PERSPECTIVES

BLOOM'S TAXONOMY: What's Old Is New Again

Cecelia Munzenmaier, MS, with Nancy Rubin, PhD

THE eLEARNING GUILD™ RESEARCH

The eLearning Guild
120 Stony Point Rd., Suite 125
Santa Rosa, CA 95401
1.707.566.8990

Written by: Cecelia Munzenmaier, MS, with Nancy Rubin, PhD
Copy Editing: Charles Holcombe
Publication Design: Scott Hanson

Guild Research Types

The eLearning Guild delivers four specific types of research reports whose single goal is helping you make sense of the depth of our field. We work with great thinkers to analyze existing and new sources of knowledge and bring you concise reports that you can use to make important decisions, inform practice, and keep up-to-date. This is where you will find out about research in the field, new technologies, and what your peers are doing and thinking, in practical language.

- **Perspectives:** This type of report discusses myths, issues, and concerns, and educates learning and eLearning practitioners and managers so they can make informed decisions on important issues in the learning field. These reports include relevant references from the field and provide educated opinions.
- **Hot Topics:** The training industry is constantly coming up with new technologies. This type of report explains new technologies from all relevant angles to learning and eLearning practitioners and managers so they can quickly get up to speed on critical new knowledge.
- **Big Answers:** This type of report provides definitive answers to significant questions that learning and eLearning practitioners and managers need to improve their practice. These reports pull together relevant research on critical questions in the learning field in an open and practitioner-friendly way.
- **Survey:** This type of report answers questions that learning and eLearning practitioners and managers have about the thoughts, practices, actions, and choices of other eLearning professionals. These reports are based on survey responses from *eLearning Guild* members.

Disclaimer

The ratings, information, and opinions set forth on the *Guild* Research section of *The eLearning Guild* Website, and in the *Guild Research* charts and graphs found in this report, are those of the members of *The eLearning Guild*. *The eLearning Guild*, *Focuszone Media, Inc.*, and its officers, employees, directors, and shareholders have no liability for any loss, damage, action, causes of action, expense, cost, or liability including attorney fees, arising out of any statements, ratings, information, opinions, or claims set forth in the *Guild* Research section. See the "*Guild* Research" section of the Privacy, Membership, and Terms of Use Agreement at http://www.elearningguild.com/pbuild/linkbuilder.cfm?selection=fol.12.

License Agreement for Guild Research

The eLearning Guild (the "*Guild*") provides charts, graphs, studies, reports, and other research materials in the field of eLearning on its website and in printed form (the "Materials") for use by persons engaged in advancing research and study in eLearning. Except as provided herein, none of the Materials may be duplicated, copied, re-published, or reused without written permission from the *Guild*. The Materials reflect the research and opinion of the *Guild's* members, as well as the opinions of certain subject matter experts contracted by the *Guild*.

The *Guild* grants a limited, non-exclusive, non-transferable license to each user permitted under the particular license category he/they have purchased (each "Member," "Member-Plus," or "Premium Member" being a "Licensee") to use the Materials in accordance with the following terms and conditions:

1. Except as otherwise restricted in this License Agreement, Licensee may read, download, and print the Materials for Licensee's personal use for purposes of research, evaluation, development, and testing in order to advance knowledge in the field of eLearning.
2. Licensee may cite, reproduce, or copy up to four statistics, tables, graphs, or charts in any 12-month period, but may not reproduce images that show product comparisons without written permission from the *Guild*. Additional citations, reproductions, or copies may be made only with written permission from the *Guild*.
3. The *Guild* must be cited as the source of any original statistics, tables, graphs, charts, or any other Materials copied or reproduced by Licensee. The citation to the *Guild* as the source must be in eight-point font or larger, and be placed immediately following the portion of the Materials used by Licensee.
4. Licensee may not use or distribute the materials for commercial purposes, directly or indirectly. Commercial use or distribution of the Materials is permitted only pursuant to a separate reprint/redistribution commercial license agreement between Licensee and the *Guild*. The *Guild* retains all commercial rights in the Materials.
5. This License Agreement grants to Licensee no right, title, or interest in or to the *Guild's* copyrights or other intellectual property in the Materials. Other than the specific rights granted by this License Agreement, the *Guild* retains all right, title, and interest in and to the Materials.
6. The *Guild* makes no representations or warranties of any kind, express or implied, with regard to the Materials. The *Guild* makes no express or implied warranties of merchantability or fitness for a particular purpose with regard to the Materials, and no warranty that the use of the Materials will not infringe any patent, copyright, trademark, or other intellectual or proprietary rights.
7. Licensee agrees to use the materials in compliance with all applicable laws.
8. In any use of the Materials by Licensee, Licensee may not, in any way, indicate or imply that the *Guild* has endorsed Licensee or its products.
9. Neither the *Guild*, nor its employees, agents, or representatives, will be liable or responsible to Licensee in any manner whatsoever for damages of any nature, incidental, consequential, or punitive, arising from the termination of this License Agreement or the use of the Materials by Licensee.
10. The provisions of the Privacy, Membership, and Terms of Use Agreement between Licensee and the *Guild*, including specifically but without limitation the *Guild* Research section of such agreement, are incorporated in this License Agreement by reference, and are a part of this License Agreement.
11. This License Agreement is to be construed and enforced in accordance with the laws of the state of California. The parties consent to the exclusive jurisdiction of the state and federal courts located in Sonoma County, California.

Table of Contents

THE eLEARNING GUILD

Community & Resources
for eLearning Professionals

The Benefits of Guild Membership

The eLearning Guild is the oldest and most trusted source of information, networking, and community for eLearning professionals. The *Guild* produces conferences, online events, research reports, and *Learning Solutions Magazine*.

With multiple levels of individual or group membership, the *Guild* provides all learning professionals with the opportunity to share their knowledge, expertise, and ideas to build a better industry—and better learning experiences for everyone.

DevLearn · Learning Solutions Conference & Expo · LearnCon · Performance Support Symposium 2013 · The eLearning Guild Academy · Online Forums · Thought Leaders Webinar Series · The eLearning Guild Research · Learning Solutions Magazine

Not a Member? **Join Today**

Tap into the vast wealth of professional development opportunities available to *eLearning Guild* members:	Member $99	Member-Plus $695	Premium $1,695
Conferences Industry-leading events offering unparalleled learning and networking opportunities	20% Discount	20% Discount	One Conference + One Pre-conference Workshop
Conference Archive Handouts, Concurrent Session Videos, and Keynote Videos	Handouts + Sessions	Handouts + Sessions + Keynotes	Handouts + Sessions + Keynotes
Online Forums Two-day online conferences delivering real eLearning for eLearning professionals	20% Discount	All Live Events + 800 Session Archive	All Live Events + 800 Session Archive
Guild Research High-quality, actionable research reports to help you make smarter business decisions	50+ Report Library	50+ Report Library	50+ Report Library
Thought Leaders Webinars Monthly discussions with leading thinkers on the latest ideas, techniques, and strategies	All Live Events + Archive	All Live Events + Archive	All Live Events + Archive
Additional Benefits *Learning Solutions Magazine*, Job Board, eBooks, and more	Full Access	Full Access	Full Access

JOIN TODAY! www.eLearningGuild.com | +1.707.566.8990

The eLearning Guild | 120 Stony Point Road, Suite 125 | Santa Rosa, CA 95401

Executive Summary

Bloom's Taxonomy … is there anything in the learning sciences that is more familiar? But is a heuristic from the 1950s still relevant in our tech-savvy world? Surprisingly (or maybe not surprisingly), it is extremely relevant! Those of us who design instruction use Bloom's familiar pyramid and verbs to write learning objectives. Online instructors have used it to measure the quality of online discussions, and curriculum planners continue to find innovative applications of the framework. And it's increasingly called on to support the new Common Core standards in K-12 education. But as you'll see in this research report, educators in all venues can use revised and digital versions of Bloom's to support what we now know about cognition, performance objectives, and social learning.

Benjamin Bloom's eponymous taxonomy emerged from a series of informal discussions with colleagues that began at the American Psychological Association in 1948. He actually intended his work for a narrow audience: assessment experts who were developing new ways to measure what college students learned. But Bloom's Taxonomy became the most widely used method of creating learning objectives.

Bloom's Taxonomy helped make an important shift in educator's focus: from teaching to learning. When the original taxonomy was published, as much as 90 percent of classroom time was spent on activities designed to help learners recall facts. Forty years later, Bloom estimated that the percentage of lower-order assessment questions had been reduced to about 70 percent. By correlating assessment questions to Bloom's cognitive levels, test developers can ensure that their questions promote both retention of knowledge and critical thinking.

Among the dozens of alternatives proposed to the original framework, a revision to the taxonomy was published in 2001: *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. The new version has two dimensions—knowledge and cognitive processes—and the subcategories within each dimension are more extensive and specific.

The new emphasis on cognitive processes remedies a weakness in the original taxonomy. In the 1956 version, the verbs associated with each cognitive level describe behaviors. However, the same behavior can sometimes be performed at different cognitive levels. Adding a second dimension allows objective writers to differentiate between, say, retrieving a list or constructing one.

In 2007, Andrew Churches updated Bloom's work one step further when he introduced Bloom's Digital Taxonomy. His intent was to marry Bloom's cognitive levels

to 21st-century digital skills. Churches added ways to use Web 2.0 technologies to each cognitive level in Bloom's revised taxonomy.

Within the report are numerous charts, job aids, and activities that allow you to make the most of the innovations and updates in Bloom's Taxonomy for yourself and your work team.

Measured against the criteria Bloom established in 1956, his work stands the test of time. His taxonomy is a widely accepted metric that continues to provoke new research, shape best instructional and assessment practice, and provide a common language and framework for collaboration.

Bloom's Original Taxonomy: The Beginning

Benjamin Bloom didn't intend to invent educational dogma. When he began developing his taxonomy of educational objectives (grouping educational objectives into ordered categories), his main goal was to find a common language that educational measurement experts could use to share findings and exchange test items.

Bloom's Taxonomy emerged from a series of informal discussions with colleagues that began at the American Psychological Association in 1948. At the time, educators were wrestling with a number of questions, many prompted by the influx of World War II veterans enrolling in college. The veterans wanted a good education, but what makes an education "good"? How could instructors ensure that learners graduated with more than just lower-level factual knowledge?

One of Bloom's students, Lee S. Shulman, recalls that when these questions were raised, educators were just beginning to consider assessment. Bloom, as the director of the examiner's office at the University of Chicago, was developing assessments to measure learning. When he tried to share ideas and test items with other evaluators, he found that instructors agreed that they wanted learners to "understand," but they had very different ideas about what understanding meant.

Bloom envisioned a taxonomy that would organize educational goals into a hierarchy, much as biologists classify living creatures into categories that ascend from species to kingdom. The taxonomy that bears his name is based on the work of hundreds of collaborators, including reviewers, contributors of case studies and examples, and a core working group of about 30 people. The result of their efforts, published in 1956, is officially known as *Taxonomy of Educational Objectives.* Bloom often called this work *The Handbook*. However, the educators, instructional designers, researchers, and evaluators who apply this classification generally refer to it as Bloom's Taxonomy. This recognizes Bloom's foundational contribution to the project: He convinced his collaborators to organize learning behaviors on a continuum from the simplest to the most complex.

Four Key Principles

Bloom identified four principles that guided the development of the taxonomy. Categories should:

- Be based on student behaviors
- Show logical relationships among the categories
- Reflect the best current understanding of psychological processes
- Describe rather than impose value judgments

In his discussion of these principles, found in Chapter 1 of *The Handbook*, Bloom anticipated some of the most frequent criticisms of his work. The taxonomy is based on behaviors that teachers can observe, so its language does not capture the complexities of internal learning processes. The psychological understanding of the 1950s does not reflect what we now know about how learners construct knowledge, monitor their thinking, or regulate their own mental processes. Bloom also acknowledged that the taxonomy does not provide a complete theory of learning. However, he hoped that this classification system would support the development of a comprehensive theory by providing a framework that educators could use to identify research problems, develop hypotheses, plan learning, and identify methods and metrics, and by defining a common language to use when setting learning goals, measuring outcomes, and sharing findings.

