**Revised Bloom’s Taxonomy**

**The Cognitive Process Dimension**

Two of the most important educational goals are to promote retention and to promote transfer (which, when it occurs, indicates meaningful learning). *Re­tention* is the ability to remember material at some later time in much the same way as it was presented during instruction. *Transfer* is the ability to use what was learned to solve new problems, to answer new questions, or to facilitate learning new subject matter (Mayer and Wittrock, 1996). *Retention* focuses on the past, whereas *transfer* emphasizes the future. Two major compo­nents in problem solving are problem representation—in which a student builds a mental representation of the problem—and problem solution—in which a student devises and carries out a plan for solving the problem (Mayer, 1992). A focus on meaningful learning is consistent with the view of learning as knowledge construction, in which students seek to make sense of their exper­iences. In constructivist learning students engage in active cognitive processing, such as paying attention to relevant incoming in­formation, mentally organizing incoming information into a coherent represen­tation, and mentally integrating incoming information with existing knowl­edge (Mayer, 1999).

What cognitive processes are used for retention and transfer? Our revised Bloom’s Taxonomy framework includes six categories of processes—one most closely related to retention *(Remember)* and the other five increasingly related to transfer *(Understand, Apply, Analyze, Evaluate,* and *Create).* They selected 19 cognitive processes that fit within these six cate­gories. These 19 specific cognitive processes are intended to be mutually exclu­sive; together they delineate the breadth and boundaries of the six categories.

If assess­ment tasks are to tap higher-order cognitive processes, they must require that students cannot answer them correctly by relying on memory alone. (Anderson & Krathwohl, 2001).

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| **Revised Bloom’s Taxonomy Level 1. *Remember* - Retrieve relevant knowledge from long-term memory**   * *Remembering* knowledge is essential for meaningful learning and problem solving as that knowledge is used in more complex tasks. When teachers focus on meaningful learning, however, remembering knowledge is integrated within the larger task of constructing new knowledge or solving new problems. | | |
| **Cognitive Process 1.1 Recognizing (Identifying)**   * Retrieving relevant knowledge from long-term memory in order to compare it with presented information * Student searches long-term memory for a piece of information that is identical or ex­tremely similar to the presented information | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To recognize the correct dates of im­portant events in U.S. history 2. To recognize the numbers of sides in basic geometric shapes. | 1. "True or false: The Declaration of Independence was adopted on July 4, 1776." 2. Multiple- choice test with items such as the following: "How many sides does a penta­gon have? (a) four, (b) five, (c) six, (d) seven." | * Purpose of assessment is verification, matching, and forced choice * *Verification* tasks - the student is given some information and must choose whether or not it is correct. The true-false format is the most common example. * *Matching* - two lists are pre­sented, and the student must choose how each item in one list corresponds to an item in the other list. * *Forced choice* tasks - the student are given a prompt along with several possible answers and must choose which answer is the cor­rect or "best answer." Multiple-choice is the most common format. |
| **Cognitive Process 1.2 Recalling (Retrieving)**   * Retrieving relevant knowledge from long-term memory when given a prompt to do so. * Prompt is often a question | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To recall the major exports of various South American countries. 2. To recall the poets who wrote various poems | 1. "What is the major export of Bolivia?" 2. "Who wrote *The Charge of the Light Brigade?"* | * Vary in the number and quality of cues that students are provided. With low cueing, the student is not given any hints or related information (such as "What is a meter?"). With high cueing, the student is given several hints (such as "In the metric system, a meter is a measure of \_\_\_\_.) * Assessment tasks for *Recalling* can also vary in the amount of embedding, or the extent to which the items are placed within a larger meaningful context. With low embedding, the recall task is presented as a single, isolated event, as in the preceding examples. With high embedding, the recall task is included within the context of a larger problem, such as asking a student to recall the formula for the area of a circle when solving a word problem that requires that formula. |
