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A Revision of Bloom's Taxonomy: An Overview

THE TAXONOMY OF EDUCATIONAL OBJECTIVES is a framework for classifying statements of what we expect or intend students to learn as a result of instruction. The framework was conceived as a means of facilitating the exchange of test items among faculty at various universities in order to create banks of items, each measuring the same educational objective. Benjamin S. Bloom, then Associate Director of the Board of Examinations of the University of Chicago, initiated the idea, hoping that it would reduce the labor of preparing annual comprehensive examinations. To aid in his effort, he enlisted a group of measurement specialists from across the United States, many of whom repeatedly faced the same problem. This group met about twice a year beginning in 1949 to consider progress, make revisions, and plan the next steps. Their final draft was published in 1956 under the title, *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive Domain* (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956).[1] Hereafter, this is referred to as the original Taxonomy. The revision of this framework, which is the subject of this issue of *Theory Into Practice,* was developed in much the same manner 45 years later (Anderson, Krathwohl, et al., 2001). Hereafter, this is referred to as the revised Taxonomy.[2]

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Bloom saw the original Taxonomy as more than a measurement tool. He believed it could serve as a

- common language about learning goals to facilitate communication across persons, subject matter, and grade levels;
- basis for determining for a particular course or curriculum the specific meaning of broad educational goals, such as those found in the currently prevalent national, state, and local standards;
- means for determining the congruence of educational objectives, activities, and assessments in a unit, course, or curriculum; and
- panorama of the range of educational possibilities against which the limited breadth and depth of any particular educational course or curriculum could be contrasted.

The Original Taxonomy

The original Taxonomy provided carefully developed definitions for each of the six major categories in the cognitive domain. The categories were *Knowledge, Comprehension, Application, Analysis, Synthesis,* and *Evaluation.*[3] With the exception of *Application,* each of these was broken into subcategories. The complete structure of the original Taxonomy is shown in Table 1.

The categories were ordered from simple to complex and from concrete to abstract. Further, it was assumed that the original Taxonomy represented a cumulative hierarchy; that is, mastery of

Table 1
Structure of the Original Taxonomy

1.0 Knowledge

    1.10 Knowledge of specifics

        1.11 Knowledge of terminology

        1.12 Knowledge of specific facts

    1.20 Knowledge of ways and means of dealing with specifics

        1.21 Knowledge of conventions

        1.22 Knowledge of trends and sequences

        1.23 Knowledge of classifications and categories

        1.24 Knowledge of criteria

        1.25 Knowledge of methodology

    1.30 Knowledge of universals and abstractions in a field

        1.31 Knowledge of principles and generalizations

        1.32 Knowledge of theories and structures

2.0 Comprehension

    2.1 Translation

    2.2 Interpretation

    2.3 Extrapolation

3.0 Application

4.0 Analysis

    4.1 Analysis of elements

    4.2 Analysis of relationships

    4.3 Analysis of organizational principles

5.0 Synthesis

    5.1 Production of a unique communication

    5.2 Production of a plan, or proposed set of operations

    5.3 Derivation of a set of abstract relations

6.0 Evaluation

    6.1 Evaluation in terms of internal evidence

    6.2 Judgments in terms of external criteria

each simpler category was prerequisite to mastery of the next more complex one.

At the time it was introduced, the term *taxonomy* was unfamiliar as an education term. Potential users did not understand what it meant, therefore, little attention was given to the original Taxonomy at first. But as readers saw its potential, the framework became widely known and cited, eventually being translated into 22 languages.

One of the most frequent uses of the original Taxonomy has been to classify curricular objectives and test items in order to show the breadth, or lack of breadth, of the objectives and items across the spectrum of categories. Almost always, these analyses have shown a heavy emphasis on objectives requiring only recognition or recall of information, objectives that fall in the *Knowledge* category. But, it is objectives that involve the understanding and use of knowledge, those that would be classified in the categories from *Comprehension* to *Synthesis*, that are usually considered the most important goals of education. Such analyses, therefore, have repeatedly provided a basis for moving curricula and tests toward objectives that would be classified in the more complex categories.

