

ROCKY MOUNTAIN
Alchemy

TURNING THE PLAIN
INTO THE PRECIOUS



LEARNING TAXONOMIES IN THE COGNITIVE,
AFFECTIVE, AND PSYCHOMOTOR DOMAINS

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Introduction

Overview

A taxonomy is an orderly classification of a field of study (e.g., botany, animal kingdom, anthropology) according to the natural relationships within the field. Taxonomies allow different researchers to study and discuss the same field of study using shared terminology.

This document contains overviews of taxonomies in the field of education and learning across the three learning domains. These taxonomies should provide a helping hand in the development of solid learning objectives.

Learning domains

There are three primary learning domains:

Learning Domain	Definition
Cognitive	Learning related to knowledge (i.e., from simple recognition and memory to complex problem solving and evaluation)
Psychomotor	Learning related to actions and motor skills (i.e., from simple actions to complex choreography)
Affective	Learning related to attitudes, feelings, & emotions

Crossing domains

It's possible to have an activity or task that spans multiple domains (e.g., performing a task with a computer system will require aspects from the cognitive domain (navigation, button functions, field entry formats, etc.) as well as the psychomotor domain (manipulating the mouse and using the keyboard)). In such cases, the terminal objective should focus on the dominant domain (e.g., in the case of the computer system, knowledge of the system navigation, button functions, and field entry formats would be dominant to using the mouse and keyboard).

**Role of taxonomies
in objectives**

A common error designers make is selecting an inaccurate or mismatched foundational verb for their objective. For example, a designer creating training for a computer system may write the objective “describe the use of the function keys,” when the actual on the job performance is “use the function keys to perform tasks a, b, and c.” *(Describing the use of the keys may be an appropriate enabling objective, but if that is left as the terminal objective, the learner could still leave the training unable to perform the task.)*

The taxonomies of the learning domains presented in this paper can be used as job aids during the learning needs analysis to help identify and define gap or criterion knowledge, skills, and/or attitudes (KSAs), which will in turn form the foundational verbs for your objectives.

Robert Gagné’s Learning Taxonomy

Overview

The first taxonomy we’ll discuss is that of Robert Gagné. Although Gagné’s learning taxonomy does not specify the three primary domains recognized today (cognitive, psychomotor, and affective), it’s not too difficult to demonstrate how these domains are represented (*see the table below*).

The following table illustrates how Gagné’s taxonomy is broken down and shows its relationship to KSAs and the learning domains:

KSA	Learning Domain	Gagne’s Taxonomy
Knowledge	Cognitive	Intellectual Skills Cognitive Strategy Verbal Information
Skill	Psychomotor	Motor Skills
Attitude	Affective	Attitude

Perhaps the most important aspect of Gagné’s taxonomy is that it focuses on learning *outcomes*. In addition, Gagné’s Intellectual Skills is developed as a hierarchy; this set of skills is arranged in order of complexity, implying the only way to master a higher skill is to first master the lower level skills. This concept is foundational to the work we’ll see later in Bloom et al.

Note: The learning taxonomy is only part of Gagné’s instructional theory. In addition to the taxonomy that focuses on learning outcomes are his propositions:

- Certain conditions (internal and external) are necessary to achieve these outcomes.
- There are nine specific events of instruction (a.k.a., Gagné’s Checklist or Gagné’s Nine Events of Instruction), which serve as a guideline for designing instruction.

Intellectual Skills

Intellectual skills include discrimination, concrete concept, rule using, and problem solving.

Note: As pointed out earlier, the Intellectual Skills are arranged in order of complexity.