| **Revised Bloom’s Taxonomy Level 2. *Understand*- Construct meaning from instructional messages, including oral, written, and graphic communication**   * When the goal of instruc­tion is to promote transfer, the focus shifts to the other five cognitive processes, *Understand* through *Create.* * Construct meaning from instructional messages, including oral, written, and graphic communications, however, they are presented to students: during lectures, in books, or on computer monitors. * Build connections between the "new" knowledge to be gained and their prior knowledge. More specifically, the incom­ing knowledge is integrated with existing schemas and cognitive frameworks. | | |
| **Cognitive Process 2.1 Interpreting (Clarifying, Paraphrasing, Representing, Translating)**   * Changing from one form of representation (e.g., numerical) to another (e.g., verbal) (e.g., Paraphrase important speeches and documents) * Involve converting words to words (e.g., paraphrasing), pictures to words, words to pictures, numbers to words, words to numbers, musical notes to tones, and the like. | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To paraphrase important speeches and documents from the Civil War period in U.S. history. 2. To draw pictorial representations of various natural phenomena | 1. Ask a student to para­phrase a famous speech, such as Lincoln's Gettysburg Address 2. Ask a student to draw a series of diagrams illustrating photosynthesis | * Constructed response (i.e., supply an answer) and selected response (i.e., choose an answer) * Students are asked either to construct or to select the same information in a different form * To increase the probability that *Interpreting* rather than *Remembering* is be­ing assessed, the information included in the assessment task must be new. |
| **Cognitive Process 2.2 Exemplifying (Illustrating, Instantiating)**   * Finding a specific example or illustration of a concept or principle (e.g., Give examples of various artistic painting styles) * Involves identifying the defining features of the general concept or principle (e.g., an isosceles triangle must have two equal sides) and using these features to select or construct a specific instance (e.g., being able to select which of three presented triangles is an isosceles triangle). | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To give examples of various artistic painting styles 2. To give examples of various kinds of chemical compounds | 1. Ask a student to select which of four paintings represents the impressionist style 2. Ask the student to locate an inorganic com­pound on a field trip and tell why it is inorganic (i.e., specify the defining fea­tures) | * Constructed re­sponse format—in which the student must create an example * Selected response format—in which the student must select an example from a given set |
| **Cognitive Process 2.3 Classifying (Categorizing, Subsuming)**   * Determining that something belongs to a category (e.g., *Classify* observed or described cases of mental disorders) * Involves detecting relevant features or patterns that "fit" both the specific instance and the concept or principle * Whereas *Exemplifying* begins with a general concept or principle and requires the student to find a specific instance or example, C*lassi­fying* begins with a specific instance or example and requires the student to find a general concept or principle. | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To classify observed or described cases of mental disorders 2. To categorize the species of various prehistoric animals | 1. Ask a student to observe a video of the behavior of a person with mental illness and then indicate the mental disorder that is displayed 2. Give a stu­dent some pictures of prehistoric animals with instructions to group them with others of the same species | * In *constructed* response tasks, a student is given an instance and must produce its related concept or principle. * In *selected* re­sponse tasks, a student is given an instance and must select its concept or prin­ciple from a list. * In a *sorting* task, a student is given a set of instances and must determine which ones belong in a specified category and which ones do not, or must place each instance into one of multiple categories. |
| **Cognitive Process 2.4 Summarizing (Abstracting, Generalizing)**   * Abstracting a general theme or major point(s) (e.g., Write a short summary of events portrayed on a videotape) * Involves con­structing a representation of the information, such as the meaning of a scene in a play, and abstracting a summary from it, such as determining a theme or main points. | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To write short summaries of events portrayed pictorially 2. To summarize the major contributions of famous scientists after reading several of their writings | 1. Ask a student to watch a videotape on the French Revolution and then write a short summary 2. Ask a student to read selected writings about Charles Darwin and summarize the major points | * Constructed response or selection formats, involving either themes or summaries * In a *con­structed* response task, the student may be asked to read an untitled passage on the California Gold Rush and then write an appropriate title. * In a *selection* task, a student may be asked to read a passage on the California Gold Rush and then select the most appropriate title from a list of four possible titles or rank the titles in order of their "fit" to the point of the passage. |