Today, Bloom's Taxonomy is the most widely used method of creating learning objectives. Researchers use its levels to measure outcomes and compare everything from programs to methods of learning. While several modifications have been proposed, Bloom's description of learning domains and levels of complexity is still widely used.

Three Original Domains

Bloom's original taxonomy consisted of three domains:

- Cognitive—knowledge-based domain
- Affective—attitude-based domain
- Psychomotor—physical skills-based domain

Table 1 (on page 5) outlines the three domains of Bloom's original taxonomy and gives a brief overview of each domain with the abilities associated with each domain.

Table 1:

Domains in Bloom's original taxonomy

Domain	Overview	Abilities
Cognitive	Content and intellectual knowledge: What do I want learners to know?	• Conceptualization • Comprehension • Application • Evaluation • Synthesis
Affective	Emotional knowledge: What do I want learners to think or care about?	• Receiving • Responding • Valuing • Organizing • Characterizing
Psychomotor	Physical/mechanical knowledge: What action(s) do I want learners to be able to perform?	• Perception • Simulation • Conformation • Production • Mastery

Despite Bloom's intent to speak to all three domains, *The Handbook* focuses only on intellectual skill development. The affective domain was addressed by David Krathwohl in his *Handbook II: Affective Domain* (1964). There was no *Handbook III* for the psychomotor domain, but authors such as Simpson and Harrow have developed taxonomies for this domain (see the University of Connecticut's Assessment Primer at http://assessment.uconn.edu/primer/taxonomies1.html). The focus of this paper is the cognitive domain.

One Cognitive Hierarchy

The cognitive domain of Bloom's original taxonomy has six levels organized in a hierarchy (Figure 1). The base of the pyramid is the foundation of all cognition, knowledge. Each ascending level of the pyramid depends on the one below it: For example, learners must comprehend what a homesteader's exemption is before they can apply the definition to determine whether someone qualifies for a tax break. Knowledge and comprehension are often referred to as lower-order thinking skills. The skills above them are termed higher-order or critical thinking skills.

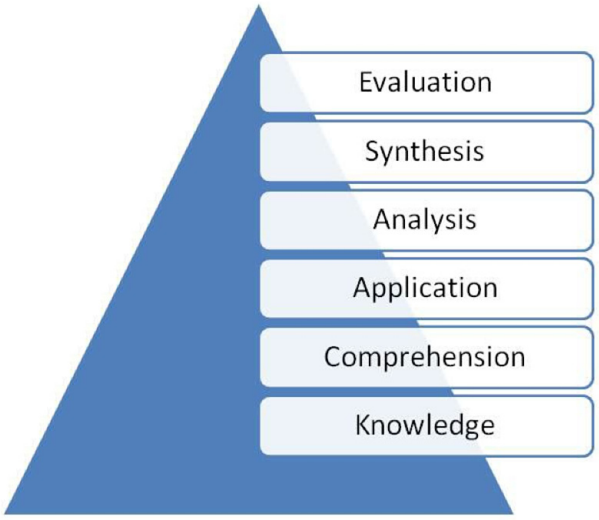


Figure 1:

The six levels of the cognitive domain of Bloom's original taxonomy

The knowledge level, at the bottom of the hierarchy, is defined as remembering or retrieving previously learned material. Learning objectives at this level often include defining key terms, listing steps in a process, or repeating something heard or seen. For example, an objective for an orientation session might include new hires recognizing a correct description of how employees become vested in the company's retirement plan. In this case, knowledge-level objectives are clearly critical, as they are foundational to understanding additional materials. However, designers tend to write too many knowledge-level objectives because they find it so easy to pick out definitions and details.

Comprehension represents the largest category of cognitive skills and abilities. The key skill at this level is processing new information. For example, after orientation new hires might be asked to use the benefits information they were given to answer basic questions such as, if a person starts in the middle of the month, when do medical benefits begin?

At the application level, a learner should be able to solve a new problem by applying information without having to be prompted. Objectives at this level might require learners to interpret information, demonstrate mastery of a concept, or apply a skill learned. At an orientation, for example, participants might be asked to apply time-off calculations to their own schedules.

Analysis requires learners to recognize relationships among parts. Objectives at this level of the hierarchy often include verbs such as *differentiate*, *compare and contrast*, *criticize*, or *experiment*. At an employee orientation, participants might be asked to classify workers into different categories according to eligibility for unpaid leave.

Synthesis calls for creative behavior because learners produce newly constructed and, many times, unique products. At this level, objectives might have learners create a plan, propose an idea, design a product, or organize information. During an employee orientation, for example, participants might plan the best way to maximize use of the 401K plan.

Evaluation involves making judgments about value. Learning objectives at this level require learners to measure, value, estimate, choose, or revise something, perhaps information, a product—or solve a problem. A newly hired employee, for example, might need to evaluate which insurance plan provides the most appropriate coverage.

Instruction that stops too low on the taxonomy doesn't give learners the chance to think critically enough about what they are learning. When objectives focus solely on recall and comprehension, learners may understand what they have learned but fail to recognize when to apply their knowledge. Higher-order objectives require learners to use what they have learned and can give them practice in developing new approaches to problems, identifying critical variables, and making needed judgments. Both the original Bloom's Taxonomy and its later revisions can be used to develop much-needed critical thinking.

Original Bloom's in Action: Writing Objectives

Learning objectives, also called instructional objectives, are statements describing what learners will be able to do upon completion of a unit of instruction. They help us decide what learners should learn and how we will determine whether they have learned that content. This brings up an important point: We write these objectives, at least at the outset, to guide the design of the instruction.

Clear objectives guide instructional designers, teachers, and facilitators in choosing appropriate instructional delivery methods and instructional strategies and therefore help learners achieve desired learning outcomes. To ensure that activities and evaluation are valid and properly aligned to instructional goals and content, assessments should be developed from objectives.

Suppose that one objective of a lesson calls for nursing students to determine whether a patient in the emergency room needs immediate care. This requires clinical judgment, so students need practice in interpreting assessment data and predicting outcomes. To assess this objective, questions on the knowledge and comprehension levels may be used to determine whether students can recall the facts needed to make an informed decision. However, the objective cannot be met unless students demonstrate that they can use higher-order thinking skills to make a clinical judgment.

Objectives can also be used to determine whether instruction aligns with educational outcomes or business goals. Suppose that a company invests in training to improve the performance of its service technicians. If the technicians meet only lower-level objectives, their skill is unlikely to improve. They might be able to label every part of every machine without error, but to do their job effectively they must develop the higher-order skills of diagnosing malfunctions and making repairs.

Cognitive Levels

In the original taxonomy, the verbs in learning objectives describe intended behavior—what learners will do to show that they have attained the objective. Learning objectives using verbs from the taxonomy have at least two parts:

- A noun or noun phrase identifying who is to perform the action
- A verb phrase describing the required behavior

For example:

Noun/Noun Phrase	Verb Phrase
The *learner*	will *identify* the flammable items.
The *learner*	will *determine* the merits of a proposal to create a new international division to handle international accounts.

In this example, the verb is *identify*. The cognitive skill required is recalling information. So the first example clearly targets Bloom's level 1, knowledge. In the second example, the verb *determine* could be associated with more than one cognitive level. Trainees might analyze whether the benefits of the proposal outweigh its costs. However, they might also be expected to judge whether the proposal is written in a way that meets criteria for communication excellence. The second objective should be revised so that the verb clearly targets either level 4, analysis, or level 6, evaluation.

Much of the power of Bloom's Taxonomy lies in its verbs. The verbs associated with each cognitive level identify what students can do to demonstrate that they have met objectives. The secret of alignment, whether at the lesson or program level, is to choose verbs that correlate instructional goals with content and assessment. Suppose a company develops a program to improve managers' coaching skills. If the instructional objectives are "List the steps in the coaching process" and "Define coaching," the program has a fatal flaw: its objectives are limited to the knowledge level, but its goals include mastery of higher-order skills that participants may not have learned or practiced. If instruction is limited to the knowledge level and participants must use higher-order skills to show mastery, the misalignment between lower-level instruction and higher-level assessment sets learners up to fail.

The lesson here is that it is critical to construct learning objectives at the level that you expect learners to perform.

Tools for Writing Objectives

Because learning objectives are so critical to instruction and assessment, many tools have been created to help writers use the original taxonomy to develop them. The most basic tools are tables that suggest verbs correlated to each level of cognition, such as Table 2 (on page 10) for an example. To use such tables, first identify the cognitive level you want to target; then choose a verb from the key words column and use it to begin your objective.

Table 2:

Bloom's Taxonomy cognitive levels and key words

	Skill	Definition	Verbs
Level 1	Knowledge	Recall information	Identify, describe, name, label, recognize, reproduce, follow
Level 2	Comprehension	Understand the meaning, paraphrase a concept	Summarize, convert, defend, paraphrase, interpret, give examples
Level 3	Application	Use the information or concept in a new situation	Build, make, construct, model, predict, prepare
Level 4	Analysis	Break information or concepts into parts to understand it more fully	Compare/contrast, break down, distinguish, select, separate
Level 5	Synthesis	Put ideas together to form something new	Categorize, generalize, reconstruct
Level 6	Evaluation	Make judgments about value	Appraise, critique, judge, justify, argue, support

Objectives at the knowledge level might ask learners to:

- Define a key term
- List the steps in a process
- Label a diagram

These objectives require learners to find an application for what they have learned:

- Predict the answer to a problem given certain variables
- Select the key concepts to cover in a course unit or training module

Some tools add a third element: an observable behavior that learners perform to show that they have met the objective. The result is a three-part learning objective that specifies who is to meet the objective, what is to be done, and what the result will be.

Who	does what	to accomplish this
The learner	will identify the parts of a Widget2000	by labeling a diagram
The sales representative	will use the jujitsu strategy	to develop counters to at least two anticipated objections

Tools that include this third element often show relationships among cognitive levels and components of the objective graphically. For example, the original taxonomy is often depicted as a staircase (Figure 2 on page 11) because it is a cumulative hierarchy.

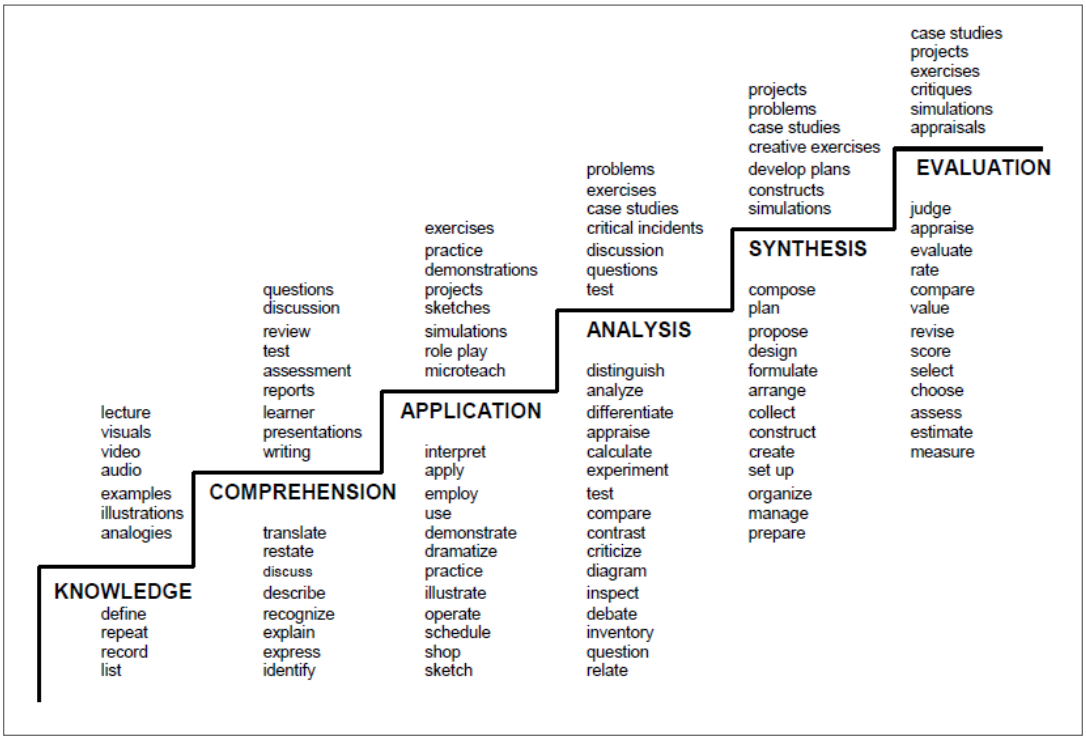
Learners are expected to climb the levels in sequence, and mastery of each step is required before moving to the next, more complex, level.

