

APPENDIX F

Bloom's Taxonomy

The articulation of BOK learning outcomes and related levels of achievement comes, in part, from the desire to clarify what should be taught and learned. Clarification can be achieved through the use of Bloom's Taxonomy of Educational Objectives^a for the cognitive domain, which systematically differentiates outcome characteristics and promotes common understanding for all users of the BOK. The cognitive domain refers to educational objectives that involve the recall and recognition of knowledge and the development of intellectual abilities and skills.

Bloom's Taxonomy was originally conceived as a technique to reduce the labor of preparing comprehensive examinations through the exchange of test items among faculty at various universities.^a The goal was to create banks of test items in which each bank attended to the same educational objective. A team of measurement specialists began meeting in 1949 to create the taxonomy of objectives and their first draft was published in 1956. Bloom believed, however, that the original taxonomy went beyond measurement. Among his many ideas was his belief that the taxonomy could serve as a common language for expressing and understanding learning goals or objectives.^b

Bloom's emphasis on the use of measurable, action-oriented verbs facilitates the creation of outcome statements that lend themselves to more consistent and more effective

assessment. Bloom's Taxonomy consists of six levels in the cognitive domain, which herein are called levels of achievement. These achievement levels for cognitive development will occur as a result of formal education and experience.

The *Levels of Achievement Subcommittee Report*^c details the recommendation to use Bloom's Taxonomy as the levels of achievement for the BOK. The purpose of this appendix is to define the achievement levels and provide definitions of the active verbs used in the BOK for each level. These definitions are helpful because some of the active verbs can be used at different levels. Moreover, for some outcomes, Bloom's Taxonomy was not directly applicable and verbs were chosen with specific definitions to convey the progression through the levels of achievement. These special instances are noted in the definitions at each level. The definitions of the verbs were taken from *Webster's Third New International Dictionary, Unabridged*.^d The definition of the levels of achievement were summarized from Bloom's Taxonomy of Educational Objectives,^a *Stating Objectives for Classroom Instruction*, 2nd Edition^e and from the Levels of Achievement Subcommittee Report.^c

Level 1—Knowledge

Knowledge is defined as the remembering of previously learned material. This may

involve the recall of a wide range of material, from specific facts to complete theories, but all that is required is the bringing to mind of the appropriate information. Knowledge represents the lowest level of learning outcomes in the cognitive domain.^e

Define: to discover and set forth the meaning of.

Describe: to present distinctly by means of properties and qualities.

Identify: to select; to choose something for a number or group.

List: to declare to be.

Recognize: to perceive clearly.

Other illustrative verbs at the *knowledge* level include: enumerate, label, match, name, reproduce, select, and state.

Level 2—Comprehension

Comprehension is defined as the ability to grasp the meaning of material. This may be shown by translating material from one form to another (words to numbers), by interpreting material (explaining or summarizing), and by estimating future trends (predicting consequences or effects). These learning outcomes go one step beyond the simple remembering of material, and represent the lowest level of understanding.^e

Explain: to make plain or understandable.

Describe: to present distinctly by means of properties and qualities.

Distinguish: to perceive as being separate or different.

Discuss: to present in detail.

Other illustrative verbs at the *comprehension* level include: classify, cite, convert, estimate, generalize, give examples, paraphrase, restate (in own words), and summarize.

Level 3—Application

Application refers to the ability to use learned material in new and concrete situations. This may include the application of such things as rules, methods, concepts, principles, laws, and theories. Learning outcomes in this area require a higher level of understanding than those under comprehension.^e

Solve: to find an answer, solution, explanation, or remedy for.

Apply: to use for a particular purpose or in a particular case.

Use: to carry out a purpose or action by means of.

Formulate: to plan out in orderly fashion.

Develop: to make clear, plain, or understandable. Develop is similar to “explain” but at a greater level of detail.

Conduct: the act, manner, or process of carrying out (as a task) or carrying forward.

Report: to give an account of; to give a formal or official account or statement of.

Organize: to put in a state of order.

