

## **The Taxonomy of Cognitive Objectives and the Theory of Structural Cognitive Modifiability**

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In the 1950's, an American Psychologist, Benjamin Bloom, headed a task force for the American Psychological Association to create a taxonomy of objectives for assessors. Bloom and his colleagues eventually developed three taxonomies: Cognitive, Affective, and Psychomotor. The most famous of these endeavors was the cognitive officially entitled the Taxonomy of Objectives in the Cognitive Domain. It is usually simply called Bloom's Taxonomy. Also in the 1950's a young cognitive psychologist, who studied in Geneva with Piaget, was working in Israel developing his theory of structural cognitive modifiability. His name was Reuven Feuerstein. This short paper proposes to investigate the work of both of these eminent psychologists, to examine Bloom's taxonomy and Feuerstein's cognitive modifiability and to discuss the commonalties between the two.

Briefly the work of Professor Bloom can be stated as assessment in the cognitive domain has six components:

- Knowledge
- Comprehension
- Application
- Analysis
- Synthesis
- Evaluation

The essence of Professor Feuerstein's theory is that

“Intelligence is not fixed. It is modifiable.”

## The Taxonomy of Cognitive Objectives

Bloom places knowledge at the first level of cognition. Knowledge can be characterized as awareness of specifics and of the ways and means of dealing with specifics. Essentially, the knowledge level focuses on memory or recall. While this is the lowest level of cognition, it is not a level to be ignored. Recall can be related to terms or facts or of procedures. It can be a simple definition or a lengthy poem, a remembrance of the steps in finding the area of a rectangle or the steps to a surgical procedure. This first level of the taxonomy provides a floor upon which the other levels depend and can build. The student recalls or recognizes information, ideas, and/or principles in the approximate form in which they were learned.

### Examples:

- List in order the presidents who have held office since FDR.
- When did Columbus discover America?
- Who were the three bears?

The next level of cognition is comprehension. Comprehension is understanding. Has the knowledge been internalized or understood? Often at this level, we will ask students to explain a concept in their own words. We ask them to translate, interpret, or extrapolate. Reading can be defined as a knowledge task – decode the words, read them orally – or a comprehension task – extrapolate some piece of information from the passage. The student translates, comprehends, or interprets information based on prior learning.

### Examples:

- Using class notes, make a chart of the U.S. presidents since FDR and list the major accomplishments of each.
- Tell why Columbus wanted to sail to America?
- Why did Goldilocks go into the bears' house?

Application is the use of knowledge. Can one use knowledge in a new situation? It's the word problem in mathematics. It's the application of theory to the real world. The

student selects, transfers, and uses data and principles to complete a life problem task with a minimum of direction.

Examples:

Choose any U.S. president and explain how he exercised his power as Commander in Chief of the Armed Forces.

If you were making a comparable trip today, what would you bring?

Predict which bed Goldilocks will fall asleep in?

Analysis involves taking apart of a piece knowledge, the investigation of parts of a concept. It can only occur if one has obtained knowledge of and comprehends a concept. We can analyze the elements of a whole, the relationship between elements and the whole and different elements of the same whole. We can also analyze the underlying organizational principles of an analysis, sort of a meta-analysis. It's the deductive process. The student examines, classifies, hypothesizes, collects data, and draws conclusions. It is deconstruction.

Examples:

Design a diagram to show the various responsibilities of the US president.

Divide Columbus' life into several parts and explain why you divided it that way

Compare Goldilocks to Little Red Riding Hood.

Synthesis is the creative act. It's the taking of knowledge and the creation of something new. It is the making of a new product, the creation of a new hypothesis, the development of a plan. It's the inductive process. It's a building process rather than one of breaking down. Quality synthesis depends on thoughtful analysis. The student originates, integrates, and combines ideas into a product or proposal that is new to him or her. It is reconstruction.

Examples:

You are working for a major political party in the US. The year is 2008. You are asked create a presidential candidate. Describe how you will do it.

In what way are the events in Columbus' life similar to those of an astronaut?

Create a new ending for the story.

Evaluation is judgement or decision making. Evaluation is about decision making and being able to defend that decision. Evaluation can use personal criteria or generic criteria. Of most importance when asking for a decision is then following up with a request for why the option was chosen. An example of an evaluation task is deciding whether Columbus was justified in lying to his crew about the distance traveled on the voyage. The student appraises, assesses or criticizes on a basis of specific standards and criteria.

Example:

List characteristics you feel a good president should have. Using these criteria, choose the president you feel was the greatest American president.

The film showed Columbus to be a hero. Was he? What evidence supports your answer?