| **Cognitive Process 2.5 Inferring (Concluding, Extrapolation, Interpolating, Predicting)**   * Drawing a logical conclusion from presented information (e.g., In learning a foreign language, infer grammatical principles from examples) * Involves finding a pattern within a series of examples or instances * Occurs when a student is able to abstract a concept or principle that accounts for a set of examples or instances by encoding the relevant features of each instance and, most important, by noting relationships among them * Involves making comparisons among instances within the context of the entire set * *Inferring* is different from A*ttributing* (a cognitive process associated with *Analyze). Attributing* focuses solely on the pragmatic issue of determining the author's point of view or intention, whereas I*nferring* focuses on the issue of inducing a pattern based on presented information. * *Attributing* is broadly applicable to situations in which one must "read between the lines," especially when one is seeking to determine an author's point of view. *Inferring,* on the other hand, occurs in a context that supplies an expectation of what is to be inferred. | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To infer grammat­ical principles from examples 2. To infer the relationship expressed as an equation that represents several observations of values for two variables | 1. A student is given the article- noun pairs "la casa, el muchacho, la senorita, el pero" and asked to formulate a principle for when to use "la" and when to use "el." 2. Ask a student to describe the relationship as an equation involving x and *y* for situations in which if *x* is 1, then y is 0; if *x* is 2, then *y* is 3; and if x is 3, then y is 8. | * Three common tasks that require *inferring* (often along with *implementing)* are completion tasks, analogy tasks, and oddity tasks. * In *completion* tasks, a student is given a series of items and must determine what will come next, as in the number series example above. * In *analogy* tasks, a student is given an analogy of the form A is to B as C is to D, such as "nation" is to "president" as "state" is to \_\_\_\_\_\_\_. The student's task is to produce or select a term that fits in the blank and completes the analogy (such as \_\_\_\_\_ governor"). * In an *oddity* task, a student is given three or more items and must determine which does not belong. * For example, a student may be given three physics problems, two involving one principle and another involving a differ­ent principle. To focus solely on the inferring process, the question in each as­sessment task could be to state the underlying concept or principle the student is using to arrive at the correct answer. |
| **Cognitive Process 2.6 Comparing (Contrasting, Mapping, Matching)**   * Detecting correspondences between two ideas, objects, and the like (e.g., Compare historical events to contemporary situations) * Detecting similarities and differences between two or more objects, events, ideas, problems, or situations, such as determining how a well- known event (e.g., a recent political scandal) is like a less familiar event (e.g., a historical political scandal). * When used in conjunction with I*nferring* (e.g., first, abstracting a rule from the more familiar situation) and I*mplementing* (e.g., second, applying the rule to the less familiar situation), C*omparing* can con­tribute to reasoning by analogy. | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To understand historical events by comparing them to familiar situations 2. To compare an electrical circuit to a more familiar system | 1. "How is the American Revolution like a family fight or an argument between friends?" 2. "How is an electrical circuit like water flowing through a pipe?" | * The major technique is mapping where a student must show how each part of one object, idea, problem, or situation corresponds to (or maps onto) each part of another. * For example, a student could be asked to detail how the battery, wire, and resistor in an electrical circuit are like the pump, pipes, and pipe constructions in a water flow system, respectively. |
| **Cognitive Process 2.7 Explaining (Construction)**   * Construction a cause-and-effect model of a system (e.g., Explain the causes of important 18th-century events in France) * The model may be derived from a formal theory (as is often the case in the natural sciences) or may be grounded in research or expe­rience (as is often the case in the social sciences and humanities). * Involves constructing a cause-and-effect model, including each major part in a system or each major event in the chain, and using the model to determine how a change in one part of the system or one "link" in the chain affects a change in another part | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To explain the causes of important eighteenth-century historical events 2. To explain how basic physics laws work | 1. After reading and discussing a unit on the American Revolution, students are asked to construct a cause-and-effect chain of events that best explains why the war occurred. 