Function: to carry on in a certain capacity.

Demonstrate: to illustrate or explain in an orderly and detailed way especially with many examples, specimens, and particulars.

Explain: to give the reason for or cause of. Although commonly a level 2 or

level 5 verb when used in the context of outcome 11, contemporary issues and historical perspectives, the verb “explain” conveys the application of broad education to the identification, formulation, and solution of engineering problems.

Other illustrative verbs at the *application* level include: administer, articulate, calculate, chart, compute, contribute, establish, implement, prepare, provide, and relate.

Level 4— Analysis

Analysis refers to the ability to break down material into its component parts so that its organizational structure may be understood. This may include the identification of parts, analysis of the relationship between parts, and recognition of the organizational principles involved. Learning outcomes here represent a higher intellectual level than comprehension and application because they require an understanding of both the content and the structural form of the material.^e

Analyze: to ascertain the components of or separate into component parts; determine carefully the fundamental elements of (as by separation or isolation) for close scrutiny and examination of constituents or for accurate resolution of an overall structure or nature.

Select: to choose something from a number or group.

Organize: to arrange by systematic planning and coordination; to unify into a coordinated functioning whole. Although “organize” is not typically a level 4 verb, it is appropriate for outcomes 8 (problem recognition and solving), 16 (communication), and 20 (leadership). For each of these out-

comes, the verb “organize” conveys the appropriate educational objective progression.

Compare: to examine the character or qualities of, especially for the purpose of discovering resemblances or differences.

Contrast: to compare in respect of differences; to examine like objects by means of which dissimilar qualities are made prominent.

Illustrate: to make clear by giving examples or instances.

Formulate: to put into a systematized statement or expression.

Deliver: give forth in words; to make known to another. Although the verb “deliver” is not typically a level 4 verb, it is appropriate for outcome 16 (communication) because it conveys the appropriate educational objective progression.

Function: to carry on in a certain capacity. For level 4, the verb “function” is only used for outcome 21 (teamwork) and it has the same definition at level 4 as it does at level 3. In this case, the verb does not convey the educational progression between levels 3 and 4. Rather, the progression is delineated by the movement from an intradisciplinary to a multidisciplinary team.

Direct: to carry out the organizing, energizing, and supervising of, especially in an authoritative capacity; to regulate the activities or course of; to guide and supervise; to assist by giving advice, instruction, and supervision. The verb “direct” may not be considered a typical level 4 verb; however, within the context of outcome 20 (leadership), the verb “direct” conveys the logical educational progression in the outcome.

Identify: to establish the distinguishing characteristic of; to select; to choose something from a number or group. The verb “identify” is also a level 1 verb; however, within the context of outcome 23 (lifelong learning), the verb “identify” conveys the ability to determine the additional knowledge, skills, and attitudes appropriate for professional practice, which is a level 4 task.

Other illustrative verbs at the *analysis* level include: break down, correlate, differentiate, discriminate, infer, and outline.

Level 5—Synthesis

Synthesis refers to the ability to put together to form a new whole. This may involve the production of a unique communication, a plan of operation (research proposal), or a set of abstract relations (scheme for classifying information). Learning outcomes in this area stress creative behaviors and place major emphasis on the formulation of new patterns or structure.^e

Create: to produce (as a work of art or of dramatic interpretation) along new or unconventional lines; to make or bring into existence something new.

Design: to conceive and plan out in the mind; to create, fashion, execute, or construct according to plan; to originate, draft, and work out, set up, or set forth.

Specify: to tell or state precisely or in detail. Although not usually considered a level 5 verb, when used with outcome 7 (experiments), the verb “specify” refers to the ability to determine which experiment or experiments are required. Drawing from a wide range of possibilities and then specifying the appropriate one(s) is a level 5 task.

Explain: to show the logical development or relationships of. “Explain” is also a level 2 verb when it simply means to make plain or understandable. Showing a logical development or relationships are level 5 tasks.