Skill	Description/Examples
Discrimination	<p>Making different responses to the different members of a particular class. Seeing the essential differences between inputs and responding differently to each.</p> <p>Examples:</p> <p>Distinguish yellow finches from house finches on the basis of markings.</p> <p>Differentiate between gauges on an instrument panel.</p>
Concrete concept	<p>Responding in a single way to all members of a particular class of observable events. Seeing the essential similarity among a class of objects, people, or events, which calls for a single response.</p> <p>Examples:</p> <p>Classify music as jazz, country western, or rock.</p> <p>Categorize a manhole cover, a penny, and the moon as "round."</p>
Rule using	<p>Applying a rule to a given situation or condition by responding to a class of inputs with a class of actions. Relating two or more simpler concepts in the particular manner of a rule. A rule states the relationship among concepts. If a task is a procedure, then use flowcharting to analyze the task. If you can convert a statement into an "if-then" statement, then it is a rule or principle.</p> <p>Example:</p> <p>Apply a simple geometrical theorem to find the answer to a singular equation.</p>
Problem solving	<p>Combining lower level rules to solve problems in a situation never encountered by the person solving the problem. May involve generating new rules which receive trial and error use until the one that solves the problem is found.</p> <p>Example:</p> <p>Combine multiple mathematical theories to solve a complex problem.</p>

Cognitive Strategy An internal process by which the learner controls his or her own ways of thinking and learning.

- Engage in self-testing to decide how much study is needed.
- Know what sorts of questions to ask to best define a domain of knowledge.
- Form a mental model of a problem.

Verbal Information Verbal information includes labels and facts, and bodies of knowledge.

Skill	Description/Examples
Labels and facts	Naming or making a verbal response to a specific input. The response may be naming or citing a fact or set of facts. The response may be vocal or written. Examples: Name objects, people, or events. Recall a person's date of birth or hobbies. List the U.S. states and their capitals.
Bodies of knowledge	Recalling a large body of interconnected facts. Examples: Paraphrase the meaning of textual materials. State a set of rules or regulations.

Motor Skills Bodily movements involving muscular activity.

- Start a car.
- Shoot a target.
- Swing a golf club.

Attitude An internal state which affects an individual's choice of action toward some object, persons, or event (i.e., call to action).

- Choose to visit an art museum.
- Write letters in pursuit of a cause.

Bloom et al.'s Taxonomy of the Cognitive Domain

Introduction

Benjamin Bloom, M. Englehart, E. Furst, W. Hill, and David R. Krathwohl worked together to develop a taxonomy of educational objectives to measure the cognitive domain of human behavior.

- Since Bloom's name appears first on the report alphabetically, over time the other names have been practically forgotten (i.e., it is common to hear this taxonomy referred to as "Bloom's Taxonomy of the Cognitive Domain").
- Although there are actually three sets of domains (cognitive, affective, and psychomotor), the taxonomy for the cognitive domain is by far the most well known.

These objectives relate to "levels" of learning. Level one (knowledge) is the lowest level, and level six (evaluation) is the highest. Learning at the lower levels must be achieved in order to master the higher levels.

The table below describes each level of the taxonomy and lists some common foundational verbs.

- These foundational verbs will form the basis of the defined KSAs and objectives.

Level	Basic Description	Objective Terms
Knowledge (Level 1)	Remember (recall) appropriate, previously learned facts and information. <ul style="list-style-type: none"> • Know common terms • Know specific facts • Know basic concepts • Know principles 	Define, Describe, Identify, Know, Label, List, Match, Memorize, Name, Outline, Quote, Recall, Recognize, Relate, Repeat, Restate, Select, State
Comprehension (Level 2)	Interpret information (understand in your own words). <ul style="list-style-type: none"> • Understand facts • Interpret charts and graphs • Justify methods and procedures • Estimate future consequences 	Classify, Convert, Describe, Discuss, Distinguish between, Estimate, Explain, Extend, Generalize, Give Examples, Interpret, Paraphrase, Predict, Reorder, Rewrite, Summarize
Application (Level 3)	Apply information (use information to solve problems). <ul style="list-style-type: none"> • Apply concepts and principles to new situations • Solve mathematical problems • Construct charts and graphs • Demonstrate correct usage of a method 	Apply, Arrange, Complete, Compute, Demonstrate, Develop, Dramatize, Employ, Exhibit, Modify, Operate, Practice, Predict, Produce, Relate, Show, Solve, Use

