



## 2.3.4 Cognitive Domain

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The cognitive domain contains learning skills predominantly related to mental (thinking) processes. Learning processes in the cognitive domain (Table 1) include a hierarchy of skills involving processing information, constructing understanding, applying knowledge, solving problems, and conducting research. These processes enable performance at five different levels of learner knowledge that parallel levels of educational objectives originally defined by Bloom and elaborated in **2.2.1 Bloom's Taxonomy—Expanding its Meaning**. However, Bloom's taxonomy focused on describing levels of attainments rather than process skills, and did not substantially address the manner in which the learner proceeds from one level to the next. The cognitive domain includes skill clusters that organize a complete, concise, and complementary listing of the learning skills most critical for each process. The cognitive domain learning skills presented here are a valuable reference for curriculum design, classroom observation, and assessment of learning outcomes.

### Role of the Cognitive Domain

The cognitive domain encompasses thinking skills that are independent of context and discipline. In contrast to other domains of learning, the cognitive domain addresses development that is individual rather than interpersonal, focuses on content rather than context, and is independent of emotion. The organizational framework given in Table 1 is intended to support learner-centered knowledge acquisition as well as learner-centered growth in cognitive performance.

Cognitive skills can be evidenced at many levels of proficiency (Bransford, Brown, & Cocking, 2000). Five distinct levels that apply to all learning skills are suggested in the **Classification of Learning Skills (2.3.3)**. Cognitive skill development is best sequenced following the levels that parallel educational objectives laid out in Bloom's taxonomy because learning skills from lower-level processes are embedded in learning skills associated with higher-level processes (Bloom, 1956; Anderson & Krathwohl, 2001).

In the cognitive domain, skilled professionals typically utilize a set of specific, highly developed skills along with discipline-specific knowledge in conjunction with a broad spectrum of less-developed skills (Wenger, 1998). Methodologies provide tools for novices as well as experts to strengthen these complex performances (**2.3.7 Learning Processes through the Use of Methodologies**). By strengthening underlying learning skills, one can accelerate the mastery of important methodologies (**2.3.8 Learning Process Methodology**, **3.2.3 Facilitation Methodology**, and **4.1.4 Assessment Methodology**).

### Cognitive Domain Processes

As illustrated in Table 1, five thinking processes comprise the cognitive domain. These processes are sequenced and identified as processing information, constructing understanding, applying knowledge, solving problems, and conducting research. Processing information includes collecting data, generating data, organizing data, retrieving data, and validating information. Constructing understanding includes analyzing, synthesizing, reasoning, and validating understanding. Applying knowledge includes performing with knowledge, modeling, being creative, and validating results. Solving problems includes identifying the problem, structuring the problem, creating solutions, and improving solutions. Conducting research includes formulating research questions, obtaining evidence, discovering, and validating scholarship.

Critical thinking is purposely not identified with a single process area in the cognitive domain. Instead, critical thinking is considered a super-process that draws from all process areas in the cognitive domain during the creation of new knowledge or the improvement of existing knowledge. This viewpoint is consistent with principles of the National Council for Excellence in Critical Thinking (Paul, 2003). Further exploration of the holistic nature of critical thought is given in **2.2.5 Overview of Critical Thinking**.

### Cognitive Domain Clusters

Clusters of learning skills are identified under each of the cognitive domain processes. As many as five clusters support each process area. Each skill cluster contains up to a half-dozen unique but closely related learning skills. Skill clusters are given labels that communicate their role within each process area. In Table 1, skill clusters are arranged left-to-right in a progression of increasing sophistication. There is no special significance in the order in which the learning skills appear within a cluster.

Table 1

**Cognitive Domain Learning Skills****Processing Information****Collecting Data** (from a disorganized source)

- Observing – seeing details in an environment/object
- Listening – purposeful collection of aural data
- Skimming – inventorying using key prompts
- Memorizing – active mental storage of information
- Recording – transcribing key information
- Measuring – obtaining data using a predetermined scale

**Generating Data** (to fill a void)

- Predicting – forecasting from experience
- Estimating – approximating from mathematical models
- Experimenting – inferring from empirical study
- Brainstorming – gathering ideas from previous experience

**Organizing Data** (for future use)

- Filtering – selecting data based on criteria
- Outlining – identifying primary and subordinate groupings
- Categorizing – associating data with established groups
- Systematizing – designing an organizational framework

**Retrieving Data** (from an organized source)

- Recognizing patterns – perceiving consistent repetitive occurrences
- Searching – locating information within a system
- Recalling – retrieving from memory
- Inventorying – retrieving from collective memory