In Figure 2, the stairs represent the cognitive levels, arranged in ascending sequence. Above each step is a list of suggested activities for that level. Below each step is a list of verbs that might be used to create objectives targeted to that cognitive level.

Figure 2:

Bloom's Taxonomy staircase

(Source: ftp://ftp-fc.sc.egov.usda.gov/NEDC/isd/taxonomy.pdf)



Let's see how the staircase in Figure 2 can be used to create learning objectives.

1) Select the cognitive level of the learning objective.
2) Choose a verb from the list below that step.
3) Connect the verb to an activity above the step.

Sample application learning objective: Learners will demonstrate how to create a ticket for a request for computer support.

Sample evaluation learning objective: Learners will compare three sales call scripts and judge which is most likely to close the sale.

Objectives can be made more specific by basing them on real-world conditions or performance criteria, as shown in Table 3 (on page 12).

Table 3:

Examples of objectives with conditions and performance criteria

(Source: Shank)

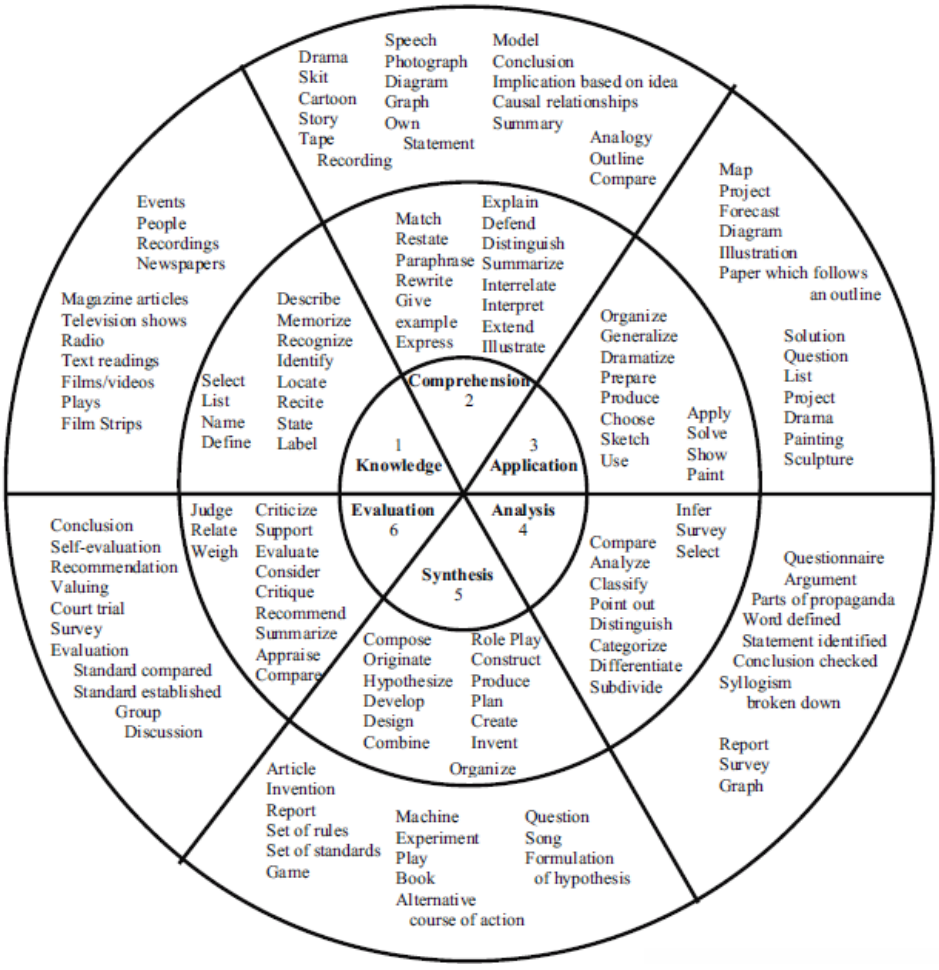
Who	Action	Conditions	Criteria
The student will	assess which window treatment(s) will work best.	given window size, facing, type, and budget	
The customer service rep will	manage client phone complaints		with fewer than 2% escalated to managers

The Bloom's Taxonomy question and task design wheel has a more extensive list of ideas for active learning. The wheel, available from CESA 7, is organized as a series of rings. The inner ring identifies the cognitive level of Bloom's Taxonomy; the middle ring contains action-oriented verbs; and the outer ring lists products and activities that demonstrate mastery.

Figure 3:

Bloom's Taxonomy question and task design wheel

(Source: CESA 7; http://www.cesa7.org/tdc/documents/bloomswheelforactivestudentlearning.pdf)



For an example of how to use Bloom's Taxonomy to differentiate outcomes for basic and advanced courses, see the University of Connecticut's Assessment Primer (http://assessment.uconn.edu/primer/taxonomies1.html). Note that students use higher-order thinking skills in both introductory and advanced courses. The verbs describing cognitive processes do not change; what does change is the amount of critical thinking students are expected to do, which increases as they advance.

Another strategy for writing objectives is to complete a prompt. A critical thinking poster in a Flickr photostream by Enokson (no real name given) illustrates how to use sentence frames to create questions and objectives for each level of Bloom's Taxonomy. For example, a question for the analysis level is "What evidence can you present for _____?" An objective for the evaluation level is "Prioritize _____ according to _____." The poster, which may be freely used by not-for-profit organizations, is available at http://www.flickr.com/photos/vblibrary/4576825411/in/pool-27724923@N00/.

Still more tools, some interactive, are available on Larry Ferlazzo's Websites of the Day blog, which has an entry on "The Best Resources for Helping Teachers Use Bloom's Taxonomy in the Classroom" (http://larryferlazzo.edublogs.org/2009/05/25/the-best-resources-for-helping-teachers-use-blooms-taxonomy-in-the-classroom/).

Original Bloom's in Action: Developing Critical Thinking Questions

Forty years after the original taxonomy was published, Bloom reflected that one reason his work was widely adopted was the need for a systematic approach to educational planning. The taxonomy influenced practitioners to think about objectives, shifting their focus from what teachers did to what was learned. The distinction between higher- and lower-order thinking skills also raised awareness of the need to foster critical thinking. When the original taxonomy was published, as much as 90 percent of classroom time was spend on activities designed to help learners recall facts. Forty years later, Bloom estimated that the percentage of lower-order questions had been reduced to about 70 percent.

The tendency for instructors to ask more lower-order than higher-order questions persists, even though student achievement improves when teachers ask more higher-order questions. For a discussion of the correlation between student achievement and critical thinking questions, see Wenglinsky's 2001 report for the Educational Testing Service, "Teacher Classroom Practices and Student Performance."

The same bias toward lower-order questions is found in teacher-made and standardized tests. One reason is that lower-order questions are easier to write and score. However, testing at higher cognitive levels is both more valid and more efficient, according to Usova. When answering higher-level questions, learners must use knowledge and skills from lower cognitive levels. For example, a question might ask learners to analyze the differences between a company's new defined-contribution plan and the pension plan it replaced. To make the comparison, they must know the definition of each type of plan, understand the purpose of each type, and use this information to categorize the differences.

Not only is testing at higher cognitive levels more efficient, asking too many lower-order questions can actually impede learning. If you ask lower-order questions, the result will be lower-order learning, according to Andre (cited in Bloom's "Reflections"). To encourage higher-level learning, you must ask higher-order questions. Effective higher-order questions are often based on real-world experience, so asking learners to think critically in response to questions based on realistic situations develops their thinking and makes them more likely to use what they have learned. Andre's conclusions have particular relevance for educators who must provide evidence of student achievement and for trainers and instructional designers who must show how their work contributes to organizational goals.

By correlating assessment questions to Bloom's cognitive levels, practitioners and test developers can ensure that their questions promote both retention of knowledge *and* critical thinking. The model test items developed for *The Handbook* are still considered excellent examples of how to construct test questions. The editors of the revised taxonomy believed that they could not improve on the model items in the original.

Criticisms and the Need for Revision

The original taxonomy is still widely used by teachers, instructional designers, researchers, and assessment writers. However, a revised version of the taxonomy was published in 2001 to update the original and provide more guidance for classroom teachers. The editors also addressed some common criticisms of the original:

- The hierarchy lacks internal consistency; this is the most frequent criticism. Some categories overlap, and some skills—such as understanding—can be exercised at many cognitive levels.
- The taxonomy has not been validated by external evidence. Different raters often assign different cognitive levels to the same items, and the hierarchical relationship of the cognitive levels has not been proven.
- The taxonomy is too simplistic in the way it represents thinking and learning. Learning does not always follow a step-by-step progression. Also, the categories at the top level of the hierarchy do not adequately describe higher-order thinking processes.
- The taxonomy is a framework, or set of loosely organized principles, rather than a theory of instruction that can be used to predict how learners will behave.
- The term "lower-level thinking skills" has led educators to devalue the foundational knowledge required for higher-order thinking.
- The original taxonomy was based on the classroom practice and educational psychology of the 1950s.

In 1965, Bloom and one of his chief collaborators responded to calls for a revision by calling a meeting to find ways to make the framework easier for elementary and high school teachers to use. Their first effort to revise the taxonomy failed, explains David Krathwohl in "The Taxonomy: Past, Present, and Future," largely because of the difficulty of constructing one unified theory of learning.

During the 1970s, the use of Bloom's cognitive levels became institutionalized. Recipients of Title I funds used the taxonomy to develop objectives that met the federal government's reporting requirements. As states began standardized testing programs, item development guidelines called for questions that targeted both higher- and lower-order thinking.

In 1983, a National Commission on Excellence in Education warned that widespread deficiencies in critical thinking were making America *A Nation at Risk*, as it titled its report. The Association for Supervision and Curriculum Development met the following year to consider solutions to the problem. One recommendation called for an update to Bloom's Taxonomy. In response, 28 organizations formed a collaborative to revise the original version, but their efforts bore no fruit.

The Revised Version of Bloom's Taxonomy

Among the dozens of alternatives proposed to the original framework, the revision published by Lorin Anderson and his collaborators in 2001, *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*, has gained the widest acceptance. Anderson was a student of Bloom's, and one of his principal collaborators, David Krathwohl, also collaborated on the original taxonomy. They describe their work as an extension of the original framework rather than a replacement.

The original taxonomy was never intended to be definitive. In fact, Bloom expressed concern that people might grant the framework such authority that it would "freeze" thinking about curriculum, assessment, and instruction. He and his collaborators considered the framework a work in progress. In Bloom's ideal world, each field would have its own taxonomy written in the language of its discipline.

So the revision published in 2001 is not a heretical departure from the original *Handbook*, but a continuation of Bloom's work.