2. Ask students who have studied Ohm's law to explain what happens to the rate of the current when a second battery is added to a circuit, or ask students who have viewed a video on lightning storms to explain how differences in temper­ature affect the formation of lightning. | * Includes reasoning, troubleshooting, redesigning, and predicting * In *reasoning* tasks, a student is asked to offer a reason for a given event. For example, "Why does air enter a bicycle tire pump when you pull up on the handle?" * In *troubleshooting*, a student is asked to diagnose what could have gone wrong in a malfunctioning system. For example, "Suppose you pull up and press down on the handle of a bicycle tire pump several times but no air comes out. What's wrong?" * In *redesigning*, a student is asked to change the system to accomplish some goal. For example, "How could you improve a bicycle tire pump so that it would be more efficient?" * In *predicting*, a student is asked how a change in one part of a system will effect a change in another part of the system. For example, "What would hap­pen if you increased the diameter of the cylinder in a bicycle tire pump?" |
| **Revised Bloom’s Taxonomy Level 3. *Apply*- Carry out or use a procedure in a given situation**   * Involves using procedures to perform exercises or solve problems * An exercise is a task for which the student already knows the proper procedure to use, so the student has developed a fairly routinized approach to it. * A problem is a task for which the student initially does not know what procedure to use, so the student must locate a procedure to solve the problem. * The Apply category consists of two cognitive processes: Executing—when the task is an exercise (familiar)—and Implementing—when the task is a problem (unfamiliar). | | |
| **Cognitive Process 3.1 Executing (Carrying out)**   * Apply a procedure to a familiar task (e.g., Divide one whole number by another whole number, both with multiple digits * Frequently associated with the use of skills and algorithms than with techniques and methods * Skills and algorithms have two qualities. First, they consist of a sequence of steps that are gener­ally followed *in a fixed order.* Second, when the steps are performed correctly, the end result is a predetermined answer. * Student simply carries out a known procedure to perform a familiar task | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To divide one whole number by another, both with mul­tiple digits 2. To compute the value of variables using scientific formulas | 1. A student is given a worksheet that has 15 whole-number division exercises 2. A student is given the formula Density = Mass/Volume and must answer the question "What is the density of a material with a mass of 18 pounds and a volume of 9 cubic inches?" | * Student is given a familiar task that can be performed using a well-known procedure * Emphasis is on the procedure as well as the answer |
| **Cognitive Process 3.2 Implementing (Using)**   * Applying a procedure to an unfamiliar task (e.g., Use Newton’s Second Law in situations in which it is appropriate) * Because selection is required, students must possess an under­standing of the type of problem encountered as well as the range of procedures that are available. * *Implementing* is used in conjunction with other cogni­tive process categories, such as *Understand* and *Create.* * Because the student is faced with an unfamiliar problem, he or she does not immediately know which of the available procedures to use. Furthermore, no single procedure may be a "perfect fit" for the problem; some modification in the procedure may be needed. * *Implementing* is more frequently associated with the use of techniques and methods than with skills and algorithms. * Techniques and methods have two qualities: First, the procedure may be more like a "flow chart" than a fixed sequence; that is, the procedure may have "decision points" built into it (e.g., after completing Step 3, should I do Step 4A or Step 4B?). Second, there often is no single, fixed answer that is expected when the procedure is applied correctly. * The notion of no single, fixed answer is especially applicable to objectives that call for *applying conceptual knowledge* such as theories, models, and struc­tures. | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To solve a variety of personal finance problems 2. To use the most effective, efficient, and affordable method of conducting a research study to address a specific research question | 1. Present students with a problem in which they must choose the most economical financing package for a new car 2. Give students a research question and have them propose a research study that meets specified criteria of effectiveness, efficiency, and affordability. Notice that in both of these assessment tasks, the student must not only apply a procedure (i.e., engage in *implementing)* but also rely on conceptual understanding of the problem, the procedure, or both | * Since a student is given an unfamiliar problem that must be solved, most assessment formats begin with speci­fication of the problem. Students are asked to determine the procedure needed to solve the problem, solve the problem using the selected procedure (making modifications as necessary), or usually both. |