**Validating Information** (for value)

- Testing perceptions – verifying based on interpretations
- Validating sources – verifying based on credibility
- Controlling errors – verifying based on procedures
- Identifying inconsistency – detecting outliers/anomalies
- Ensuring sufficiency – verifying data quantity/quality to suit the context

*Key for Table 1*

<p><b>Process</b></p> <p><b>Skill Cluster</b></p> <p>Specific skill</p>
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**Constructing Understanding****Analyzing** (characterizing individual parts)

- Identifying similarities – recognizing common attributes of parts
- Identifying differences – recognizing/distinguishing attributes of parts
- Identifying assumptions – examining preconceptions/biases
- Inquiring – asking key questions
- Exploring context – seeing the relationship of parts to the environment

**Synthesizing** (creating from parts)

- Joining – connecting identifiable parts
- Integrating – combining parts into a new whole
- Summarizing – representing the whole in a condensed statement
- Contextualizing – connecting related parts to the environment

**Reasoning** (revealing meaning)

- Interpreting – adding meaning for better understanding
- Inferring – drawing conclusions from evidence and logic
- Deducing – arriving at conclusions from general principles
- Inducing – arriving at a general principle by observing specific instances
- Abstracting – describing the essence of an idea, belief, or value

**Validating Understanding** (for reliability)

- Ensuring compatibility – testing consistency with prior knowledge
- Thinking skeptically – testing against fundamental principles/schema
- Validating completeness – checking for missing aspects
- Bounding – recognizing the limits of the application of knowledge

**Applying Knowledge****Performing with Knowledge** (in real context)

- Clarifying expectations – defining proficiency level
- Strategizing – planning how to use knowledge
- Using prior knowledge – integrating unprompted knowledge
- Transferring – using ideas in a new context

**Modeling** (in abstract context)

- Analogizing – representing similar elements in dissimilar contexts
- Exemplifying – showing by example
- Simplifying – representing only primary features
- Generalizing – transferring knowledge to multiple contexts
- Quantifying – representing with numbers or equations
- Diagramming – clarifying relationships through visual representation

**Being Creative** (in new contexts)

- Challenging assumptions – exploring possibilities by relaxing constraints
- Envisioning – imagining desired conditions
- Linear thinking – generating new ideas from previous ideas
- Divergent thinking – taking variety of positions to stimulate ideas
- Transforming images – manipulating images to gain new insight
- Lateral thinking – generating new ideas from associations

**Validating Results** (for appropriateness)

- Complying – comparing results with accepted standards
- Benchmarking – comparing with results from best practices
- Validating – using alternative methods to test results

Table 1

**Cognitive Domain Learning Skills (continued)**

<b>Solving Problems</b>	
<b>Identifying the Problem</b> (to establish focus)	<b>Creating Solutions</b> (for quality results)
Recognizing the problem – stating what is wrong or missing	Reusing solutions – adapting existing methods/results
Defining the problem – articulating a problem and need for solution	Implementing – executing accepted solution practices
Identifying stakeholders – naming key players/audiences	Choosing alternatives – selecting alternatives using criteria
Identifying issues – inventorying key stakeholder desires and concerns	Harmonizing solutions – fitting components into holistic solution
Identifying constraints – recognizing limitations to solutions	
<b>Structuring the Problem</b> (to direct action)	<b>Improving Solutions</b> (for greater impact)
Categorizing issues – grouping by underlying principles	Generalizing solutions – modifying for broader applicability
Establishing requirements – articulating solution criteria	Ensuring robustness – modifying to fit more contexts
Subdividing – separating into sub-problems	Analyzing risks – identifying external sources/impacts of error
Selecting tools – finding methods to facilitate solution	Ensuring value – testing against requirements and constraints

**Conducting Research****Formulating Research Questions** (to guide inquiry)

- Locating relevant literature – searching out seminal sources
- Identifying missing knowledge – determining gaps in community understanding
- Stating research questions – asking empirically answerable questions
- Estimating research significance – forecasting the value/impact to the community
- Writing measurable outcomes – specifying deliverables from research

**Obtaining Evidence** (to support research)

- Designing experiments – specifying observable parameters and sampling
- Selecting methods – determining research procedures
- Extracting results – analyzing data to produce quality characterizations
- Replicating results – duplicating experiments and findings