Synthesize: combine or put together by the composition or combination of parts or elements so as to form a whole; the combining of often varied and diverse ideas, forces, or factors into one coherent or consistent complex.

Relate: to show or establish a logical or causal connection between.

Develop: to open up; to cause to become more completely unfolded so as to reveal hidden or unexpected qualities or potentialities; to lay out (as a representation) into a clear, full, and explicit presentation. “Develop” is also a level 3 verb when—much like the verb “explain”—it means to make clear, plain, or understandable. For outcomes 10 (sustainability), 12 (risk and uncertainty), 17 (public policy), and 19 (globalization) develop requires synthesis.

Plan: to devise or project the realization or achievement of; to arrange the parts of.

Compose: to form by putting together two or more things, elements, or parts; to put together; to arrange in a fitting, proper, or orderly way.

Integrate: to make complete; to form into a more complete, harmonious, or coordinated entity, often by the addition or arrangement of parts or elements; to combine to form a more complete, harmonious, or coordinated entity; to incorporate (as an individual or group) into a larger unit or group.

Construct: to form, make, or create by combining parts or elements; to create by organizing ideas or concepts

logically, coherently, or palpably; to draw with suitable instruments so as to fulfill certain specified conditions; to assemble separate and often disparate elements.

Adapt: to make suitable (for a new or different use or situation) by means of changes or modifications.

Organize: to arrange or constitute into a coherent unity in which each part has a special function or relation; to arrange by systematic planning and coordination of individual effort; to arrange elements into a whole of interdependent parts.

Execute: to put into effect; to carry out fully and completely.

Other illustrative verbs at the *synthesis* level include: anticipate, collaborate, combine, compile, devise, facilitate, generate, incorporate, modify, reconstruct, reorganize, revise, and structure.

Level 6—Evaluation

Evaluation concerns the ability to judge the value of material for a given purpose. The judgments are to be based on definite criteria. These may be internal criteria (organization) or external criteria (relevance to the purpose) and the individual may determine the criteria or be given them. Learning outcomes in this area are highest in the cognitive hierarchy because they contain elements of all the other categories as well as conscious value judgments based on clearly defined criteria.^e

Evaluate: to examine and judge concerning the worth, quality, significance, amount, degree, or condition of.

Compare: to examine the character or qualities of, especially for the purpose

of discovering resemblances or differences. This definition is the same as for level 4; however, when used in context with the verb “evaluate” for outcome 8 (problem recognition and solving), the combined action requires evaluation and is a level 6 task.

Appraise: to judge and analyze the worth, significance or status of; especially to give a definitive expert judgment of the merit, rank, or importance of.

Justify: to prove or show to be just, desirable, warranted, or useful.

Assess: to analyze critically and judge definitively the nature, significance, status, or merit of; to determine the importance, size, or value of.

Self-assess: to personally or internally analyze critically and judge definitively the nature, significance, status, or merit of a personal trait. Outcome 23 (life-long learning) uses the verb “self-assess” to convey the concept of introspective reflection.

Other illustrative verbs at the *evaluation* level include: compare and contrast, conclude, criticize, decide, defend, judge, and recommend.

Cited Sources

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- b) Anderson, L., D. R. Krathwohl, P. W. Airasian, K. A. Cruikshank, R. E. Mayer, P. R. Pintrich, J. Raths, and M. C. Wittrock. 2001. *A Taxonomy of Learning, Teaching, and Assessment: A*

Revision of Bloom's Taxonomy. Addison Wesley Longman, Inc. New York, NY.

- c) ASCE Levels of Achievement Subcommittee. 2005. *Levels of Achievement Applicable to the Body of Knowledge Required for Entry Into the Practice of Civil Engineering at the Professional Level*, Reston, VA, September. (<http://www.asce.org/raisethebar>)
- d) *Webster's Third New International Dictionary, Unabridged*. Merriam-Webster, 2002. Available at <http://unabridged.merriam-webster.com>.
- e) Gronlund, N. E. 1978. *Stating Objectives for Classroom Instruction*, 2nd Edition, Macmillan, New York, NY.