and nonstrategic knowledge during problem solving.

Higher-order thinking skills are “goal directed, multi-step, strategic processes such as designing, decision-making and problem solving” that require analysis, evaluating, connecting, imagining, elaborating and synthesizing (Iowa Department of Education, 1989). Higher-order thinking is based on the concepts in the cognitive domain of Bloom’s Taxonomy and suggests that some types of learning require more cognitive processing than others. Bloom’s Taxonomy suggests that skills involving analysis, synthesis and evaluation are of a higher order, requiring different instructional practices. It also suggests that higher-order thinking involves “the learning of complex judgmental skills such as critical thinking and problem solving.” Higher-order thinking is thought to be more useful because such skills (analysis, synthesis) are considered more likely to be useable in situations other than those in which the skill was initially learned (Burton, 2010).

While questioning is identified as one of the most effective instructional strategies, research on questioning indicates that the use of questions by teachers is predominantly low level. Researchers suggest that professional development on the effective use of questioning strategies and the development of high-level questions is helpful to teachers. Teachers ask hundreds of questions every day and it is important that they use questioning techniques that challenge the thinking of all of their students.

Here are five important teaching tips for high-level questioning (Burton, 2010):

1. Require all learners to answer the question. Instead of simply asking a question and having one or two students raise their hand to answer, the teacher should have all students write down an answer to the question. This way the teacher has gotten all of her students involved in the question and answer process. Or, instead of having all students write their answer, the teacher could simply ask the question and have all students share their response with a partner.

2. Require students to defend, or back-up, their answers.
3. Use Bloom's Taxonomy to create high-level questions. For example, instead of asking,

“Which U.S. President authorized the use of the atomic bomb at the end of World War II?”, a

teacher could ask, “Was President Truman justified in using the atomic bomb to end World

War II and why do you think that?”

4. Differentiate questions as appropriate.
5. Promote examination of new and different perspectives. For example, instead of asking,

“What happened at Hiroshima and Nagasaki?”, a teacher could ask, ‘How would you have reacted when you heard the news about the atomic bombing of Hiroshima and Nagasaki?’”

Bloom's Taxonomy was intended as a method of classifying educational objectives, educational experiences, learning processes and evaluation of questions and problems. These led to a natural linkage of specific verbs and products with each level of the taxonomy. Bloom created this taxonomy for categorizing level of abstraction of questions that commonly occur in educational settings. The Taxonomy Table given below gives a clear picture of the expected learning outcomes in each level and how to achieve them.

Table I: Bloom's Taxonomy Table (Cognitive Domain)

Cognitive Levels with expected outcomes	Key Verbs to use in each level with model questions
<p>Knowledge Level: Questions in this level should relate to testing of knowledge. Students should be able to remember or recall data or information.</p>	<p>Key Verbs: what, why, where, when, who, which, how, state, mention, give, define, recall, write, name, list, tell, show, select, match, etc.</p> <p>Example: What are the health benefits of eating apples?</p>
<p>Comprehension Level: Questions in this level should relate to testing of understanding of acquired knowledge. Students should be able to understand the meaning of material and able to reproduce in own words, explain ideas and concepts.</p>	<p>Key Verbs: explain, elaborate, elucidate, describe, state in own words, give example, summarize, differentiate, distinguish, etc.</p> <p>Example: Elaborate on the health benefits of eating apples versus oranges giving suitable examples.</p>
<p>Application Level: Questions in this level should relate to testing of ability to apply acquired knowledge in new situations. Students should be able to use or apply a previously learned concept in a new situation.</p>	<p>Key Verbs: classify, apply, convert, modify, relate, change, prepare, solve, demonstrate, etc.</p> <p>Example: Classify the members of your family into different personality types given by Jung.</p>
<p>Analysis Level: Questions in this level should relate to testing of analytical capabilities. Students should be able to break up material into different parts for an in-depth study, distinguish between different parts.</p>	<p>Key Verbs: analyze, break down, compare, contrast, discriminate, identify, separate, etc</p> <p>Example: Compare and contrast the relevance of Semester system against Annual system.</p>
<p>Synthesis Level: Questions in this level should relate to testing of ability to synthesize existing knowledge to create something new. Students should be able to put parts together to form a new whole, create or develop a new product or idea.</p>	<p>Key Verbs: categorize, combine, compile, plan, compose, create, devise, design, explain, generate, organize, rearrange, reconstruct, etc.</p> <p>Example: Design a curriculum for Finishing School which you feel will be most suitable for Mizo students.</p>
<p>Evaluation Level: Questions in this level should relate to testing of evaluation of theory, policy, etc. Students should be able to make judgement about the value of material or ideas, justify a statement or idea.</p>	<p>Key Verbs: appraise, conclude, criticize, defend, evaluate, interpret, justify, support, etc.</p> <p>Example: Do you feel that serving of MDM to school children will improve their health and learning outcome? Justify your answer.</p>