The original taxonomy was revised for two reasons:

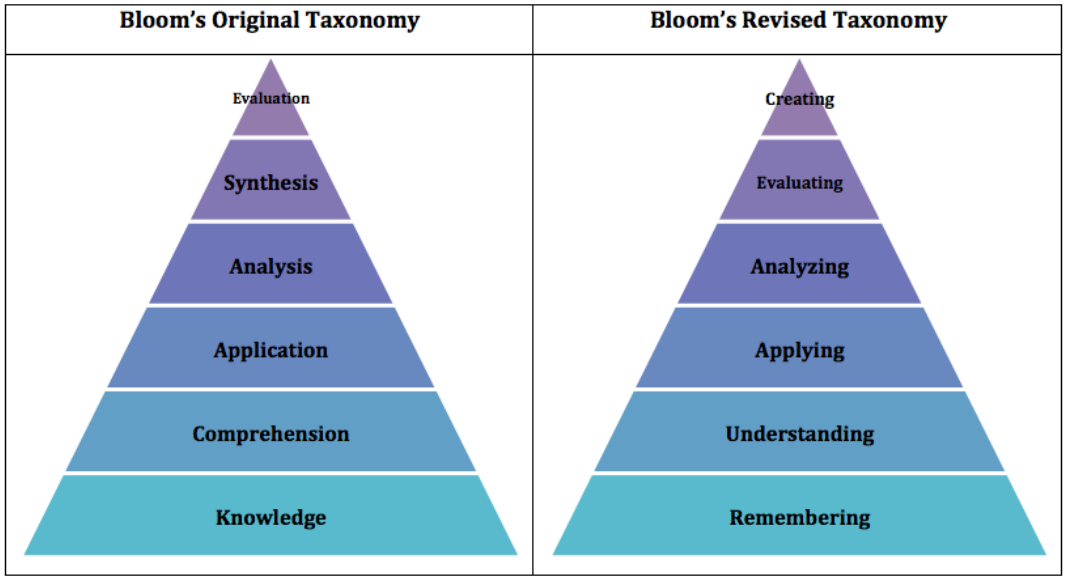
- To refocus attention on the value of the original handbook in developing accountability programs, aligning curriculums, and designing assessments
- To update the original based on new understanding of learning and new methods of instruction

Changes to the Categories

Figure 4 (on page 18) shows the most obvious differences between the 1956 and 2001 versions. In the revised taxonomy, evaluation is no longer the highest level of the pyramid. A new category, creating, claims the peak. This category was originally known as synthesis. Another significant change is that category names are no longer nouns, but verbs. For example, knowledge is now understanding. As a consequence, objectives developed using the revised taxonomy now describe learners' thinking processes rather than behaviors.

Figure 4:

Bloom's original and revised taxonomies



Other differences are more subtle. In the original taxonomy, the most important element was the categories. Six categories were arranged in a hierarchy, and it was assumed that learners must master the lowest level of the hierarchy before they could advance to the next higher level. The revised taxonomy also arranges skills from the most basic to the most complex. However, because skills such as understanding can be exercised on many levels, the developers allowed categories to overlap. For example, understand is technically lower on the hierarchy than apply. However, the skill of explaining is more cognitively complex than executing, even though that skill is associated with a higher category. As a result, "the hierarchy is no longer considered cumulative," according to Krathwohl.

From One to Two Dimensions: Knowledge Levels and Cognitive Processes

While Figure 4 makes it easy to see changes in the six categories, it does not show two important elements of the revised taxonomy: the new version has two dimensions—knowledge and cognitive processes—and the subcategories within each dimension are more extensive and specific. Each element is explained below; for a visual representation of how the elements relate to each other, see Figure 5 (on page 22).

The first dimension, knowledge, now contains four categories of knowledge arranged from the most concrete to the most abstract:

- Factual—knowledge that is basic to an area of study: essential facts, terminology, details, or elements learners must know or be familiar with in order to understand

a discipline or solve a problem within a field of study. For example, educational measurement specialists must know the difference between formative and summative assessments.

- Conceptual—knowledge of classifications, principles, generalizations, theories, models, or structures pertinent to a particular disciplinary area. For example, librarians often catalog materials according to the Dewey Decimal System or the Library of Congress classification system.
- Procedural—information or knowledge that helps learners to do something specific within an area of study. It also refers to methods of inquiry, very specific skills, algorithms, techniques, and particular methodologies. This knowledge is often subject- or job-specific. For example, nuclear power plant operators might have to follow emergency shutdown procedures.
- Metacognitive—awareness of one's own thinking and personal growth. This category was added because recent research has given us new understanding of how learners monitor and regulate their own cognitive processes. For example, an instructional designer might recognize that the objectives for a unit do not align with its content. A learner, aware of a tendency toward bias, might consciously choose to research opposing points of view.

The second dimension, cognitive processes (shown in Table 4), organizes 19 cognitive processes along a continuum from the most basic to the most complex. In the revised taxonomy, these cognitive processes are considered more important than the six categories, according to Krathwohl.

Table 4:

The cognitive processes dimension—categories and cognitive processes and alternative names

(Source: Iowa State University Center for Excellence in Learning and Teaching; http://www.celt.iastate.edu/pdfs-docs/teaching/RevisedBloomsHandout.pdf)

lower order thinking skills → higher order thinking skills

remember	understand	apply	analyze	evaluate	create
recognizing • identifying recalling • retrieving	interpreting • clarifying • paraphrasing • representing • translating exemplifying • illustrating • instantiating classifying • categorizing • subsuming summarizing • abstracting • generalizing inferring • concluding • extrapolating • interpolating • predicting comparing • contrasting • mapping • matching explaining • constructing models	executing • carrying out implementing • using	differentiating • discriminating • distinguishing • focusing • selecting organizing • finding coherence • integrating • outlining • parsing • structuring attributing • deconstructing	checking • coordinating • detecting • monitoring • testing critiquing • judging	generating • hypothesizing planning • designing producing • constructing

Adapted from Anderson & Krathwohl, 2001.

Revised Bloom's in Action: Writing Two-Dimensional Objectives

The new emphasis on cognitive processes remedies a weakness in the original taxonomy. In the 1956 version, the verbs associated with each cognitive level describe behaviors. However, the same behavior can sometimes be performed at different cognitive levels. For example, an objective might ask learners to list the three most serious sources of pollution in their state. The behavior—writing a series of related items—is the same whether learners are simply recalling information from a source or independently evaluating the most damaging sources of pollution. Adding a second dimension allows objective writers to differentiate between retrieving a list or constructing one.

Two-dimensional learning objectives follow a familiar structure:

Subject	Verb	Object
Who	does what	to accomplish this

However, two-dimensional objectives allow writers to be more specific about the level of cognitive complexity required by first *choosing a verb associated with a cognitive process* and then *targeting the type of knowledge learners are asked to master*. For example:

Subject	Cognitive Process	Type of Content
The learner will	remember (*recognize, recall*)	factual
	understand (*interpret, classify, summarize*)	conceptual
	apply (*execute, implement*)	procedural
	analyze (*differentiate, organize, attribute*)	metacognitive
	evaluate (*check, critique*)	
	create (*generate, plan, produce*)	

In the original taxonomy, verbs are associated with six categories of cognitive skills and abilities: knowledge, comprehension, application, analysis, synthesis, and evaluation. Using the revised taxonomy, objective writers can target either a category or one of the 19 cognitive processes. Airasion and Miranda suggest that writers avoid vague terms such as *learn* or *state* by choosing the names of either the categories (bolded in Table 4) or thinking skills (bulleted in Table 4) as verbs when developing objectives. For example, the objective "Learners will state the main point" could be made more precise by replacing *state* with *recall* or *summarize*.

Develop Performance-based Objectives with Bloom's

If you are using either version of Bloom's Taxonomy to write performance objectives, your choice of verbs is critical. Michele Medved of MBM Training identifies three criteria for selecting verbs for performance objectives.

Verbs in performance objectives must:

- Be measurable and observable
- Specify what the learner (not the instructor) does
- Require the learner to apply the learning

Verbs are the most critical element of a performance objective because they identify what the learner must do to meet the objective. Another component of an effective performance objective is the condition under which the learner performs. One way to identify the conditions is to use the knowledge dimension of the revised taxonomy. First, determine how (or in what context) will learners use what they have learned? Then identify the cognitive process learners must use to apply their knowledge. Objectives for any cognitive process can target any of the four categories of knowledge, as shown below.

Table 5:

Job aid using Bloom's to target the knowledge dimension

Type of Knowledge: How will learners use what they learn?	Cognitive Process: Remember	Cognitive Process: Evaluate
Factual	List the links in the Chain of Survival.	Check whether a performance objective contains all necessary elements.
Conceptual	Recognize the symptoms of a heart attack.	Determine whether a performance objective targets knowledge or skill learners need to do their job.
Procedural	Recall how to give chest compressions for an adult.	Judge whether performance criteria are fair and appropriate.
Metacognitive	Identify situations in which CPR is not the appropriate treatment.	Reflect on how I can write better performance objectives.

Figure 5 shows how the two dimensions of the revised taxonomy relate to each other and to cognitive complexity. The knowledge dimension, shown on the left in

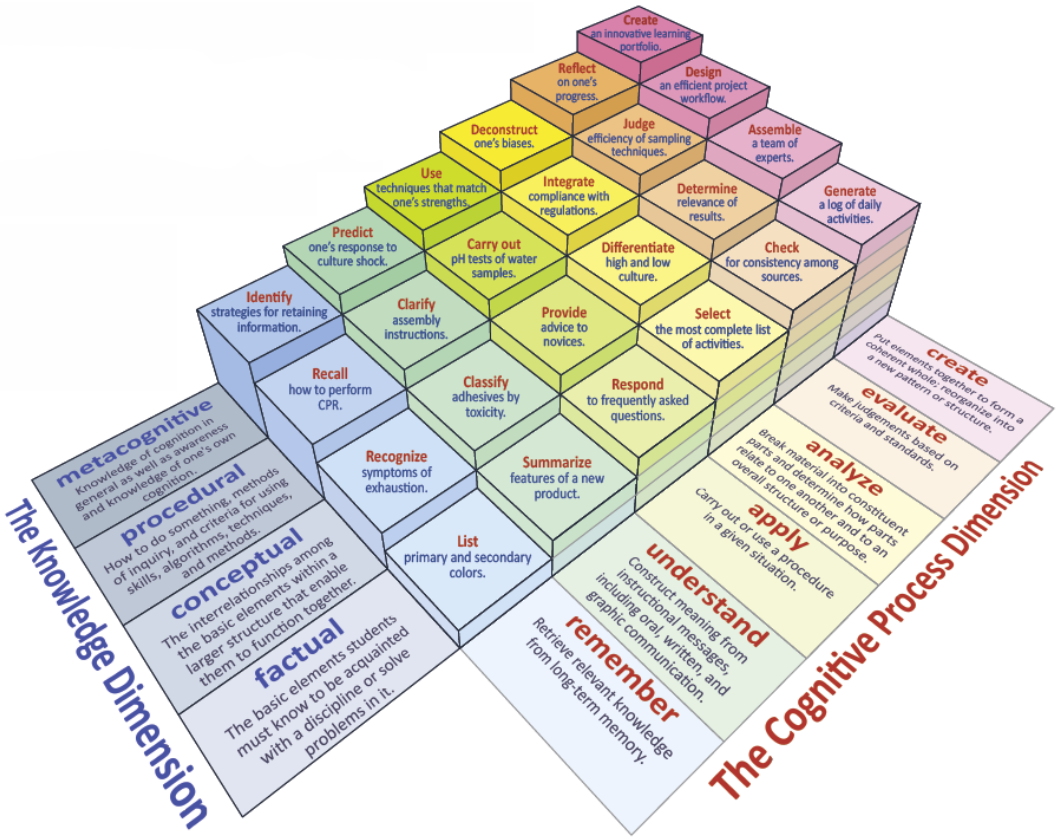
blue, categorizes the types of knowledge beginning with the most basic (factual) on the right to the most complex (metacognitive) on the left. The cognitive process dimension, shown on the right in red, categorizes increasing cognitive complexity from left (remembers) to right (create). The height of each bar illustrates the relative difficulty of objectives written at that level. For example, the procedural objective "Carry out pH tests of water samples" is expected to be more difficult than one asking learners to apply knowledge of water testing and less difficult than one that requires learners to judge whether the test supplies the data required by new regulations.

An interactive version of this model is available from the Iowa State University Center for Excellence in Learning and Teaching (http://www.celt.iastate.edu/teaching/RevisedBlooms1.html).