**Discovering** (to expand knowledge)

- Testing hypotheses – discerning significant effects
- Reasoning with theory – explaining data with accepted knowledge
- Constructing theory – formulating new conceptual structures
- Creating tools – adapting knowledge for practitioners

**Validating Scholarship** (for meaningful contribution)

- Defending scholarship – presenting within disciplinary performance expectations
- Responding to review – improving one's scholarship based on community input
- Confirming prior work – adding credibility to a body of knowledge
- Judging scholarship – evaluating scholarship against criteria

**Cognitive Domain Skills**

Learning skills are inseparable entities that can be consciously elevated and refined with proven potential to increase the rate and capacity for learning. As explained in **2.1.1 Overview of Learning Theory**, these are the mortar for building schema to which learners can connect new knowledge. Each learning skill is given a brief explanation that visualizes its use.

Two different learning skills from the cognitive domain are analyzed in Table 2: listening and identifying assumptions. These two examples illustrate how a specific skill used for basic processing of information and another skill used in constructing understanding can be demonstrated at very low levels (without conscious effort) and at very high levels (impressing and inspiring others). Monitoring learning skill proficiency along a common developmental continuum can be a tremendous motivator for learners. Similarly, recognizing which skills are underdeveloped in different learning situations can be used to plan interventions that accelerate desired cognitive development.

The cognitive domain presented in Table 1 includes over 90 transferable learning skills relevant to undergraduate education, graduate education, and professional practice. These were selected using the methods described in the **Classification of Learning Skills (2.3.3)** and worded in a manner intended to appeal to users in all academic disciplines. Enough specificity has been retained to ensure that well-defined cognitive domain learning skills can be traced to most course and program learning outcomes. Explicit attention to targeted learning skills in classroom activities, instructor interventions, and assessment sessions can increase the probability that these outcomes are achieved and that they can be transferred to other settings (**2.4.5 Learning Outcomes** and **4.1.9 SII Method for Assessment Reporting**).

Table 2

**Illustration of Cognitive Domain Competency Levels**

Level of Competency	Description of Individual Responses	Examples: a. Listening b. Identifying assumptions
<b>Level 5 Transformative Use</b>	The skill is expanded and integrated with other skills for creative, productive application in novel contexts; this inspires others to emulate use.	a. Purposefully listens and observes nuances and contextual details that deepen the understanding of information and its application to a clearly stated need b. Clearly articulates one's own assumptions as well as those of others, enabling all to understand their impacts on interpretations and conclusions on matters involving a wide variety of disciplines and perspectives
<b>Level 4 Self-Reflective Use</b>	The skill is used effectively by the learner; the skill can be self-improved and adapted to unfamiliar contexts with occasional advice from a mentor.	a. Carefully listens and reflects on success to gain maximum understanding relevant to a specific need b. Analyzes and recognizes relative impacts of assumptions made by self and others across a variety of disciplines and perspectives
<b>Level 3 Consistent Performance</b>	The skill is used routinely and effectively in multiple contexts through learner self-direction; not able to advance without external coaching.	a. Carefully listens to understand key points useful for addressing a specific need b. Looks for the impacts of assumptions by self and others in discussing interpretations and conclusions within areas of specialty
<b>Level 2 Conscious Use</b>	The skill is used knowingly, possibly proactively, by the learner, but the skill needs to be constantly challenged by a mentor.	a. Actively listens; identifies information thought to be important to a general need b. Is aware of some assumptions underlying his or her personal interpretations and conclusions, but is often unaware of assumptions made by others
<b>Level 1 Non-Conscious Use</b>	The use of the skill is initiated by a prompt or influence external to the learner; an unintended use of the skill.	a. Passively listens; notes only information that is highlighted by others b. Is unaware when assumptions are made by self or others, often leading to erroneous conclusions

**Concluding Thoughts**

Teachers and learners need to understand the hierarchy of processes and skills within the cognitive domain so they appreciate prerequisite skills for learning as well as the way these skills need to be transformed to master more complicated elements of discipline-specific concept inventories. Development of learning skills should never be taken for granted in teaching or learning new content. Skills associated with lower-level processes should be introduced in foundation courses and elevated in intermediate-level coursework. Skills associated with higher-level processes should be thoughtfully introduced and reinforced in upper-division courses. Methodically invoking key learning skills from different process areas and clusters across the cognitive domain also provides a method for infusing richness in course activities while strengthening lifelong learning skills. Like the **Social Domain (2.3.5)**, this module serves to remind us that improved cognitive domain performance is always possible, no matter what one's state of learning skill development.

**References**

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