From One Dimension to Two Dimensions

Objectives that describe intended learning outcomes as the result of instruction are usually framed in terms of (a) some subject matter content and (b) a description of what is to be done with or to that content. Thus, statements of objectives typically consist of a noun or noun phrase—the subject matter content—and a verb or verb phrase—the cognitive process(es). Consider, for example, the following objective: The student shall be able to remember the law of supply and demand in economics. "The student shall be able to" (or "The learner will," or some other similar phrase) is common to all objectives since an objective defines what students are expected to learn. Statements of objectives often omit "The student shall be able to" phrase, specifying just the unique part (e.g., "Remember the economics law of supply and demand."). In this form it is clear that the noun phrase is "law of supply and demand" and the verb is "remember."

In the original Taxonomy, the *Knowledge* category embodied both noun and verb aspects. The noun or subject matter aspect was specified in *Knowledge's* extensive subcategories. The verb aspect was included in the definition given to *Knowledge* in that the student was expected to be able to recall or recognize knowledge. This brought unidimensionality to the framework at the cost of a *Knowledge* category that was dual in nature and thus different from the other Taxonomic categories. This anomaly was eliminated in the revised Taxonomy by allowing these two aspects, the noun and verb, to form separate dimensions, the noun providing the basis for the Knowledge dimension and the verb forming the basis for the Cognitive Process dimension.

The Knowledge dimension

Like the original, the knowledge categories of the revised Taxonomy cut across subject matter lines. The new Knowledge dimension, however, contains four instead of three main categories. Three of them include the substance of the subcategories of Knowledge in the original framework. But they were reorganized to use the terminology, and to recognize the distinctions of cognitive psychology that developed since the original framework was devised. A fourth, and new category, *Metacognitive Knowledge,* provides a distinction that was not widely recognized at the time the original scheme was developed. *Metacognitive Knowledge* involves knowledge about cognition in general as well as awareness of and knowledge about one's own cognition (Pintrich, this issue). It is of increasing significance as researchers continue to demonstrate the importance of students being made aware of their metacognitive activity, and then using this knowledge to appropriately adapt the ways in which they think and operate. The four categories with their subcategories are shown in Table 2.

The Cognitive Process dimension

The original number of categories, six, was retained, but with important changes. Three categories were renamed, the order of two was interchanged, and those category names retained were changed to verb form to fit the way they are used in objectives.

The verb aspect of the original *Knowledge* category was kept as the first of the six major categories, but was renamed **Remember.** *Comprehension* was renamed because one criterion for selecting category labels was the use of terms that teachers use in talking about their work. Because *understand* is a commonly used term in objectives, its lack of inclusion was a frequent criticism of the original Taxonomy. Indeed, the original group considered using it, but dropped the idea after further consideration showed that when teachers say they want the student to "really" understand, they mean anything from *Comprehension* to *Synthesis.* But, to the revising authors there seemed to be popular usage in which *understand* was a widespread synonym for comprehending. So, *Comprehension,* the second of the original categories, was renamed **Understand.**[4]

Table 2
Structure of the Knowledge Dimension
of the Revised Taxonomy

A. *Factual Knowledge* – The basic elements that students must know to be acquainted with a discipline or solve problems in it.
  Aa. Knowledge of terminology
  Ab. Knowledge of specific details and elements

B. *Conceptual Knowledge* – The interrelationships among the basic elements within a larger structure that enable them to function together.
  Ba. Knowledge of classifications and categories
  Bb. Knowledge of principles and generalizations
  Bc. Knowledge of theories, models, and structures

C. *Procedural Knowledge* – How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.
  Ca. Knowledge of subject-specific skills and algorithms
  Cb. Knowledge of subject-specific techniques and methods
  Cc. Knowledge of criteria for determining when to use appropriate procedures

D. *Metacognitive Knowledge* – Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.
  Da. Strategic knowledge
  Db. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge
  Dc. Self-knowledge

Application, Analysis, and *Evaluation* were retained, but in their verb forms as **Apply, Analyze,** and **Evaluate.** *Synthesis* changed places with *Evaluation* and was renamed **Create.** All the original subcategories were replaced with gerunds, and called "cognitive processes." With these changes, the categories and subcategories—cognitive processes—of the Cognitive Process dimension are shown in Table 3.