Figure 5:

Taxonomy for learning, teaching, and assessing: a revision of Bloom's Taxonomy of Educational Objectives

(Source: Iowa State University Center for Excellence in Learning and Teaching; http://www.celt.iastate.edu/pdfs-docs/teaching/RevisedBloomsHandout.pdf)



Rex Heer, Iowa State University Center for Excellence in Learning and Teaching, March 2009.

In "Rote versus Meaningful Learning," Richard Mayer recommends using the revised taxonomy to write objectives across the entire range of cognitive processes. When

your goal is to have learners retain what they have learned, write lower-level objectives to target foundational knowledge. When your goal is to have learners build knowledge or apply what they have learned, write objectives that require higher-order cognitive processing. Mayer developed his explanation of how each higher-level cognitive dimension can be used to promote and assess meaningful learning in collaboration with other members of the team that produced the revised taxonomy.

Table 6 shows how an instructional designer might write two-dimensional learning objectives at many levels of the revised taxonomy. Targeting different dimensions allows the designer to assess whether learners have mastered the basics and can apply what they have learned in new situations.

Table 6:

Two-dimensional learning objectives

Cognitive Dimension	Knowledge Dimension	Customer Service Module Objective: How to Handle a Complaint
Remember	Procedural	List the steps in documenting a customer complaint
Understand	Factual	Summarize the customer's complaint
Apply	Conceptual	Provide advice to a new call center employee about how to handle an irate customer
Analyze	Factual	Select the most appropriate way to handle a complaint from a given set of options
Evaluate	Conceptual	Critique the way a customer service representative handled a complaint call
Create	Procedural	Develop a plan to improve customer satisfaction with the way we handle complaints

Try Revised Bloom's Yourself

Directions: The best way to understand the revised taxonomy is to develop your own two-dimensional objectives. Using Figure 5 and Table 6 as models, write objectives for at least two different cognitive levels.

Worksheet 1:

Developing two-dimensional objectives

Cognitive Dimension (remember, understand, apply, analyze, evaluate, create)	**Knowledge Dimension** (choose at least one)	**Objective**
	Factual	
	Conceptual	
	Procedural	
	Metacognitive	
	Factual	
	Conceptual	
	Procedural	
	Metacognitive	
	Factual	
	Conceptual	
	Procedural	
	Metacognitive	
	Factual	
	Conceptual	
	Procedural	
	Metacognitive	

Try Revised Bloom's Yourself: Align Coverage with the Taxonomy Table

Another tool that can be used to analyze the depth and breadth of objectives is the taxonomy table. The example in Table 7 maps the customer service objectives in Table 6 to the knowledge dimensions of each cognitive level. When these objectives are placed into the matrix, it's easy to see that they cover facts, concepts, and procedures. However, no objectives target metacognitive knowledge. That may be a deliberate decision, based on the goals of the unit. On the other hand, the designer may decide the lack of metacognitive objectives is an omission that should be remedied. The taxonomy table may also be used to analyze the degree to which instruction matches assessment and program objectives encourage higher-level thinking, as Anderson explains in his article on curricular alignment.

Table 7:

Example taxonomy table: customer service objectives from Table 6

(Adapted from Krathwohl)

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual Knowledge		✓		✓		
Conceptual Knowledge			✓		✓	
Procedural Knowledge	✓					✓
Metacognitive Knowledge						

The taxonomy table in this case shows that metacognitive knowledge is missing from the unit but does not show whether the designer of the instruction has designed the instruction appropriately. It is possible, for example, that the designer has used remember objectives in too many places and has not used application objectives where they should have been used. This is only a very high-level look at the objectives.

Digital Bloom's Taxonomy: Adapting the Hierarchy to the Digital Revolution

In 2007, Andrew Churches took the process of updating Bloom's work one step further when he introduced Bloom's Digital Taxonomy. His intent was to "marry" Bloom's cognitive levels to 21st-century digital skills.

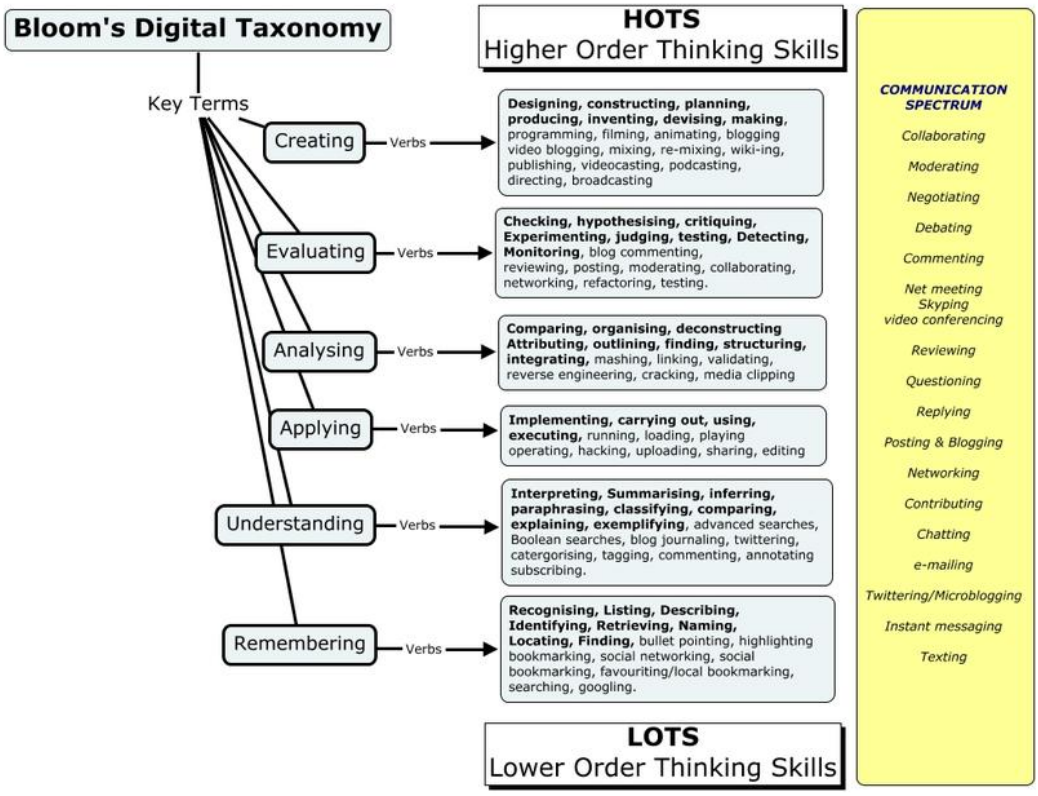
The National Education Technology Standards (NETS) developed by the International Society for Technology in Education (ISTE) define the foundations of digital literacy for K-12 education. Many thinking skills in the NETS standards are also found in Bloom's Taxonomy: analysis, synthesis, evaluation, critical thinking, and creativity. However, the technology standards require that learners use digital tools to construct knowledge and demonstrate mastery.

Churches added ways to use Web 2.0 technologies to each cognitive level in Bloom's revised taxonomy, as shown in Figure 6. Making it easier to retrieve information by bookmarking a site is a way of remembering. Commenting on a blog post is a way of evaluating. Blogging is also a way of creating. What determines cognitive level is not the tool itself, but *how* the technology is used.

Figure 6:

Bloom's Digital Taxonomy concept map

(Source: Educational Origami; http://edorigami.wikispaces.com/Bloom%27s+Digital+Taxonomy)



While Churches retains the revised Bloom's hierarchical arrangement of categories, he does not believe that learners must always start with remembering and work their way up. Lower-level skills such as searching can be used or even learned within the context of a critical thinking activity. Suppose that an instructional designer is evaluating resources to decide which to include in a digital library. After her first searches return thousands of hits, she decides to learn how to use the advanced features in her favorite search engine. Once she understands how to narrow her parameters, she returns to evaluating resources.

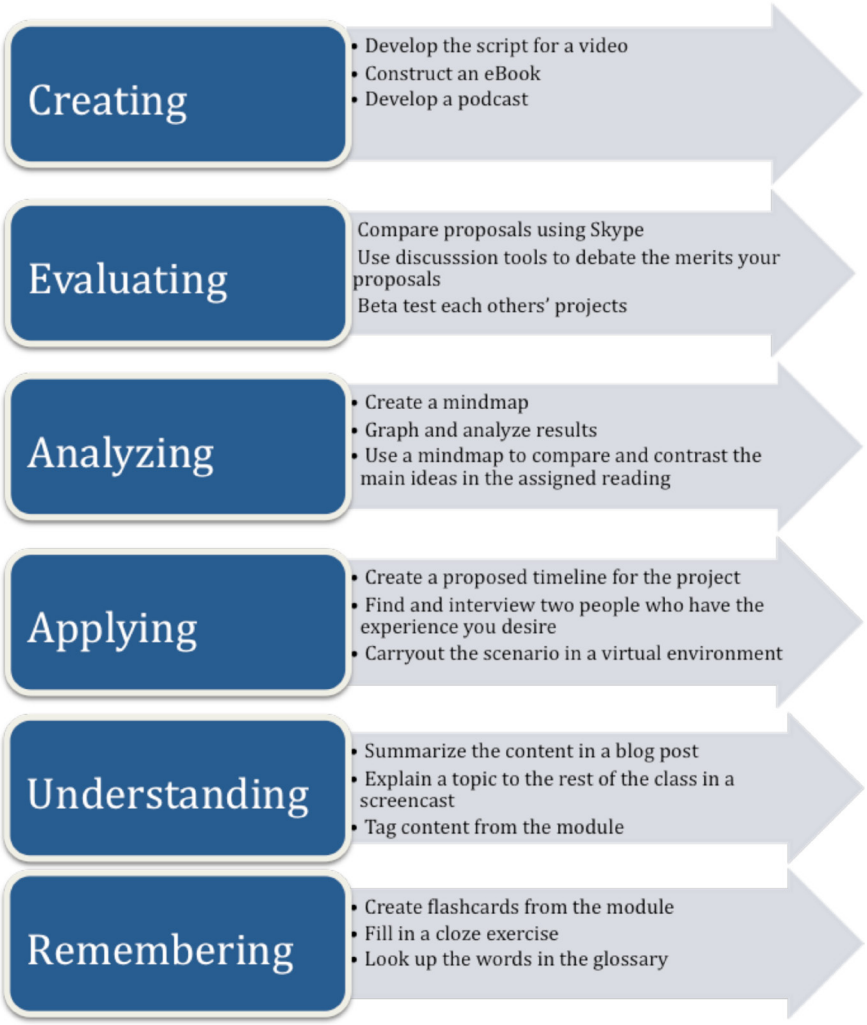
Digital Bloom's in Action: Choosing Activities for Digital Learning

Churches' model can be used to select digital activities appropriate for each level of Bloom's Taxonomy. Many of these suggested activities are tried-and-true classroom traditions. Others require learners to use new digital literacy skills, such as collaborating and validating information. Many of the suggested ways to use technology in Figure 7 are relevant to both the classroom and the workplace.

Figure 7:

Activities for each level of Bloom's Digital Taxonomy

(Adapted from http://edorigami.edublogs.org/2010/01/12/blooms-digital-taxonomy-resources)



Some find it tempting to use technology just because it's new and exciting; others resist replacing tried-and-true (and relatively inexpensive) learning methods with digital devices. No matter how they feel about new technologies, practitioners can

easily find themselves overwhelmed by the challenge of integrating digital tools into instruction. Table 8 provides a selective list of some digital tools and maps them to the cognitive levels of Bloom's revised taxonomy. Interactive tools such as mind mapping applications offer new ways for individuals to develop their own ideas and projects. Collaborative tools such as chat rooms, discussion boards, and live virtual meetings shift the focus of online learning from content delivery to learning creation by learners themselves. Although each tool is mapped to a specific level, many may be used at more than one cognitive level.