Level	Basic Description	Objective Terms
	or procedure	
Analysis (Level 4)	Break information down into parts. <ul style="list-style-type: none"> • Recognize the logical fallacies in reasoning • Evaluate the relevancy of data 	Break down, Categorize, Classify, Deduce, Detect, Diagram, Dissect, Differentiate, Discover, Distinguish, Estimate, Examine, Illustrate, Infer, Order, Outline, Prioritize, Relate, Restructure, Separate, Subdivide, Survey
Synthesis (Level 5)	Creatively or divergently apply prior knowledge and skills to produce a new or original whole. <ul style="list-style-type: none"> • Write a well organized theme • Propose a plan for an experiment • Formulate a new scheme for classifying objects 	Adapt, Anticipate, Categorize, Combine, Compose, Construct, Create, Derive, Design, Explain, Formulate, Generalize, Model, Modify, Organize, Plan, Produce, Rearrange, Revise, Write
Evaluation (Level 6)	Make judgments against set criteria or standards. <ul style="list-style-type: none"> • Judge the value of the work 	Appraise, Argue, Compare, Conclude, Consider, Contrast, Criticize, Critique, Defend, Discriminate, Explain, Grade, Invent, Judge, Justify, Rank, Relate, Support, Validate

Psychomotor Domain

Overview

There are several published taxonomies of the psychomotor domain; at the time of this writing, none are accepted as a standard across multiple industries. This section presents three taxonomies:

- Harrow's taxonomy has a focus toward physical ability.
 - Simpson's taxonomy has a focus toward the progression of mastery from observation to invention.
 - Thomas' taxonomy has a focus toward a hierarchical categorization of sensory, physical, and psychomotor tasks and skills.
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Harrow's Taxonomy of the Psychomotor Domain

Introduction

Anita Harrow (1972) developed a taxonomy for children with special physical needs. This taxonomy is better suited to assessing *ability* to perform a task or activity or to sports and recreation activities than to the typical physical activities performed in the workplace.

Level	Description	Foundational Verbs
Reflex Movements (Level 1)	Actions elicited without learning in response to some stimuli.	Extension, Flexion, Postural adjustments, Stretch
Basic Fundamental Movements (Level 2)	Inherent movement patterns which are formed by combining reflex movements (serve as the basis for complex skilled movements).	Grasp, Grip, Manipulate, Push, Run, Twist, Walk
Perceptual (Level 3)	Interpretation of various stimuli that enable one to make adjustments to the environment. Visual, auditory, kinesthetic, or tactile discrimination. Suggests cognitive as well as psychomotor behavior.	Catching, Coordinated movements (e.g., jumping rope), Punting
Physical Activities (Level 4)	Endurance, strength, vigor, and agility which produce a sound, efficiently functioning body.	All activities which require (a) strenuous effort for long periods of time; (b) muscular exertion; (c) a quick, wide range of motion at the hip joints; (d) quick, precise movements
Skilled Movements (Level 5)	The result of acquisition of a degree of efficiency when performing a complex task.	All skilled activities obvious in sports, recreation, and dance
Non-Discursive Communication (Level 6)	Communication through bodily movements ranging from facial expressions through sophisticated choreography.	Body postures, gestures, and facial expressions efficiently executed in skilled dance movement and choreography

Simpson's Taxonomy of the Psychomotor Domain

Introduction

Elizabeth Simpson's (1966) taxonomy is focused on the progression of a skill from guided response (i.e., doing what you are told to do) to reflex or habitual response (i.e., not having to think about what you're doing), then includes origination as the highest level (i.e., invention of a new way to perform a task).

Level	Description	Foundational Verbs
Perception (Level 1)	The process of becoming aware of objects, qualities, etc. by way of senses. Basic in situation-interpretation-action chain leading to motor activity. May include sensory stimulation, cue selection, translation.	Associate, Compare, Feel, Hear, Identify, Inspect, Listen, Notice, Recognize, Scan, Select, Smell, Taste
Set (Level 2)	Readiness for a particular kind of action or experience. This readiness or preparatory adjustment may be mental, physical or emotional.	Adjust, Arrange, Comprehend, Identify, Locate, Organize, Recognize, Respond, Select
Guided Response (Level 3)	Overt behavioral act of an individual under guidance of an instructor, or following model or set criteria. May include imitation of another person, or trial and error until appropriate response obtained.	Adapt, Correct, Imitate, Match, Practice, Repeat, Reproduce, Simulate
Mechanism (Level 4)	Occurs when a learned response has become habitual. At this level the learner has achieved certain confidence and proficiency or performance. The act becomes part of his/her repertoire of possible responses to stimulus and demands of situations.	Assemble, Fasten, Manipulate, Mix, Mold, Set-up, Shape
Complex (Level 5)	Overt Response Performance of a motor act that is considered complex because of movement pattern required. May include resolution of uncertainty, i.e., done without hesitation; and automatic performance, finely coordinated with great ease and muscle control.	Adjust, Combine, Coordinate, Integrate, Manipulate, Regulate
Adaptation (Level 6)	Altering motor activities to meet demands of problematic situations.	Adapt, Adjust, Alter, Convert, Correct, Integrate, Order, Standardize