Whereas the six major categories were given far more attention than the subcategories in the original Taxonomy, in the revision, the 19 specific cognitive processes within the six cognitive process categories receive the major emphasis. Indeed, the nature of the revision's six major categories emerges most clearly from the descriptions given the specific cognitive processes. Together, these processes characterize each category's breadth and depth.

Like the original Taxonomy, the revision is a hierarchy in the sense that the six major categories of the Cognitive Process dimension are believed to differ in their complexity, with *remember* being less complex than *understand,* which is less complex than *apply,* and so on. However, because the revision gives much greater weight to teacher usage, the requirement of a strict hierarchy has been relaxed to allow the categories to overlap one another. This is most clearly illustrated in the case of the category **Understand**. Because its scope has been considerably broadened over *Comprehend* in the original framework, some cognitive processes associated with **Understand** (e.g., **Explaining**) are more cognitively complex than at least one of the cognitive processes associated with **Apply** (e.g., **Executing**). If, however, one were to locate the "center point" of each of the six major categories on a scale of judged complexity, they would likely form a scale from simple to complex. In this sense, the Cognitive Process dimension is a hierarchy, and probably one that would be supported as well as was the original Taxonomy in terms of empirical evidence (see Anderson, Krathwohl, et al., 2001, chap. 16).

The Taxonomy Table

In the revised Taxonomy, the fact that any objective would be represented in two dimensions immediately suggested the possibility of constructing a two-dimensional table, which we termed the Taxonomy Table. The Knowledge dimension would form the vertical axis of the table, whereas the Cognitive Process dimension would form the horizontal axis. The intersections of the knowledge and cognitive process categories would form the cells. Consequently, any objective could be classified in the Taxonomy Table in one or more cells that correspond with the intersection of the column(s) appropriate for categorizing the verb(s) and the row(s) appropriate for categorizing the noun(s) or noun phrase(s). To see how this placement of objectives is accomplished, consider the following example adapted from the State of Minnesota's Language Arts Standards for Grade 12:

> A student shall demonstrate the ability to write using grammar, language mechanics, and other conventions of standard written English for a variety of

Table 3
Structure of the Cognitive Process
Dimension of the Revised Taxonomy

1.0 Remember – Retrieving relevant knowledge from long-term memory.
   1.1 Recognizing
   1.2 Recalling

2.0 Understand – Determining the meaning of instructional messages, including oral, written, and graphic communication.
   2.1 Interpreting
   2.2 Exemplifying
   2.3 Classifying
   2.4 Summarizing
   2.5 Inferring
   2.6 Comparing
   2.7 Explaining

3.0 Apply – Carrying out or using a procedure in a given situation.
   3.1 Executing
   3.2 Implementing

4.0 Analyze – Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose.
   4.1 Differentiating
   4.2 Organizing
   4.3 Attributing

5.0 Evaluate – Making judgments based on criteria and standards.
   5.1 Checking
   5.2 Critiquing

6.0 Create – Putting elements together to form a novel, coherent whole or make an original product.
   6.1 Generating
   6.2 Planning
   6.3 Producing

academic purposes and situations by writing original compositions that analyze patterns and relationships of ideas, topics, or themes. (State of Minnesota, 1998)

We begin by simplifying the standard (i.e., objective) by ignoring certain parts, particularly restrictions such as "using grammar, language mechanics, and other conventions of standard written English for a variety of academic purposes and situations." (Some of these specify scoring dimensions that, if not done correctly, would cause the student's composition to be given a lower grade.) Omitting these restrictions leaves us with the following:

Write original compositions that analyze patterns and relationships of ideas, topics, or themes.