Table 8:

Criteria for selecting applications according to Bloom's Taxonomy

Bloom's Level	Key Words	Digital Tools
Remember	define, describe, find, identify, label, list, locate, match, name, outline, point to, select, show, state, study, what, when, where, which, who, why	Google Documents (https://docs.google.com) and Zoho (https://www.zoho.com) are comprehensive suites of online business, productivity, and collaboration applications. Shared documents allow groups to collaborate on content. Delicious (http://delicious.com/) is a social bookmarking tool that learners can use to save and organize useful websites. Instructors can assemble resources for students and then share them.
Understand	compare, conclude, contrast, define, demonstrate, describe, estimate, explain, identify, interpret, paraphrase, predict, retell, rewrite, summarize, understand	Some of the best resources for enhancing learners' understanding of material and concepts include TED (http://www.ted.com/) and Khan Academy (http://www.khanacademy.org/). Learners can research topics on their own or instructors can assign videos to be watched before a lesson, so instructor time can be used for Q&A, practice, and other interactions.
Apply	adapt, choose, construct, determine, develop, draw, illustrate, modify, organize, practice, predict, present, produce, select, show, sketch, solve, respond	We can encourage learners to apply what they are learning using a variety of tools such as Skype (www.Skype.com). Picasa (http://picasa.google.com/) is a tool for organizing, editing, and sharing photos. Instructors could ask learners to use this tool to organize images to construct a story.

Table continued on next page.

Bloom's Level	Key Words	Digital Tools
Analyze	analyze, ask, classify, compare, contrast, correlate, diagram, differentiate, edit, examine, explain, group, identify, infer, monitor, observe, order, outline, reason, review, select, sequence, sort, survey	Mindmaps are diagrams that show words, ideas, tasks, or other items arranged around a central key word or idea. Mindomo (http://www.mindomo.com/) is one mindmapping tool that could be used for this purpose. Microsoft Word (http://office.microsoft.com/en-us/word/) and other word processing programs can be used to create outlines, diagrams, essays, and research papers.
Evaluate	assess, choose, compare, conclude, consider, construct, contrast, critique, determine, estimate, evaluate, explain, interpret, justify, prioritize, prove, recommend, relate, summarize, support, test, verify	Learners can use tools like SurveyMonkey (http://surveymonkey.com) to construct and deliver surveys and evaluate the results. Rubrics (http://rubistar.4teachers.org/) let learners know how they will be evaluated. Allowing learners to get involved in creating rubrics helps get them engaged in the assessment process. It also helps learners have a better understanding of how they are being evaluated. Something as simple as learning how to create a to-do list (http://www.toodledo.com/) can teach prioritization skills and help learners with time-management techniques.
Create	arrange, collect, combine, compose, connect, construct, coordinate, create, design, develop, explain, formulate, frame, gather, generate, graph, imagine, incorporate, integrate, interact, invent, judge, make, model, organize, plan, portray, produce, publish, rearrange, refine, reorganize, revise, rewrite, summarize, synthesize, test, write	Prezi (http://prezi.com/) is becoming an increasingly popular alternative to PowerPoint for creating interactive presentations. Microsoft Excel (http://office.microsoft.com/en-us/excel/spreadsheet-software-microsoft-excel-FX101825647.aspx) is a tool for communicating information visually through charts and graphs.

These digital tools offer opportunities for collaboration, which Trilling and Hood consider to be one of seven knowledge-age survival skills. By giving learners the opportunity to create knowledge, these digital tools shift the instructor's role from source of knowledge to co-learner.

Digital Bloom's in Action: Assessing Digital Learning

Collaborative tools also offer new ways to assess learning. For example, screen sharing allows you to see a learner's screen as the learner performs a task. The learner might demonstrate mastery of a lower-level skill such as adding headings to a Microsoft Word document. The same tool can be used to assess higher-level skills, such as making an original presentation. The cognitive level depends on the skills and cognitive processes the learner uses, not the technology used for assessment.

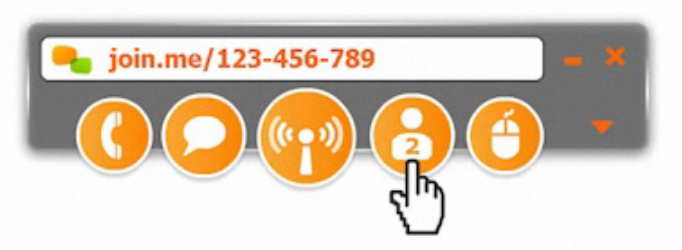


Figure 8:

Example of a free screen sharing and online meeting application: join.me

(Source: join.me; https://join.me/)

When learners are producing new knowledge by collaborating and creating original products, assessment can be a challenge. Trilling and Hood argue that knowledge-age cognitive skills are best evaluated with performance-based assessments rather than tests. For examples of how to assess learners' use of digital tools, see Churches' rubrics in his article "Bloom's Digital Taxonomy." The collaborating rubric can be used with any technology. Rubrics for audio/video conferencing and use of a whiteboard are also included.

Classroom response systems (CRS) are another high-tech way to assess learning. Each learner is given a clicker. Each time a learner clicks in response to a question, software collects and displays the answers. Clicker questions can be written to target various levels of Bloom's Taxonomy. For example, students might respond to questions designed to test their understanding of an assigned reading. If students score poorly on a particular item, the instructor might spend extra time reviewing that content. At higher levels, learners might be asked to select the best response to a scenario or analyze data generated by their responses.

Try Digital Bloom's Yourself

Directions: Try the digital version of Bloom's Taxonomy by using Table 8 as a model for how to fill in the worksheet below for an upcoming lesson. For example, an apply objective might ask students to select at least 10 images and use Picasa to organize them to tell a story.

Worksheet 2:

Tools for Bloom's Digital Taxonomy

Bloom's Level	Key Words	Digital Tools
Remember	define, describe, find, identify, label, list, locate, match, name, outline, point to, select, show, state, study, what, when, where, which, who, why	
Understand	compare, conclude, contrast, define, demonstrate, describe, estimate, explain, identify, interpret, paraphrase, predict, retell, rewrite, summarize, understand	
Apply	adapt, choose, construct, determine, develop, draw, illustrate, modify, organize, practice, predict, present, produce, select, show, sketch, solve, respond	
Analyze	analyze, ask, classify, compare, contrast, correlate, diagram, differentiate, edit, examine, explain, group, identify, infer, monitor, observe, order, outline, reason, review, select, sequence, sort, survey	
Evaluate	assess, choose, compare, conclude, consider, construct, contrast, critique, determine, estimate, evaluate, explain, interpret, justify, prioritize, prove, recommend, relate, summarize, support, test, verify	

Worksheet continued on next page.

Bloom's Level	Key Words	Digital Tools
Create	arrange, collect, combine, compose, connect, construct, coordinate, create, design, develop, explain, formulate, frame, gather, generate, graph, imagine, incorporate, integrate, interact, invent, judge, make, model, organize, plan, portray, produce, publish, rearrange, refine, reorganize, revise, rewrite, summarize, synthesize, test, write	

Blooming Applications

A growing number of schools and businesses are embracing iPads for classroom learning and workplace productivity. iPads and other mobile computing devices are relatively new, but these powerful tools can run thousands of applications with educational uses. New apps are being developed and released almost daily, and educators are finding classroom applications for them. Silvia Rosenthal Tolisano created Bloom's Taxonomy for iPads (Figure 9), which maps applications for the iPad to Bloom's Taxonomy. Kathy Schrock's Bloomin' Apps page has an interactive chart for iPad apps and graphics mapping Android, Google, and Web 2.0 applications to Bloom's cognitive levels. There's an even larger collection at Zaid Ali Alsagoff's blog Zaidlearn.

Figure 9:

iPads and Bloom's Taxonomy

(Source: Langwitches Blog; http://langwitches.org/blog/2012/03/31/ipad-apps-and-blooms-taxonomy/)

Digital Bloom's in Action: Using Applications to Target Cognitive Levels

The growing number of digital tools that can be used for instruction can make it hard to choose the best application for instructional use. The criteria in Table 9 can help you analyze the cognitive processes supported by each application you are considering.

Table 9:

Choosing applications at different levels of Bloom's revised taxonomy

(Adapted from Darrow)

Bloom's Level	Definition	Criteria: Does the app help the user?
Remembering	Improves the user's ability to define terms, identify facts, and recall and locate information	• Define information? • Name facts? • Recite information? • List facts or details? • Recall facts or ideas? • Locate facts or ideas? • Retrieve information? • Describe information? • Recognize facts or ideas in context?
Understanding	Helps users connect new learning to prior knowledge	• Summarize facts and ideas? • Restate methods or procedures? • Interpret relationships? • Paraphrase information? • Predict consequences? • Give examples? • Retell information in own words? • Retell events? • State problem in own words? • Explain ideas or concepts? • Determine importance?
Applying	Provides opportunities to implement learned procedures and methods	• Demonstrate methods and procedures? • Carry out procedures? • Use ideas or knowledge? • Discover a new purpose for skills or knowledge? • Employ knowledge in new situations? • Experiment with concepts in a different setting? • Adjust knowledge for use in a different context? • Apply procedures to unique situations?

Table continued on next page.

Bloom's Level	Definition	Criteria: Does the app help the user?
Analyzing	Improves user's ability to differentiate between the relevant and irrelevant, determine relationships, and recognize the organization of content by analysis of: • Elements (differentiating) • Relationships (attributing) • Organizational principles (organizing)	• Discriminate fact from hypothesis? • Distinguish the relevant from irrelevant? • Observe the structure? • Select important elements? • Determine biases? • Recognize intent? • Deconstruct content? • Understand the relationships? • Organize content? • Outline content?
Evaluating	Helps learners make judgments using: • Internal evidence (checking) • External criteria (critiquing)	• Check for accuracy? • Detect inconsistencies? • Monitor effectiveness? • Evaluate procedures? • Critique soluti ons? • Appraise efficiency? • Judge techniques? • Contrast performance? • Check the probability of results?
Creating	Provides opportunities to generate ideas, design plans, and produce products. • Planning: production of a plan • Producing: derivation of a set of abstract relations	• Construct designs? • Generate possibilities? • Compose ideas? • Propose hypotheses? • Produce solutions? • Brainstorm solutions? • Design products? • Assemble plans? • Rearrange operations? • Imagine possibilities?

Alternatives to Bloom's Taxonomies

Both the original and revised versions of Bloom's taxonomies are taught in teacher education programs and used to measure learning, plan programs, and target objectives to cognitive levels. As Booker notes, Bloom's work has become educational lore. However, critics find serious flaws in both the original and revised taxonomies:

- Students should not be forced to work their way up the pyramid
- Objectives should be performance-based
- Bloom's framework is not internally consistent

According to Shelley Wright, Bloom's pyramid should be turned upside down. Instruction should begin with the higher order skills of creating, analyzing, and applying. Forcing learners to climb the pyramid step-by-step condemns them to boredom and rote learning. In a "flipped" classroom, students might begin by testing different substances for conductivity. Next they would categorize the solutions they tested. Finally, they would compare their categories to the standard scientific categories. Their experiments create a context in which knowledge of ionic and covalent bonds is meaningful.

Wineburg and Schneider also think that the pyramid should be reoriented. The goal of learning is new knowledge, they argue, so placing knowledge at the bottom of the pyramid devalues both knowledge and the very purpose of learning.

These educators are not the only critics to propose alternatives to Bloom's Taxonomy. Brenda Sugrue's 2002 critique of Bloom is often cited within the performance improvement community. Sugrue argues that that Bloom's Taxonomy cannot be applied consistently and is not validated by research. She describes two performance-based alternatives. One is a content-by-performance approach in which content is categorized by type (usually facts, concepts, principles, procedures) and performance is assessed on just two levels (remember and use). Another approach is to ignore cognitive level and write all objectives as performance objectives.

Dan Topf, senior vice president of MDI Learning, concedes that Bloom's Taxonomy is widely used within the training industry, but notes that "widely used" is not the same as "actually works." A Certified Performance Technologist, Topf finds that taxonomies can actually distract planners from key performance variables. "Does any taxonomy help me (the instructional designer) ascertain what procedural and declarative knowledge is needed for high performance? Are you mindful of the learners' cognitive load? What other factors outside of the learner are affecting performance (work, workplace, world)?"