Did you like the story? Why or why not?

Often the pieces of the taxonomy are divided into higher and lower order thinking skills with the cutoff being anywhere from comprehension to synthesis. Certainly one can see how the upper levels of the taxonomy depend on the preceding levels. Sometimes it is difficult to place an activity or a question into a particular part of the taxonomy. It often depends on the particular situation and there is some degree of grayness or overlap in the categories. A telling of the events in the Goldilocks story might be a comprehension question calling for sequencing after an initial reading or a knowledge question calling for recall if the story has been heard several times before. Also important to remember is that higher order questions can be used at any instructional level as demonstrated by the samples given.

There have been many variations written on this taxonomy in the close to fifty years since it was developed. They range from a thirteen level example written by Hassentab to Bellanca's elegant yet simple "fat and skinny questions." Yet all of these systems have used Bloom as their starting point. The value of Bloom's taxonomy is that has been one of the few pieces of common language shared by educators. It provides a

common framework in which to design assessment and curriculum or in which to look at a lesson.

It is a common misconception that the cognitive objectives are a hierarchy. They are not. Evaluation questions and tasks do not have a higher value than application questions. While we move from lower to higher order questions, all of the elements of the taxonomy have their own purpose and value. The problem that many researchers see is that in classrooms from kindergarten through graduate school, they see a preponderance of knowledge and comprehension questions and tasks and a scarcity of application, analysis, synthesis, and evaluation questions and tasks.

### **The Theory of Structural Cognitive Modifiability**

Reuven Feuerstein presents the view that cognition is a variable. Thinking patterns can change; intelligence is modifiable. He states “we refer to structural changes, or to changes in the state of the organism, brought about by a deliberate program of intervention that will facilitate the generation of continuous growth by rendering the organism receptive and sensitive to internal and external sources of stimulation” (Feuerstein, 1980). In other words human beings can learn to learn how to learn. The human is capable of modifying the underlying structure of his cognition. Haywood (1975) states that Feuerstein’s definition of intelligence is “the capacity of the individual to use previously acquired experience to adjust to new situations.” Feuerstein, himself, defines intelligence as “a process broad enough to embrace a large variety of phenomena that have in common the dynamics and mechanics of adaptation.” “It is this adaptability of the organism...that we refer to as modifiability (1990).”

Feuerstein calls the process through which we help humans develop the capacity to adapt to their environments the mediated learning experience. “Feuerstein’s theory of mediated learning requires that teachers interpose themselves between the child and his or her experiences. It argues that to a large extent the diversity in student performance reflects the different needs for mediated learning. For many students, meaningful learning and the development of new concepts can not happen without mediation. (Ben-Hur, 2000).” Mediated learning differs from direct or experiential learning in that in the mediated learning experience there is the intervention of a human to filter the environment to the organism. Instead of the direct Stimulus – Response (S –

R) of Skinner or the Stimulus – Organism - Response (SOR) of Piaget, Feuerstein proposes a Stimulus – Human – Organism – Human – Response model (SHOHR). The ability of a person to learn is to a great extent dependent on a variety of factors that influence the quality of the mediated experience. Among these factors are chromosomes, environment, developmental level, socioeconomic status, culture, and the emotionality of both caregiver and child (Feuerstein and Feuerstein, 1991).

A quality mediated learning experience has three essential ingredients. These ingredients are necessary for any mediation to occur. They are Intentionality and reciprocity, mediation of meaning, and mediation of transcendence (Feuerstein and Feuerstein, 1991). The mediator explicitly conveys to the child his intention to mediate and the child must reciprocate by being aware that he is learning. Intentionality and reciprocation is a vital two way street. It is true communication. Successful motivation of the child creates reciprocity. Mediation of meaning occurs when the mediator communicates the importance and reason for an activity. Mediation of transcendence is the movement towards superordinate goals. It occurs when we convey to the student “far transfer”. It’s the big picture. Other qualities of mediation that might be present include: Mediation of the feeling of competence, mediation of regulation and control of behavior, mediation of sharing behavior, mediation of the feeling of belonging, mediation of challenge, mediation of goal seeking, goal setting and goal planning behavior, and mediation of an optimistic alternative (Feuerstein, 1990).

A lack of a mediated learning experience results in deficient cognitive functions in the individual. Feuerstein has developed two tools based on his theory to improve these deficient cognitive functions. The learning potential assessment device (LPAD) is a dynamic assessment tool that engages the examiner and subject in a series of mediated experiences. Feuerstein’ Instrumental Enrichment (FIE) is a series of non-content based instructional tasks that are used to remediate deficient cognitive functions in either the school or clinical setting.