Level	Description	Foundational Verbs
Origination (Level 7)	Creating new motor acts or ways of manipulating materials out of skills, abilities and understandings developed in the psychomotor area.	Construct, Create, Design, Develop, Formulate, Invent

Thomas' Taxonomy of the Psychomotor Domain

Introduction

Harrow's Taxonomy focuses on the ability to perform baseline physical skills. In the corporate or industrial workplace, this taxonomy may be used to establish prerequisite ability, but is not appropriate for classifying outcomes of learning.

Simpson's Taxonomy addresses the progression of learning a psychomotor skill from observation to mastery. This taxonomy can be applied in the workplace to address progression from apprentice to master performer, but is also inappropriate for classifying outcomes of learning.

Like Harrow's Taxonomy, Thomas' can be used to define minimum psychomotor requirements for a task or set of tasks which define a job. Like Simpson's Taxonomy, Thomas' is organized in a basic hierarchical structure (although not all levels are necessarily "below" other levels, nor are lower levels necessarily "prerequisites" for higher levels), building in complexity and origination. However, Thomas does not focus on the habitualization or reflex of the task, merely on the ability to perform the foundational verb behavior.

Breaking down complex outcomes

In Thomas' Taxonomy, a complex outcome (represented by a foundational verb selected from the appropriate level) should be broken down into its component foundational verbs. For example:

Outcome	Component Foundational Verbs
Build (<i>construction</i>) a brick wall.	<ul style="list-style-type: none"> • Snap (<i>operation of tools</i>) a guiding plumb line. • Haul and stack (<i>strength</i>) required bricks. • Mix (<i>operation of equipment</i>) mortar. • "Butter" (<i>construction</i>) bricks with mortar. • Lay and set (<i>dexterity</i>) bricks.

Note: Continue breaking down your verbs to meet your specific needs.

For example, if you're defining job requirements that will impact hiring and firing decisions, you'll need to break tasks down to their lowest possible level. However, this same level of effort may not be needed to define some interventions.

In a similar approach, the outcome "create a sculpture" may "live" mostly in the "art" level of the taxonomy, but the component foundational verbs (mixing materials, using tools, etc.) may be classified elsewhere in the taxonomy.

Relation to other domains

You can probably already see how other domains can also come into play in psychomotor tasks. The foundational verb of mixing paints may fall into art, but the selection of the pigments may be argued as cognitive (i.e., the understanding of what colors mix to create new colors). The same principle will apply to the operation of complex equipment. For example, tasks such as steering a sail boat, adjusting the timing of an engine, etc., are psychomotor tasks that require mastery of cognitive concepts.

Taxonomy

The following table presents this author’s attempt to provide a more categorized view of the psychomotor domain (as opposed to either a baseline abilities checklist or a progressive mastery perspective). This taxonomy is designed to classify psychomotor learning outcomes that could be applied to corporate or industrial training.

Note: Although the fundamental approach is different, Thomas’ taxonomy borrows pieces from both Harrow & Simpson.