Marzano and Kendall also question the validity of Bloom's Taxonomy, primarily on theoretical grounds. They credit Bloom with clarifying the concept of objectives and

giving educators a powerful tool for working with them. However, they disagree with his fundamental premise: that mental processes can be ordered from the most basic to the most difficult. They also criticize Bloom for conflating what is known with how it is known; for example, the Knowledge category includes both the process of recall and the knowledge that is recalled.

In their view, Bloom's Taxonomy is a framework rather than a theory because his hierarchy cannot be used to predict behavior. While Bloom intentionally used teachers' language to describe behavior, Marzano and Kendall use language intended to capture "the flow of information" and "level of consciousness." In their New Taxonomy, which they developed as a more internally consistent replacement for Bloom's, they separate types of knowledge from mental process and extend the application of each learning process across all three domains. For a fuller discussion of Marzano and Kendall's attempt to reconcile the inconsistencies in Bloom's work, see *The New Taxonomy of Educational Objectives*, published in 2007.

Table 10 shows how the New Taxonomy compares to Bloom's revised taxonomy.

Table 10:

Comparison of Marzano and Kendall's New Taxonomy to Bloom's

(Adapted from Marzano and Kendall, Designing and Assessing Educational Objectives*)*

Domains	Levels of Processing	Cognitive Level
Information	Self system (engagement and motivation)	• Examining importance • Examining efficacy • Examining emotional response • Examining motivation
Mental Procedures	Meta-cognitive system (setting goals and monitoring progress; not found in Bloom's)	• Specifying goals • Process monitoring • Monitoring clarity • Monitoring accuracy
Psychomotor Procedures	Knowledge utilization (using knowledge to accomplish a specific task)	• Decision-making • Problem-solving • Experimenting • Investigating
	Analysis (using reason to extend knowledge)	• Matching • Classifying • Analyzing Errors • Generalizing • Specifying
	Comprehension (similar to Bloom's comprehension with the addition of symbolizing knowledge)	• Integration • Symbolization
	Retrieval (Bloom's knowledge level)	• Recognition • Recall • Execution

Conclusion: Bloom's Legacy

Critics continue to question the validity of Bloom's framework. Opinion about whether its hierarchical structure is internally consistent and supported by evidence is divided. In their review of the evidence, Kreitzer and Madaus concur with an earlier analysis by Seddon, who concluded that available empirical evidence neither disproved nor confirmed the validity of the taxonomy.

Bloom's categories have been critiqued as though they were dogma, observe Kreitzer and Madaus, when they were intended only as heuristics. A more fruitful approach might be to investigate why the taxonomy is still trusted and used.

What Matters Most: Theory or Practice?

Most of the criticism of Bloom's work is based on theory rather than practical application. In "Validity vs. Utility," Postlethwaite observed that teachers and curriculum developers found that Bloom's cognitive categories simplified the process of writing objectives and planning instruction. He and other test developers tried other systems of developing objectives and test items and concluded these alternatives were too complex to be useful. When weighing validity against utility, practitioners came down solidly on the side of utility (in other words, they found Bloom's to be useful).

Cannon and Feinstein also believe the taxonomy's usefulness as a tool is more important than any theoretical shortcomings. Learning is a complex process that cannot be adequately captured by any one model. However, Bloom's revised taxonomy is "simple" and "robust." Its combination of process and content provides a solid framework for planning experiential learning, which requires learners to process vast amounts of knowledge to handle new and rapidly changing situations.

Bloom's work has also stood the test of time as a model for writing questions that require higher-order thinking. Anderson and Krathwohl believe that the examples of test items in *The Handbook* are still the best available models. This is in part because few advances have been made in the art of question-writing; however, in their judgment, the model test items remain exemplars of how to write questions that promote critical thinking.

Bloom's Criteria of Usefulness

Although Bloom's hierarchy is often taught as though it were educational dogma, Bloom himself never considered it the final word on either theory or practice. Instead, he judged its value by four criteria of usefulness:

- Comprehensiveness: Does it cover most learning behaviors?
- Communicability: Does it provide a common language for those who want to promote and assess learning?
- Provocativeness: Does it help researchers identify problems, develop hypotheses, plan learning, and identify methods and metrics? Can it be used to organize the literature and correlate varied programs and curriculums?
- Acceptability: Is it used by "workers in the field"?

According to Bloom's own criteria, his work has stood the test of time. Neither the original nor the revised taxonomies provides an all-encompassing theory of learning. However, his work made educators aware of the need to write objectives that target desired learning behaviors. His cognitive levels, properly applied, provide a workable framework for targeting two essential types of learning: foundational knowledge and higher-order cognitive processing.

Conversations about objectives and lower- versus higher-order thinking are now routine. This in itself is a desirable outcome. This does not mean the tendency to overemphasize memory and comprehension has been corrected. However, critical thinking is receiving greater emphasis. When Bloom first published his hierarchy, over 90 percent of instruction was drill-and-kill. Today that percentage is closer to 70 percent. Two factors may drive that figure lower. Critical thinking is now the most important survival skill for knowledge workers, according to Trilling and Hood. In addition, some companies want evidence of a return on their investment in training, which requires trainers and instructional designers to consider how to develop higher-order thinking skills.

Airasian considers the concept of cognitive levels to be Bloom's major contribution because it gave teachers a new sense of the "range and depth" of what could be accomplished in the classroom and has spurred the development of assessments that measure more than rote learning. While his work has not been as influential among curriculum planners, Sosniak credits Bloom with encouraging reflection on how curriculum should be developed and what the outcomes of learning should be.

Bloom's work continues to provoke thought, as he had hoped. "Properly used, a taxonomy should provide a very suggestive source of ideas and materials for each worker and should result in many economies of effort," he wrote in 1956. His work continues to be used as a metric, planning tool, and inspiration for new research or assessment tools, as shown in Table 11 (on page 41).

Table 11:

Applications of Bloom's s Taxonomy: representative examples

Who	Used to	Found in
Abudi	Develop training programs that help adults apply learning	Abudi, Gina. "Using Bloom's Taxonomy: Teaching Adults to Learn Effectively." 2010. http://www.ginaabudi.com/using-blooms-taxonomy-teaching-adults-to-learn-effectively/
Ben-Zvi & Carton	Align business games with instruction and assess learning from games	Ben-Zvi, Tal and Thomas C. Carton. "Applying Bloom's Revised Taxonomy in Business Games." *Developments in Business Simulation and Experiential Learning*, 35 (2008). http://sbaweb.wayne.edu/~absel/bkl/vol35/35bg.pdf
Callister	Organize collaboration of law librarians and plan legal research courses	Callister, Paul D. "Time to Blossom: An Inquiry into Bloom's Taxonomy as a Hierarchy and Means for Teaching Legal Research Skills." Law Library Journal 102, no. 2 (201–2012). http://www.aallnet.org/main-menu/Publications/llj/LLJ-Archives/Vol-102/publljv102n02/2010-12.pdf
Cannon & Feinstein	Develop experiential exercises	Cannon, Hugh M. and Andrew Hale Feinstein. "Bloom Beyond Bloom: Using the Revised Taxonomy to Develop Experiential Learning Strategies." *Developments in Business Simulations and Experiential Learning*, 32 (2005). http://sbaweb.wayne.edu/~absel/bkl/vol32/32cf.pdf
Claxton	Structure interviews with SMEs	Claxton, Nancy. (2010). SMEs and learning objectives. In B. Hoffman (Ed.), *Encyclopedia of Educational Technology*. SDSU Department of Educational Technology. 2010. http://eet.sdsu.edu/eetwiki/index.php/SMEs_and_learning_objectives
Concialdi	Teach nursing students how to improve their exam scores	Concialdi, Perri-Anne. "Bloom's Taxonomy: A Helpful Guide for Students." http://www.aultmancollege.edu/Files/Taxonomy.pdf
Ellenburg	Target visuals to cognitive levels	Ellenburg, Kelly. "Using Visuals [With Purpose] to Target Learning Outcomes" (presentation). October 24, 2011. http://prezi.com/jr-yju4iwrfs/visual-media/
Maynard	Generate questions	Maynard, John. "Bloom's Taxonomy's Model Questions and Key Words." http://www.cbv.ns.ca/sstudies/links/learn/1414.html
Meyer	Analyze discussions in an online course	Meyer, Katrina A. "The Ebb and Flow of Online Discussion: What Bloom Can Tell Us About Our Student Conversations." *JALN* 9, no. 1 (March 2005).

Table continued on next page.

Who	Used to	Found in
North Carolina	Write New Essential Standards	Anderson, Lorin. "Common Core State and NC Essential Standards." http://www.dpi.state.nc.us/acre/standards/
Smyth & Halloren	Provide tools for designing learning activities and programs	Smyth, Kevin and Jane Hallonen. "Using the New Bloom's Taxonomy to Design Meaningful Learning Assessments." In *The Assessment CyberGuide for Learning Goals and Outcomes*, compiled by the American Psychological Association (2009).
Tansey et al	Used as metric to compare technology-enhanced and traditional instruction	Tansey, Timothy N. et al. "Examining Technology-Enhanced Coursework in Rehabilitation Counselor Education Using Bloom's Taxonomy of Learning." *Rehabilitation Education* 23, no. 2 (2009).
University of South Carolina	Ensured equivalency of an online master's program and face-to-face instruction	Leech, Linda L. and John M. Holcomb. "Leveling the Playing Field: The Development of a Distance Education Program in Rehabilitation Counseling." *Assist Technol* 16, no. 2 (Winter 2004).
Vickery	Align instructional activities to Common Core standards	Vickery, Annie. "The Common Core and Bloom's Taxonomy." Reach Common Ground blog. http://reachcommonground.wordpress.com/the-common-core-and-blooms-taxonomy/
Wysocki	Construct a scale of project management expertise	Wysocki, Robert J., James P. Lewis, and Doug DeCarlo. *The World Class Project Manager: A Professional Development Guide*. New York: Basic Books, 2001.

Finally, Bloom's work is accepted around the world. The 93rd Yearbook of the Society for the Study of Education and two special issues of *Theory into Practice* have been devoted to his framework. Even Marzano, who proposed an alternative taxonomy, acknowledges Bloom's pioneering contribution as "incredible."

Measured against the criteria Bloom established in 1956, his work remains invaluable. His taxonomy is a widely accepted metric that continues to provoke new research, shape best instructional and assessment practice, and provide a common language and framework for collaboration. Bloom's heuristic, developed in the mid-20th century, is adaptable to new learning theories and technologies. Whatever its theoretical shortcomings, Bloom's influence has endured the test of time.

Major Takeaways

1) Bloom designed his taxonomy as a heuristic for practitioners, not an all-encompassing educational theory or dogma.

2) Bloom distinguished between lower- and higher-order thinking. Target lower-order cognitive skills to help learners remember key facts and skills. Target higher-order skills to encourage learners to apply knowledge to new situations.

3) When writing objectives, use the names of either the thinking skills or the categories in the revised taxonomy as verbs.

4) Use the taxonomy table (Table 6) to:
   a) Measure depth of coverage
   b) Evaluate balance of lower- and higher-order cognitive skills
   c) Align instruction with assessment and course or program outcomes

5) Critics have proposed alternatives to Bloom's, questioning its internal consistency and citing a lack of empirical validation. However, despite any theoretical shortcomings, practitioners continue to find Bloom's useful.

6) Bloom developed four criteria for usefulness in 1956:
   a) Comprehensiveness: covers most learning behaviors
   b) Communicability: provides a common language
   c) Provocativeness: inspires new research and applications
   d) Acceptability: is commonly used by practitioners

7) Bloom's Digital Taxonomy, adapted by Churches, provides a framework for designing and assessing eLearning.

8) Educators, instructional designers, researchers, and test developers continue to find new applications for both the original and revised taxonomies.

Even those who question the validity of Bloom's Taxonomy recognize his widespread and continuing influence.