### **The Taxonomy in Mediation**

A major methodology in a mediated learning experience is the skillful use of questioning. The use of questions is one of the major discussion points in the training of mediators. The use of higher order questions is perhaps most obvious in the mediation of challenge. Students crave challenge; challenge prevents boredom.

Students who are asked to apply, analyze, synthesize, and to judge are more likely to feel challenged than students who are simply asked to spit back what they have been taught. Having students apply their knowledge also is crucial in the mediation of meaning. The author's analysis of which parts of the taxonomy might be of particular use for different qualities of mediation is summarized in the chart below. Some of the qualities of mediation do not have a specific aspect of the taxonomy that can be associated with it. It should also be pointed out that in reality all parts of the taxonomy could be used in all the mediations.

#### Elements of Taxonomy of Particular Relevancy in Mediation

<b>Quality of Mediation</b>	<b>Particularly Relevant Aspects of Taxonomy</b>
Intentionality and reciprocity	
Meaning	Comprehension
Transcendence	Synthesis
Feeling of Competence	Evaluation
Regulation and Control of Behavior	Analysis
Sharing Behavior	
Individuation and Psychological Differentiation	Evaluation
Goal Planning	Analysis, Synthesis, Evaluation
Challenge	Application, Analysis, Synthesis, Evaluation
Self Change	Evaluation
Belonging	
Optimistic Alternative	

When we examine a particular quality of mediation, we need to observe how the mediator interacts with the subject. Mediation is the process of creating change in the organism. The use of higher order questions is essential in creating that change. Good mediators are constantly asking students to analyze and evaluate their responses, to respond to 'what if' questions, to derive principles from experience and to find examples of principles. A mediated learning experience is an example of high level teaching.

Meir Ben-Hur (2000) provides a model for the mediated learning experience that contains five steps: Practice, Decontextualization, Meaning, Recontextualization, Realization. In practice, we focus on knowledge; in decontextualizing we analyze. We construct meaning by synthesizing and internalize that meaning by comprehending. When we recontextualize, we are looking for applications and synthesizing. In the realization process, we apply our deep knowledge to new situations. Throughout we are evaluating our actions at each step. All of the taxonomy is involved in the process and each aspect builds upon and works in conjunction with the others. The skillful mediator will use the operations of the taxonomy in questioning to impact on the cognitive functions. Educators who mediate and teach students become accomplished practitioners in the content, mix, and methodology of questioning.

The purpose of mediate is to remediate deficient cognitive functions. Cognitive functions that are either not present or deficient impact on content at the point of process (Ben-Hur). The questions of the taxonomy are tools that can assist us both in our remediation of deficient cognitive functions and in the teaching of content. Often practitioners involved in this remediation use Feuerstein's Instrumental Enrichment (FIE) as a vehicle in this endeavor.

The different areas of the taxonomy and some of the deficient cognitive functions that might be associated with them are summarized in the series of charts below. Deficient cognitive functions have been defined and characterized by Feuerstein as being primarily associated with one of three phases: Input, Elaboration, and Output (1979, 1995).

### Input Phase

<b>Aspect of Taxonomy</b>	<b>Deficient Cognitive Function</b>
Knowledge	<ul style="list-style-type: none"> <li>• Lack of, or impaired receptive verbal tools that affect discrimination.</li> </ul>
Comprehension	<ul style="list-style-type: none"> <li>• Lack of, or impaired temporal concepts</li> <li>• Lack of, or impaired spatial orientation and lack of stable systems of reference by which to establish organization of space</li> </ul>
Application	
Analysis	<ul style="list-style-type: none"> <li>• Lack of, or deficient need for precision and accuracy in data collection</li> <li>• Unplanned, impulsive, and unsystematic exploratory behavior</li> </ul>
Synthesis	<ul style="list-style-type: none"> <li>• Lack of capacity for considering two or more sources of information at once</li> </ul>
Evaluation	<ul style="list-style-type: none"> <li>• Unplanned, impulsive, and unsystematic exploratory behavior</li> </ul>