| **Revised Bloom’s Taxonomy Level 4. *Analyze*- Break material into its constituent parts and determine how the parts relate to one another and to an overall structure or purpose**   * Involves breaking material into its constituent parts and determining how the parts are related to one another and to an overall structure. * Include learning to determine the rele­vant or important pieces of a message *(differentiating),* the ways in which the pieces of a message are organized *(organizing),* and the underlying purpose of the message *(attributing).* * For example, wish to develop in their students the ability to: * distinguish fact from opinion (or reality from fantasy); * connect conclusions with supporting statements; * distinguish relevant from extraneous material; * determine how ideas are related to one another; * ascertain the unstated assumptions involved in what is said; * distinguish dominant from subordinate ideas or themes in poetry or music; and * find evidence in support of the author's purposes. | | |
| **Cognitive Process 4.1 Differentiation (Discriminating, Distinguishing, Focusing, Selecting)**   * Distinguishing relevant or important parts of presented material (e.g., Distinguish between relevant and irrelevant numbers in a mathematical word problem) * Occurs when a student discrimi­nates relevant from irrelevant information, or important from unimportant in­formation, and then attends to the relevant or important information * *Differen­tiating* is different from the cognitive processes associated with *Understand* because it involves structural organization and, in particular, determining how the parts fit into the overall structure or whole. * *Differentiating* differs from *Comparing* in using the larger context to determine what is relevant or important and what is not | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To determine the major points in research reports 2. To select the main steps in a written description of how something works | 1. Require a student to circle the main points in an archeological report about an ancient Mayan city (such as when the city began and when it ended, the population of the city over the course of its existence, the geographic location of the city, the physical build­ings in the city, its economic and cultural function, the social organization of the city, why the city was built and why it was deserted). 2. Ask a student to read a chapter in a book that describes lightning for­mation and then to divide the process into major steps (including moist air rising to form a cloud, creation of updrafts and downdrafts inside the cloud, separation of charges within the cloud, movement of a stepped leader downward from cloud to ground, and creation of a return stroke from ground to cloud) | * In a *constructed* response task, a student is given some material and is asked to indicate which parts are most important or rele­vant. * In a *selection* task, a student is given some material and is asked to choose which parts are most important or relevant. |
| **Cognitive Process 4.2 Organizing (Finding coherence, Integrating, Outlining, Parsing, Structuring)**   * Determine how elements fit or function within a structure (e.g., Structure evidence in a historical description into evidence for and against a particular historical explanation) * Student builds systematic and coherent connections among pieces of presented information * Occurs in conjunction with *Differentiating.* The student first identifies the relevant or important elements and then determines the overall structure * *Organizing* can also occur in conjunction with A*ttributing,* in which the focus is on determining the author's intention or point of view. | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To structure a historical de­scription into evidence for and against a particular explanation 2. To learn to analyze research reports in terms of four sec­tions: hypothesis, method, data, and conclusion | 1. Ask a student to write an outline that shows which facts in a passage on American history support and which facts do not support the conclusion that the American Civil War was caused by differences in the rural and urban composition of the North and South 2. Students are asked to produce an outline of a presented research report | * Imposing a structure on ma­terial (such as an outline, table, matrix, or hierarchical diagram) * In a *constructed* response task, a student may be asked to produce a written outline of a pas­sage. * In a *selection* task, a student may be asked to select which of four alterna­tive graphic hierarchies best corresponds to the organization of a presented passage. |