Placement of the objective along the Knowledge dimension requires a consideration of the noun phrase "patterns and relationships of ideas, topics, or themes." "Patterns and relationships" are associated with *B. Conceptual Knowledge*. So we would classify the noun component as an example of *B. Conceptual Knowledge*. Concerning the placement of the objective along the Cognitive Process dimension, we note there are two verbs: write and analyze. Writing compositions calls for *Producing*, and, as such, would be classified as an example of *6. Create*. Analyze, of course, would be *4. Analyze*. Since both categories of cognitive processes are likely to be involved (with students being expected to analyze before they create), we would place this objective in two cells of the Taxonomy Table: B4, Analyze Conceptual Knowledge, and B6, Create [based on] Conceptual Knowledge (see Figure 1). We use the bracketed [based on] to indicate that the creation itself isn't conceptual knowledge; rather, the creation is primarily based on, in this case, conceptual knowledge.

By using the Taxonomy Table, an analysis of the objectives of a unit or course provides, among other things, an indication of the extent to which more complex kinds of knowledge and cognitive processes are involved. Since objectives from *Understand* through *Create* are usually considered the most important outcomes of education, their inclusion, or lack of it, is readily apparent from the Taxonomy Table. Consider this example from one of the vignettes in the revised Taxonomy volume in which a teacher, Ms. Gwendolyn Airasian, describes a classroom unit in which she integrates Pre-Revolutionary War colonial history with a persuasive writing assignment. Ms. Airasian lists four specific objectives. She wants her students to:

1. Remember the specific parts of the Parliamentary Acts (e.g., the Sugar, Stamp, and Townshend Acts);
2. Explain the consequences of the Parliamentary Acts for different colonial groups;
3. Choose a colonial character or group and write a persuasive editorial stating his/her/its position on the Acts (the editorial must include at least one supporting reason not specifically taught or covered in the class); and
4. Self- and peer edit the editorial.

Categorizing the first objective, *1. Remember* is clearly the cognitive process, and "specific parts of the Parliamentary Acts" is *Ab. Knowledge of specific details or elements,* a subcategory of *A. Factual Knowledge*. So this objective is placed in cell A1.[5] "Explain," the verb in the second objective, is the seventh cognitive process, *2.7 Explaining,*

The Cognitive Process Dimension

The Knowledge Dimension	1. *Remember*	2. *Understand*	3. *Apply*	4. *Analyze*	5. *Evaluate*	6. *Create*
A. *Factual Knowledge*						
B. *Conceptual Knowledge*				X		X
C. *Procedural Knowledge*						
D. *Metacognitive Knowledge*						

Figure 1. The placement in the Taxonomy Table of the State of Minnesota's Language Arts Standard for Grade 12.

under **2. Understand**. Since the student is asked to explain the "consequences of the Parliamentary Acts," one can infer that "consequences" refers to generalized statements about the Acts' aftereffects and is closest to **Bc. Knowledge of theories, models, and structures**. The type of knowledge, then, would be **B. Conceptual Knowledge**. This objective would be classified in cell B2.

The key verb in the third objective is "write." Like the classification of the State of Minnesota's standard discussed above, writing is **6.3 Producing**, a process within **6. Create**. To describe "his/her/its position on the Acts" would require some combination of **A. Factual Knowledge** and **B. Conceptual Knowledge**, so this objective would be classified in two cells: A6 and B6. Finally, the fourth objective involves the verbs "self-edit" and "peer edit." Editing is a type of evaluation, so the process involved is **5. Evaluate**. The process of evaluation will involve criteria, which are classified as **B. Conceptual Knowledge**, so the fourth objective would fall in cell B5. The completed Taxonomy Table for this unit's objectives is shown in Figure 2.

From the table, one can quickly visually determine the extent to which the more complex categories are represented. Ms. Airasian's unit is quite good in this respect. Only one objective deals with the **Remember** category; the others involve cognitive processes that are generally recognized as the more important and long-lasting fruits of education—the more complex ones.