LEARNING SOLUTIONS CONFERENCE & EXPO

March 13 – 15, 2013 | Orlando, FL

Maximizing Performance with Learning Technologies

Learning Solutions is where the entire eLearning community comes together to learn, share, and connect around one common goal: to create more engaging and effective learning experiences. Join the best minds in the industry and discover the strategies, tools, technologies, and best practices to help you maximize performance in your organization.

Focus on Management, Design, and Development

Organized into three primary focus areas—Management, Design, and Development—*Learning Solutions 2013* is designed to help you build new skills and knowledge.

Featured Speakers

Management

Global Learning and Development Trends and Impacts

Karen Kocher, Chief Learning Officer, Cigna

Design

Ideas You Can Play With

Stephen Anderson, Independent Consultant, PoetPainter

Development

Herding Racehorses and Racing Sheep

Andy Hunt, Author, The Pragmatic Programmers

More Than 140 Learning Opportunities, Including Sessions Like These:

- The Day the LMS Stood Still: The Future of Learning Management
- Preparing Large Organizations for Successful Moves from ILT to Online Mobile Learning
- eLearning Development for an HTML5 World
- Successful eLearning Design Projects: Tips for Designers/Developers
- If Tablets Could Talk: Design Secrets that Improve Employee Performance
- Evaluating and Using Cloud Technologies for Hands-on Learning
- Getting the Content You Need from Your SMEs
- Management Perspectives on the Myths and Realities of Social Learning

SolutionFest

SOLUTION FEST 2013

Explore dozens of eLearning projects, network with colleagues, and get some great ideas!

Tin Can Alley

TIN CAN ALLEY

Learn about the new Experience API, ADL's next-generation SCORM specification.

Learning Stages

Explore three educational learning stages running throughout the event.

INNOVATION SHOWCASE · TECHNOLOGY SOLUTIONS · mobile Learning

GUILD MEMBERS SAVE 20% | REGISTER TODAY!

www.LearningSolutions13.com/blm

+1.707.566.8990

References

Airasian, Peter, W. "The Impact of the Taxonomy on Testing and Evaluation." *Bloom's Taxonomy: A Forty-Year Retrospective*, edited by Lorin Anderson and Lauren A. Sozniak. 93rd Yearbook. (Chicago: National Society for the Study of Education).

Airasian, Peter W. and Helena Miranda. "The Role of Assessment in the Revised Taxonomy." *Revising Bloom's Taxonomy*, edited by Lorin W. Anderson, special issue, *Theory Into Practice*, 41, no. 4 (2002).

Alsagoff, Zaid Ali. *Zaidlearn* (blog). "A Juicy Collection of Bloom's Digital Taxonomies!" http://zaidlearn.blogspot.com/2012/10/a-juicy-collection-of-blooms-digital.html.

Alsagoff, Zaid Ali. *Zaidlearn* (blog). "Use Bloom's Taxonomy Wheel for Writing Learning Objectives." http://zaidlearn.blogspot.com/2009/07/use-blooms-taxonomy-wheel-for-writing.html.

Anderson, Lorin W. "Curricular Alignment: A Re-Examination." *Revising Bloom's Taxonomy*, edited by Lorin W. Anderson, special issue, *Theory Into Practice*, 41, no. 4 (2002).

Anderson, Lorin W. and David R. Krathwohl. *A Taxonomy for Learning, Teaching, and Assessing*. New York: Longman, 2001.

Betts, S.C. "Teaching and Assessing Basic Concepts to Advanced Applications: Using Bloom's Taxonomy to Inform Graduate Course Design." *Academy of Educational Leadership Journal* 12, no. 3 (2008).

Bloom, Benjamin S. "Reflections on the Development and Use of the Taxonomy." In *Bloom's Taxonomy: A Forty-Year Retrospective*, edited by Lorin Anderson and Lauren A. Sozniak. 93rd Yearbook. (Chicago: National Society for the Study of Education).

Bloom, Benjamin S., ed. *Taxonomy of Educational Objectives: The Classification of Educational Goals: Handbook I, Cognitive Domain*. New York: Longmans, 1956.

Booker, Michael J. "A Roof without Walls: Benjamin Bloom's Taxonomy and the Misdirection of American Education." *Academic Questions*, 20, no. 4 (2007).

Bruff, Derek. "Classroom Response Systems ('Clickers')." Vanderbilt University Center for Teaching. http://cft.vanderbilt.edu/teaching-guides/technology/clickers/.

Cannon, Hugh M. and Andrew Hale Feinstein. "Bloom Beyond Bloom: Using the Revised Taxonomy to Develop Experiential Learning Strategies." *Developments in Business Simulations and Experiential Learning*, 32 (2005). http://sbaweb.wayne.edu/~absel/bkl/vol32/32cf.pdf.

CESA 7. "Bloom's Taxonomy Question & Task Design Wheel." http://www.cesa7.org/tdc/documents/bloomswheelforactivestudentlearning.pdf.

Churches, Andrew. "Bloom's Digital Taxonomy." 2007. http://edorigami.wikispaces.com/file/view/bloom%27s+Digital+taxonomy+v3.01.pdf.

Churches, Andrew. Bloom's Digital Taxonomy v2.12. 2008. http://www.scribd.com/doc/8000050/Blooms-Digital-Taxonomy-v212.

Clark, Donald. "Bloom's Taxonomy of Learning Domains." 2010. http://www.nwlink.com/~donclark/hrd/bloom.html.

Darrow, Diane. "K-5 iPad Apps According to Bloom's Taxonomy." *Edutopia* blog. 2011. http://www.edutopia.org/ipad-apps-elementary-blooms-taxomony-diane-darrow.

Enokson. "Critical Thinking Skills" (poster). May 2010. Retrieved from http://www.flickr.com/photos/vblibrary/4576825411/.

Ferlazzo, Larry. Larry Ferlazzo's Websites of the Day... (blog). "The Best Resources for Helping Teachers Use Bloom's Taxonomy in the Classroom." http://larryferlazzo.edublogs.org/2009/05/25/the-best-resources-for-helping-teachers-use-blooms-taxonomy-in-the-classroom/.

Forehand, Mary. "Bloom's Taxonomy: Original and Revised." *Emerging Perspectives on Learning, Teaching, and Technology*, edited by Michael Orey. 2005. http://projects.coe.uga.edu/epltt/index.php?title=Bloom%27s_Taxonomy.

Halawi, Leila A., Richard V. McCarthy, and Sandra Pires. "An Evaluation of E-Learning on the Basis of Bloom's Taxonomy: An Exploratory Study." *Journal of Education for Business* 84, no. 6 (July 2009).

International Society for Technology in Education. "NETS for Students." 2007. http://www.iste.org/standards/nets-for-students/nets-student-standards-2007.

International Society for Technology in Education. "NETS for Teachers." 2008. http://www.iste.org/docs/pdfs/nets-t-standards.pdf?sfvrsn=2.

Iowa State University Center for Excellence in Learning and Teaching. "A Model of Learning Objectives." 2013. www.celt.iastate.edu/teaching/RevisedBlooms1.html.

Krathwohl, David R. "A Revision of Bloom's Taxonomy: An Overview." *Revising Bloom's Taxonomy*, ed. Lorin W. Anderson, special issue, Theory Into Practice, 41, no. 4 (2002).

Krathwohl, David R. and Lorin Anderson. "Bloom's Taxonomy." n.d. http://www.education.com/reference/article/blooms-taxonomy/.

Krathwohl, David R., Benjamin S. Bloom, and Bertram B. Masia. *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook II: The Affective Domain*. New York: Longman, Green, 1964.

Kreitzer, Amelia E. and George F. Madaus. "Empirical Investigations of the Hierarchical Structure of the Taxonomy." *Bloom's Taxonomy: A Forty-Year Retrospective*, edited by Lorin Anderson and Lauren A. Sozniak. 93rd Yearbook. (Chicago: National Society for the Study of Education).

Latislaw, Corey Leigh. "Android" (presentation). (August 13, 2012). http://prezi.com/gqiqbkkumfyt/android-101-class-1/.

Marzano, Robert J. *Designing a New Taxonomy of Educational Objectives*. Thousand Oaks, CA: Corwin Press, 2000.

Marzano, Robert J., and John S. Kendall, eds. *Designing and Assessing Educational Objectives: Applying the New Taxonomy*. Thousand Oaks, CA: Corwin Press, 2008.

Marzano, Robert J., and John S. Kendall, eds. *The New Taxonomy of Educational Objectives*. 2nd ed. Thousand Oaks, CA: Corwin Press, 2006.

Mayer, Richard E. "Rote Versus Meaningful Learning." *Revising Bloom's Taxonomy*, edited by Lorin W. Anderson, special issue, *Theory Into Practice*, 41, no. 4 (2002).

Medved, Michele B. "Learning Bytes: Episode One" (presentation). 2011. https://www.facebook.com/video/video.php?v=1613304088158.

Postlethwaite, T. Neville. "Validity vs. Utility: Personal Experiences with the taxonomy." *Bloom's Taxonomy: A Forty-Year Retrospective*, edited by Lorin Anderson and Lauren A. Sozniak. 93rd Yearbook. (Chicago: National Society for the Study of Education).

Schrock, Kathy. *Kathy Shrock's Guide to Everything* (blog). "Bloomin' Apps." http://www.schrockguide.net/bloomin-apps.html

Seddon, George M. "The Properties of Bloom's Taxonomy of Educational Objectives for the Cognitive Domain. *Review of Educational Research* 48, no. 2 (1978).

Shank, Patti. *Designing Learning Assessments for Classroom, Online, and Blended Learning*. Learning Peaks, 2006.

Simpson, Elizabeth J. *The Classification of Educational Objectives in the Psychomotor Domain*. Washington DC: Gryphon House, 1972.

Sozniak, Lauren A. "The Taxonomy, Curriculum, and Their Relations." *Bloom's Taxonomy: A Forty-Year Retrospective*, edited by Lorin Anderson and Lauren A. Sozniak. 93rd Yearbook. (Chicago: National Society for the Study of Education), pp. 103–125.

Sugrue, Brenda. "Problems with Bloom's Taxonomy." 2002. http://eppicinc.files.wordpress.com/2011/08/sugrue_bloom_critique_perfxprs.pdf.

Tolisano, Sylvia. "iPad Apps and Bloom's Taxonomy." (2012, March 31). Retrieved from http://langwitches.org/blog/2012/03/31/ipad-apps-and-blooms-taxonomy/.

Trillig, Bernie and Paul Hood. "Learning, Technology, and Education Reform in the Knowledge Age, or 'We're Wired. Webbed, and Windowed, Now What?'" 1999. http://www.wested.org/cs/we/view/rs/654.

The University of Connecticut. "Assessment Primer: Learning Taxonomies." 2013. http://assessment.uconn.edu/primer/taxonomies1.html.

Usova, George M. "Effective Test Item Discrimination Using Bloom's Taxonomy." *Education* 118, no. 1: 100–110. MasterFILE Premier.

Wenglinsky, Harold. *Teacher Classroom Practices and Student Performance: How Schools Can Make a Difference*. Educational Testing Service Research Report RR-01-19. (September 2001). http://www.ets.org/Media/Research/pdf/RR-01-19-Wenglinsky.pdf.

Wineburg, Sam and Schneider, Jack. "Was Bloom's Taxonomy Pointed in the Wrong Direction?" *Phi Delta Kappan* 91, no. 4 (December 2009): 56. MasterFILE Premier.

Wright, Shelley. "Flip This: Bloom's Taxonomy Should Start with Creating." *Mindshift* (blog). http://blogs.kqed.org/mindshift/2012/05/flip-this-blooms-taxonomy-should-start-with-creating/.

Cecelia Munzenmaier, MS, teaches her college students how to use Bloom's Taxonomy to raise their grades. When she writes instructional materials for her educational publishing clients, she uses Bloom's to develop learning objectives and assessment items. Her master's degree in adult learning is from Drake University. She has written two books, *Write More, Stress Less* and *Write Better Emails*, and several workplace writing assessments and job aids.