| **Cognitive Process 4.3 Attributing (Deconstructing)**   * Determine a point of view, a bias, values, or intent underlying presented material (e.g., Determine the point of view of the author of an essay in terms of his or her political perspective) * Involves a process of deconstruction, in which a student determines the intentions of the author of the presented material * In contrast to *Interpreting,* in which the student seeks to *Understand* the meaning of the presented material, A*ttributing* involves an extension beyond basic understanding to infer the intention or point of view underlying the presented material. | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To determine the under­lying point of view or intention of the author 2. To determine the point of view of the author of an essay on a contro­versial topic in terms of his or her theoretical perspective | 1. For the students having read Shakespeare's *Macbeth,* ask what motive(s) Shakespeare attributed to Mac­beth for the murder of King Duncan 2. Ask a student whether a report on Amazon rain forests was written from a pro-environment or pro-business point of view | * Assessed by presenting some written or oral material and then asking a student to construct or select a description of the author's or speaker's point of view, intentions, and the like * A *constructed* response task is "What is the author's purpose in writing the essay you read on the Amazon rain forests?" * A *selection* version of this task is "The author's purpose in writing the essay you read is to: (a) provide factual information about Amazon rain forests, (b) alert the reader to the need to protect rain forests, (c) demonstrate the economic advantages of developing rain forests, or (d) describe the consequences to humans if rain forests are developed." |
| **Revised Bloom’s Taxonomy Level 5. *Evaluate*- Make judgments based on criteria and standards**   * Making judgments based on criteria and standards * The criteria most often used are quality, effectiveness, efficiency, and consistency. They may be determined by the student or by others. * The standards may be either quantitative (i.e., Is this a sufficient amount?) or qualitative (i.e., Is this good enough?). * The standards are applied to the criteria (e.g., Is this process sufficiently effective? Is this product of sufficient quality?) * Not all judgments are evaluative. For example, students make judgments about whether a specific example fits within a cate­gory. They make judgments about the appropriateness of a particular proce­dure for a specified problem. They make judgments about whether two objects are similar or different. Most of the cognitive processes, in fact, require some form of judgment. * What most clearly differentiates *Evaluate* as defined here from other judgments made by students is the use of standards of performance with clearly defined criteria. | | |
| **Cognitive Process 5.1 Checking (Coordinating, Detecting, Monitoring, Testing)**   * Detecting inconsistencies or fallacies within a process or product; determining whether a process or product has external consistency; determining the effectiveness of a procedure as it is being implemented (e.g., Determine if a scientist’s conclusions follow from the raw data) * When a student tests whether or not a conclusion follows from its premises, whether data support or disconfirm a hypothesis, or whether presented material contains parts that contradict one another * When combined with Planning (a cognitive process in the category Create) and implementing (a cognitive process in the category Apply), checking involves determining how well the plan is working. | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To detect inconsistencies in persuasive messages 2. To determine whether a scientist's conclusion follows from the observed data | 1. Ask students to watch a television advertise­ment for a political candidate and point out any logical flaws in the persuasive message 2. Ask a student to read a report of a chemistry experiment and determine whether or not the conclusion follows from the results of the experiment. | * Involve operations or products given to the students or ones created by the students themselves * *Checking* can also take place within the context of carrying out a solution to a problem or performing a task, where one is concerned with the consistency of the actual implementation (e.g., Is this where I should be in light of what I've done so far?). |
| **Cognitive Process 5.2 Critiquing (Judging)**   * Determining inconsistencies between a product and external criteria; determining whether a product has external consistency; procedure for a given problem (e.g., Judge which of two methods is the best way to solve a given problem) * Judging a product or operation based on externally im­posed criteria and standards * A student notes the positive and neg­ative features of a product and makes a judgment based at least partly on those features * *Critiquing* lies at the core of what has been called critical thinking. An example of C*ritiquing* is judging the merits of a particular solution to the prob­lem of acid rain in terms of its likely effectiveness and its associated costs (e.g., requiring all power plants throughout the country to restrict their smokestack emissions to certain limits). | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To evaluate a proposed solution (such as "eliminate all grading") to a social problem (such as "how to improve K-12 education") in terms of its likely effectiveness 2. To evaluate the reasonableness of a hypothesis (such as the hypoth­esis that strawberries are growing to extraordinary size because of the un­usual alignment of the stars). |  | * A student may be asked to critique his or her own hypotheses or creations or those generated by someone else. * The critique could be based on positive, negative, or both kinds of criteria and yield both positive and negative consequences. * For example, in C*ritiquing* a school district's pro­posal for year-round schools, a student would generate positive consequences, such as the elimination of learning loss over summer vacation, and negative consequences, such as disruption of family vacations. |