Level	Description	Foundational Verbs
Perception (Level 1)	Gathering stimuli through the senses.	Examine, Feel, Hear, Identify, Inspect, Listen, Locate, Notice, Scan, See, Smell, Taste
Communication (Level 2)	Physical aspects of communication (e.g., organizing a persuasive speech would rely on elements of the cognitive domain, but actually delivering that speech would be psychomotor).	Diagram (verb), Send/Receive Signals (e.g., Semaphore, Morse Code, Sign Language), Shout, Sing, Speak, Vocalize, Write
Movement (Level 3)	Physical movement from simple body positioning to complex locomotion.	Ascend/Descend, Bend, Climb, Crawl, Crouch, Fall, Jump, Kneel, Reach, Run, Slide, Step, Stoop, Stretch, Swim, Walk
Strength (Level 4)	Actions or tasks requiring a degree of physical strength and/or endurance.	Break, Carry, Drag, Haul, Hoist, Lift, Load/Unload, March, Move (relocate an object), Paddle, Pull, Push, Row, Stack, Throw, Twist
Dexterity (Level 5)	Tasks requiring hand control and skill.	Adjust, Aim, Assemble/Disassemble/ Reassemble, Cut (surgical), Grip, Manipulate, Solder, Splice, Suture, Tie, Trace, Tune, Wind (as in wind a watch)
Coordination (Level 6)	Synchronization of multiple physical activities.	Adapt, Adjust, Balance, Catch, Coordinate, Dance, Multitask, Pitch, Swing & Hit (golf, baseball bat, etc.), Throw (with aim)

Level	Description	Foundational Verbs
Operation of Tools & Equipment (Level 7)	Actions and skills associated with operating tools and/or pieces of equipment.	Adapt, Adjust, Align, Avoid (steer), Bore, Calibrate, Click (mouse, touchscreen), Compile, Configure, Connect, Correct, Dig, Drill, Drive, Fill, Fit, Flip (switches), Focus (lenses), Hammer, Log-On/Off, Lubricate, Maneuver (vehicle), Mortar, Mouse, Nail, Navigate, Open/Close, Operate, Pile, Plug/Unplug, Press, Push (buttons), Regulate, Replace, Run (operate), Sand, Saw, Screw, Select, Set, Sharpen/Hone, Shift (gears), Shut Down, Start/Stop, Steer, Test, Tighten/Loosen, Turn (dials), Turn On/Off, Twist, Type
Construction (Level 8)	Activities or tasks involved in building or constructing an object or structure.	Apply (glue/paint), Arrange, Assemble, Attach, Break, Build, Clean, Combine, Connect/Disconnect, Construct, Create, Dig, Dismantle, Fasten, Fill, Fix, Gauge, Glue, Hammer, Install, Knock Down, Level, Mix, Mold, Order, Organize, Package, Plane, Plant, Pound, Pour, Prepare, Repair, Sew, Shape, Sift, Smooth, Sort, Stitch, Tear Down, Wire
Art (Level 9)	Refined and/or skilled actions associated with creating art.	Arrange, Bend, Chisel, Compose, Create, Design, Draw, Manipulate, Mold, Paint, Play (instrument), Sculpt

Krathwohl's Taxonomy of the Affective Domain

Introduction

Translating affective goals into observable behaviors or performance objectives is challenging, at best. Objectives from the affective domain are typically measured through survey instruments or similar tools.

Note: This taxonomy is controversial largely due to its limited scope and failure to include affective constructs of self-concept, self-esteem, and motivation.

Note: It's also worth noting that Krathwohl worked on the team that developed the taxonomy commonly referred to as "Bloom's Taxonomy."

Level	Description	Foundational Verbs
Receiving (Level 1)	Being aware of or sensitive to the existence of certain ideas, material, or phenomena and being willing to tolerate them.	Accept, Choose, Differentiate, Follow, List (for), Respond to, Show interest
Responding (Level 2)	Committed in some small measure to the ideas, materials, or phenomena involved by actively responding to them.	Acclaim, Answer, Commend, Comply, Comply with, Follow, Spend leisure time in, Volunteer
Valuing (Level 3)	Willing to be perceived by others as valuing certain ideas, materials, or phenomena.	Associate with, Assume responsibility, Believe in, Debate, Increase measured proficiency in, Participate, Relinquish, Subsidize, Support
Organization (Level 4)	Relates the value to those already held and brings it into a harmonious and internally consistent philosophy.	Adhere to, Balance, Classify, Defend, Discuss, Examine, Formulate, Identify with, Theorize
Characterization by Value or Value Set (Level 5)	Acts consistently in accordance with the values he or she has internalized.	Avoid, Change behavior, Develop life philosophy, Influence, Manage, Rate high in the value, Require, Resist, Resolve, Revise

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