### Elaboration Phase

<b>Aspect of Taxonomy</b>	<b>Deficient Cognitive Function</b>
Knowledge	<ul style="list-style-type: none"> <li>• Non elaboration of certain cognitive categories because the verbal concepts are not a part of the individual verbal inventory or a receptive level, or because they are not mobilized at the expressive level</li> </ul>
Comprehension	<ul style="list-style-type: none"> <li>• Inadequacy in the perception of the existence of a problem and its definition</li> </ul>
Application	<ul style="list-style-type: none"> <li>• Lack of spontaneous comparative behavior or the limitation of its application by a restricted need system</li> <li>• Lack of, or impaired need for hypothesis testing</li> </ul>
Analysis	<ul style="list-style-type: none"> <li>• Inability to select relevant as opposed to irrelevant cues in defining a problem</li> <li>• Lack of spontaneous comparative behavior or the limitation of its application by a restricted need system</li> <li>• Lack of need for the education or establishment of relationships</li> <li>• Lack of, or impaired planning behavior</li> <li>• Lack of, or impaired strategies for hypothesis testing</li> <li>• Lack of, or impaired need for pursuing logical evidence</li> </ul>
Synthesis	<ul style="list-style-type: none"> <li>• Lack of, or impaired strategies for hypothesis testing</li> <li>• Lack of, or impaired planning behavior</li> <li>• Lack of, or impaired need for pursuing logical evidence</li> <li>• Lack of, or impaired inferential hypothetical testing</li> </ul>
Evaluation	<ul style="list-style-type: none"> <li>• Lack of need for and/or exercise of summative behavior</li> <li>• Lack of, or impaired strategies for hypothesis testing</li> <li>• Lack of, or impaired need for pursuing logical evidence</li> </ul>

### Output Phase

Aspect of Taxonomy	Deficient Cognitive Function
Knowledge	<ul style="list-style-type: none"> <li>• Lack of, or impaired verbal or other tools for communicating adequately elaborated responses</li> </ul>
Comprehension	
Application	<ul style="list-style-type: none"> <li>• Trial and error responses</li> </ul>
Analysis	
Synthesis	<ul style="list-style-type: none"> <li>• Lack of, or impaired need for the precision and accuracy in the communication of one's responses</li> </ul>
Evaluation	<ul style="list-style-type: none"> <li>• Lack of, or impaired need for the precision and accuracy in the communication of one's responses</li> </ul>

The last examination of this paper concerns the instruments of FIE themselves. We use aspects of the taxonomy in our mediation of the cognitive deficiencies through the use of the instruments. When mediating a task, mediators are constantly questioning and assisting students in questioning. Building on a base of knowledge, checking for comprehension and moving towards the higher order thinking skills of application, analysis, synthesis, and evaluation.

Each instrument is a series of tasks specifically designed to remediate deficient cognitive functions. The tasks within each instrument increase in complexity and have a range of variation built into the design. The completion of the tasks often require a heavy use of analysis, some comprehension of a very limited content, the tasks sometimes call for application of rules and for synthesis. Students are often called upon to evaluate their work and many pages are specifically design for the student to evaluate errors, which also requires error analysis.

The author selected a short series of pages from two of the instruments to analyze in terms of the taxonomy.

Temporal Relations is a heavily verbal instrument given usually in the middle of the program. As its name suggests it is specifically designed to remediate the cognitive function of lack of, or impaired temporal concepts. A unit from the middle of the

instrument (pages 9 to 11) deals with the content of dates and the sequencing of dates. There is both content and procedural knowledge covered.

The first activity on page 9 presents directions for the activity and an example as a model. A series of dates is presented in numerical format that must be ordered. The activity requires application of the model to new situations and an analysis of each date. At the end of the activity an analysis of the process is required. In the second activity, some dates are given and dates must be made up to fit the sequence. A complication is introduced in that the placement of the numbers is not sequential. The activity requires simultaneous use of two or more sources of information, application and analysis. Page ten continues the discussion of time. A series of directions are given requiring comparison of two sets of years and deciding which time span is longer and the identification of the earliest date. Again the activity calls some procedural knowledge, analysis and application. The second activity requires synthesis in that dates must be supplied that will meet certain contingencies. Page 11 requires two application activities that ask the students to collect the birth dates of family members and the construction of tables, an excellent synthesis activity.

Temporal Relations is a heavily verbal instrument. Analytic Perception is mostly non-verbal. It is generally presented early in the program. As the title suggests it requires a heavy dose of analysis. Other aspects of the taxonomy are also used. A series of similar looking pages (13-17) demonstrate the variations in the tasks and the need for different aspects of the taxonomy. On page thirteen the student is asked to combine drawings to make a given complete figure. This part to whole approach is classic synthesis. Page 14, 15, and 17 require the same activity with different drawings. Page 16 requires the analysis of errors and an evaluation of the process.

Hopefully these two examples demonstrate the compatibility of the two theories. The author feels that a thorough knowledge of Bloom's taxonomy will enhance the mediator's ability to modify deficient cognitive functions.

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