In addition to showing what was included, the Taxonomy Table also suggests what might have been but wasn't. Thus, in Figure 2, the two blank bottom rows raise questions about whether there might have been procedural or metacognitive knowledge objectives that could have been included. For example, are there procedures to follow in editing that the teacher could explicitly teach the students? Alternatively, is knowledge of the kinds of errors common in one's own writing and preferred ways of correcting them an important metacognitive outcome of self-editing that could have been emphasized? The panorama of possibilities presented by the Taxonomy Table causes one to look at blank areas and reflect on missed teaching opportunities.

The Taxonomy Table can also be used to classify the instructional and learning activities used to achieve the objectives, as well as the assessments employed to determine how well the objectives were mastered by the students. The use of the Taxonomy Table for these purposes is described and illustrated in the six vignettes contained in the revised Taxonomy volume (Anderson, Krathwohl, et al., 2001, chaps. 8-13). In the last two articles of this issue, Airasian discusses assessment in greater detail, and Anderson describes and illustrates alignment.

The Cognitive Process Dimension

The Knowledge Dimension	1. *Remember*	2. *Understand*	3. *Apply*	4. *Analyze*	5. *Evaluate*	6. *Create*
A. *Factual Knowledge*	Objective 1					Objective 3
B. *Conceptual Knowledge*		Objective 2			Objective 4	Objective 3
C. *Procedural Knowledge*						
D. *Metacognitive Knowledge*						

Figure 2. The classification in a Taxonomy Table of the four objectives of Ms. Airasian's unit integrating Pre-Revolutionary War colonial history with a persuasive writing assignment.

Conclusion

The Taxonomy of Educational Objectives is a scheme for classifying educational goals, objectives, and, most recently, standards. It provides an organizational structure that gives a commonly understood meaning to objectives classified in one of its categories, thereby enhancing communication. The original Taxonomy consisted of six categories, nearly all with subcategories. They were arranged in a cumulative hierarchical framework; achievement of the next more complex skill or ability required achievement of the prior one. The original Taxonomy volume emphasized the assessment of learning with many examples of test items (largely multiple choice) provided for each category.

Our revision of the original Taxonomy is a two-dimensional framework: Knowledge and Cognitive Processes. The former most resembles the subcategories of the original *Knowledge* category. The latter resembles the six categories of the original Taxonomy with the *Knowledge* category named **Remember**, the *Comprehension* category named **Understand**, *Synthesis* renamed **Create** and made the top category, and the remaining categories changed to their verb forms: **Apply, Analyze**, and **Evaluate**. They are arranged in a hierarchical structure, but not as rigidly as in the original Taxonomy.

In combination, the Knowledge and Cognitive Process dimensions form a very useful table, the Taxonomy Table. Using the Table to classify objectives, activities, and assessments provides a clear, concise, visual representation of a particular course or unit. Once completed, the entries in the Taxonomy Table can be used to examine relative emphasis, curriculum alignment, and missed educational opportunities. Based on this examination, teachers can decide where and how to improve the planning of curriculum and the delivery of instruction.

Notes

1. *The Taxonomy of Educational Objectives: Handbook II, The Affective Domain* was published later (Krathwohl, Bloom, & Masia, 1964). A taxonomy for the psychomotor domain was never published by the originating group, but some were published by Simpson (1966), Dave (1970), and Harrow (1972).

2. The revised Taxonomy is published both in a hardcover complete edition and a paperback abridgment, which omits Chapters 15, The Taxonomy in Relation to Alternative Frameworks; 16, Empirical Studies of the Structure of the Taxonomy; 17, Unsolved Problems; and Appendix C, Data Used in the Meta-Analysis in Chapter 15.
3. Terms appearing in the original Taxonomy appear in italics with initial caps; terms in the revised Taxonomy add boldface to these specifications.
4. *Problem solving* and *critical thinking* were two other terms commonly used by teachers that were also considered for inclusion in the revision. But unlike *understand*, there seemed to be no popular usage that could be matched to a single category. Therefore, to be categorized in the Taxonomy, one must determine the intended specific meaning of *problem solving* and *critical thinking* from the context in which they are being used.
5. One can use the subcategories to designate the rows and columns; however, for the sake of simplicity, the examples make use of only the major categories.

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