| **Revised Bloom’s Taxonomy Level 6. *Create* - Put elements together to form a coherent or functional whole; reorganize elements into a new pattern or structure**   * Involves putting elements together to form a coherent or functional whole * Students make a new product by mentally reorganizing some elements or parts into a pattern or structure not clearly present before * Although *Create* requires creative thinking on the part of the student, this is not completely free creative expression unconstrained by the demands of the learning task or situation. * *Create,* as used here, however, although it includes objectives that call for unique production, also refers to objectives calling for production that all students can and will do. If nothing else, in meeting these objectives, many students will create in the sense of producing their own syn­thesis of information or materials to form a new whole, as in writing, painting, sculpting, building, and so on. * Although many objectives in the *Create* category emphasize originality (or uniqueness), educators must define what is original or unique. Can the term *unique* be used to describe the work of an individual student (e.g., "This is unique for Adam Jones") or is it reserved for use with a group of students (e.g., "This is unique for a fifth-grader")? * Many objectives in the *Create* category do not rely on originality or uniqueness * Although the process categories of *Understand, Apply,* and *Analyze* may involve detecting relationships among presented elements, *Create* is different because it also involves the construction of an original product. Unlike *Create,* the other categories involve working with a given set of elements that are part of a given whole; that is, they are part of a larger structure the student is trying to understand. * In *Create,* on the other hand, the student must draw upon ele­ments from many sources and put them together into a novel structure or pat­tern relative to his or her own prior knowledge. * A task that requires *Create* is likely to require aspects of each of the earlier cognitive process categories to some extent, but not neces­sarily in the order in which they are listed in the Taxonomy Table. * Composition (including writing) often, but not always, requires the cognitive processes associated with *Create.* For example, *Create* is not involved in writing that represents the remembering of ideas or the inter­pretation of materials. * Three phases of *Create*: *problem representa­tion*, in which a student attempts to understand the task and generate possible solutions; *solution planning*, in which a student examines the possibilities and devises a workable plan; and *solution execution*, in which a student success­fully carries out the plan. * Thus, the creative process can be thought of as start­ing with a divergent phase in which a variety of possible solutions are consid­ered as the student attempts to understand the task *(generating).* This is followed by a convergent phase, in which the student devises a solution method and turns it into a plan of action *(planning).* Finally, the plan is executed as the student constructs the solution *(producing).* | | |
| **Cognitive Process 6.1 Generating (Hypothesizing)**   * Coming up with alternative hypotheses based on criteria (e.g., Generate hypotheses to account for an observed phenomenon) * Problem is initially rep­resented suggests possible solutions; however, redefining or coming up with a new representation of the problem may suggest different solutions. * When *gen­erating* transcends the boundaries or constraints of prior knowledge and exist­ing theories, it involves divergent thinking and forms the core of what can be called creative thinking. * *Generating* is used in a restricted sense here. *Understand* also requires gen­erative processes, which we have included in *translating, exemplifying, summa­rizing, inferring, classifying, comparing,* and *explaining.