Bloom's Taxonomy Table provides a clear, concise representation of the alignment between standards and educational goals, objectives, products and activities. Clear alignment of educational objectives with expected outcomes is a

necessity. Like pieces of a huge puzzle, everything must fit properly. The taxonomy table clarifies the fit of each lesson plan's purpose, essential questions, goals or objectives (Anderson & Krathwol, 2001)

A good and reasonable examination paper must consist of various difficulty levels to accommodate the different capabilities of students. Whether or not the written examination is able to assess the student's ability very much depends on the questions presented in the examination paper. On a daily basis, academics use questions to stimulate thinking and reasoning in students, while at the same time testing their retention and application skills. The assumption exists that questions relating to application skills should start to dominate the higher academic levels in education, with a corresponding reduction in questions requiring retention skills. Effective questions include informational or problem solving questions, and significantly more complex thinking questions that stimulate a student's mental activities. These questions require much more brain power and more extensive and elaborate answers. The ability to reason effectively and to solve problems creatively are skills which must be acquired through appropriate instruction and training. Teachers can provide this type of instruction and training by using a blend of Higher, Intermediate and Lower Order Cognitive questions given in Bloom's Taxonomy (Jones, Harland, Reid & Bartlett, 2009)

In order to improve the quality of teaching and learning, it is widely believed that one must set good/proper questions where appropriate attention is given to maintaining the correct balance between lower, intermediate and higher order cognitive questions. It is commonly accepted that memorization and recall are lower order cognitive skills (LOCS) that require only a minimum level of understanding, whereas the application of knowledge and critical thinking are higher-order cognitive skills (HOCS) that

require deep conceptual understanding . Teachers tend to ask questions in the ‘knowledge’ category 80% to 90% of the time. While these questions are not bad in themselves, using them all the time is not good practice. . It is preferable to try to utilize higher order level of questions provided by Bloom’s Taxonomy.

Conclusion

In order to produce useful graduates who can contribute to the knowledge-based global economy, we must provide quality higher education. This means producing graduates who are intuitive and creative, and who are able to use their cognitive skills when faced with problem solving tasks. Students should possess a number of cognitive skills such as an understanding of methodologies or ability in critical analysis. An essential need is the development of reliable tools and methods that reinforce and assess new curriculum designs, new teaching-learning strategies, new learning styles, new evaluation techniques and so on (Narayanan & Adithan, 2015).

All higher educational institutions and Universities should enhance critical thinking skill amongst their students and should be held accountable to provide this when students are enrolled and pursuing a degree programme. Active learning, which includes activities such as discussion, debates, role plays and cooperative learning encourages critical thinking and helps the students retain technical contents better. When active learning activities are employed, students have to use a deep level approach when learning course contents, which results in students using higher order thinking skills. (Annette Mallory Donovan, 2003). Bloom’s Taxonomy will serve as an effective tool guiding the faculty to arouse the curiosity of learners in their subjects.

Bloom’s Taxonomy is a highly valuable tool in the construction and assessment of question papers. It has been widely used by curriculum planners, administrators, researchers, and

teachers at all levels of education. It is easily understood and is considered a complete recipe which relates to all the four pillars of quality education and can help us in addressing the quality in any type and level of education (Mary Forehand, 2005). If we can gradually adjust our way of teaching and questioning towards higher order cognitive skills according to Bloom's Taxonomy and use it to help design examinations and analyze the results, it will greatly improve the quality of assessment in education.

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