* However, the goal of *Un­derstand* is most often convergent (that is, to arrive at a single meaning). In contrast, the goal of *generating* within *Create* is divergent (that is, to arrive at various possibilities). | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To generate multiple useful solutions for social problems 2. To generate hypotheses to explain ob­served phenomena | 1. "Suggest as many ways as you can to assure that everyone has adequate medical insurance." To assess student responses, the teacher should construct a set of criteria that are shared with the students. These might include the number of alternatives, the reasonableness of the various alterna­tives, the practicality of the various alternatives, and so on. 2. Ask students to write as many hypotheses as they can to explain strawberries growing to extraordinary size. Again, the teacher should establish clearly defined criteria for judging the quality of the responses and give them to the students | * *Constructed* response - student is asked to produce alternatives or hypotheses * Two traditional subtypes are consequences tasks and uses tasks. * In a *consequences* task, a student must list all the possible consequences of a certain event, such as "What would happen if there was a flat income tax rather than a graduated income tax?" * In a uses task, a student must list all possible uses for an object, such as "What are the possible uses for the World Wide Web?" |
| **Cognitive Process 6.2 Planning (Designing)**   * Devising a procedure for accomplishing some task (e.g., Plan a research paper on a given historical topic) * Devising a solution method that meets a problem's criteria, that is, developing a plan for solving the problem * Planning stops short of carrying out the steps to create the actual solution for a given problem. * In planning, a student may establish sub-goals, or break a task into subtasks to be performed when solving the problem. * Teachers often skip stating planning objectives, instead stating their objectives in terms of producing, the final stage of the creative process. When this happens, planning is either assumed or implicit in the producing objective. In this case, planning is likely to be carried out by the student covertly during the course of constructing a product (i.e., producing). | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To plan research papers on given historical topics 2. To design studies to test various hypotheses | 1. Ask the student, prior to writing a research paper on the causes of the American Revolution, to submit an outline of the paper, including the steps he or she intends to follow to conduct the research. 2. Ask students to plan a way of determining which of three factors determines the rate of oscillation of a pendulum. | * *Planning* may be assessed by asking students to develop worked-out solutions, describe solution plans, or select solution plans for a given problem. |
| **Cognitive Process 6.3 Producing (Constructing)**   * Inventing a product (e.g., Build habitats for a specific purpose) * Involves carrying out a plan for solving a given problem that meets certain specifications | | |
| **Sample Behavior of Objectives** | **Assessments Corresponding to Objectives** | **Assessment Formats** |
| 1. To write papers pertaining to particular historical periods that meet speci­fied standards of scholarship 2. To design habitats for certain species and certain purposes | 1. Ask students to write a short story that takes place during the American Revolution. 2. Ask students to design the living quarters of a space station. | * A common task for assessing *producing* is a de­sign task, in which students are asked to create a product that corresponds to certain specifications. For example, students may be asked to produce schematic plans for a new high school that include new ways for students to conveniently store their personal belongings. |

Two findings from research in cognitive science point to the important role of context in learning and thinking (Bransford, Brown, and Cocking, 1999; Mayer, 1992; Smith, 1991). First, research suggests that the nature of the cogni­tive process depends on the subject matter to which it is applied (Bruer, 1993; Mayer, 1999; Pressley and Woloshyn, 1995). Second, research on authentic assessment suggests that the nature of a process depends on the authenticity of the task to which it is applied (Baker, O'Neil, and Linn, 1993; Hambleton, 1996). Although we have described the cognitive processes individually, they are likely to be used in coordination with one another to facilitate meaningful school learning. Most authentic academic tasks require the coordinated use of several cognitive processes as well as several types of knowledge. For exam­ple, to solve a mathematical word problem, a student may engage in:

* *interpreting* (to understand each sentence in the problem);
* *recalling* (to retrieve the relevant *Factual knowledge* needed to solve the problem);
* *organizing* (to build a coherent representation of the key information in the problem, that is, *Conceptual knowledge);*
* *planning* (to devise a solution plan); and
* *producing* (to carry out the plan, that is, *Procedural knowledge)* (Mayer, 1992). Similarly, to write an essay, a student may engage in:
* *recalling* (to retrieve relevant information that may be included in the essay);
* *planning* (to decide what to include in the essay, determine what to say, and how to say it);
* *producing* (to create a written product); and
* *critiquing* (to make sure the written essay "makes sense") (Levy and Rans­dell, 1996).

Anderson, L. W. & Krathwohl, D. R., et al (Eds..) (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of educational objectives. Boston, MA:Allyn & Bacon.