

Cognitive Process and Levels of Knowledge

Introduction

Educational objectives and cognitive processes define how human beings acquire, process, and internalize information. To systematically structure these mental mechanisms, educational psychologists developed specific classification frameworks called **Taxonomies of Learning**. These systems help educators transition students from basic rote memorization to complex critical analysis and self-awareness.

1. Bloom's Taxonomy of Learning Domains

Developed originally in 1956 by **Benjamin Bloom** and later revised in 2001 by Lorin Anderson and David Krathwohl, Bloom's framework divides learning into **three distinct domains** (often called the **3 Ks/CAP** of learning):

- **Cognitive Domain:** Brain-based learning (Knowledge/Thinking).
- **Affective Domain:** Heart-based learning (Attitudes/Feelings).
- **Psychomotor Domain:** Hand-based learning (Manual/Physical skills).

2. The Cognitive Domain (Cognitive Process Dimension)

The Cognitive Domain handles the mental processing of facts, concepts, and analytical ideas. It was updated in 2001 from a **noun-based model** to a **verb-based model** to better reflect active cognitive processing.

A. Remembering

- Represents the **lowest tier of cognitive processing**.
- Focuses entirely on **retrieving, recognizing, and recalling** relevant knowledge from long-term memory.
- **Action Verbs:** Define, list, state, name, repeat, identify.

B. Understanding

- Focuses on **constructing meaning and interpreting** instructional messages.
- Students explain ideas rather than just reciting them.
- **Action Verbs:** Classify, describe, discuss, explain, identify, translate, summarize.

C. Applying

- Focuses on **carrying out or using a procedure** in a brand-new, concrete situation.



- Bridges the gap between classroom theory and real-world execution.
- **Action Verbs:** Execute, implement, solve, use, demonstrate, operate.

D. Analyzing

- Focuses on **breaking material into constituent parts** and determining how they relate to one another.
- Students identify underlying structures, patterns, and organizational setups.
- **Action Verbs:** Differentiate, organize, deconstruct, compare, contrast, distinguish.

E. Evaluating

- Focuses on **making judgments based on criteria and standards** through critiques.
- Evaluates the structural validity, accuracy, or quality of a given system.
- **Action Verbs:** Check, critique, judge, defend, assess, rate, support.

F. Creating

- Represents the **highest tier of cognitive processing**.
- Focuses on **putting elements together to form a coherent, original, or functional whole**.
- **Action Verbs:** Design, construct, assemble, generate, formulate, develop.

3. The Knowledge Dimension (Levels of Knowledge)

The 2001 revision separated the *cognitive process* (how you think) from the *knowledge dimension* (what you know). This dimension defines four progressive levels of knowledge, including metacognition.

A. Factual Knowledge

- Covers the **basic elements students must know** to be acquainted with a discipline.
- Includes isolated bits of technical terminology and specific data points.
- **Example:** Chemical symbols (O, H₂O), historical dates, geographical labels.

B. Conceptual Knowledge

- Covers the **interrelationships among basic elements** within a larger structure that enable them to function together.
- Focuses on classifications, principles, generalizations, and theories.
- **Example:** The theory of evolution, Newton's laws of motion, structures of governance.

C. Procedural Knowledge

- Covers **how to do something**, methods of inquiry, and criteria for using skills.
- Focuses on algorithms, techniques, and specialized routines.



- **Example:** Knowing how to perform a chemical titration, solve a quadratic equation, or conduct a research survey.

D. Metacognitive Knowledge

- Represents the **highest level of the knowledge dimension**.
- Focuses on **knowledge of cognition in general as well as awareness of one's own cognition**.
- It involves self-reflection on how one learns, strategic planning, and understanding individual strengths and weaknesses.
- **Example:** Realizing that you retain information better via visual diagrams than text notes, or practicing active self-monitoring techniques during an exam.

4. The Psychomotor Domain (Physical/Skill-Based Learning)

Mainly formalized by educators like **R.H. Dave (1970)** and **E.J. Simpson (1972)**, this domain handles the progressive development of manual and physical skills.

Level (Dave's Model)	Description	Example
1. Imitation	Observing a master and attempting to repeat the physical action.	Watching a teacher demonstrate a pipette and copying their grip.
2. Manipulation	Performing an action independently by following written directions or memory.	Operating a microscope by reading a instruction manual booklet.
3. Precision	Executing the physical task with high accuracy, control, and minimal errors .	Drawing a complex, perfectly scaled biological cellular chart.
4. Articulation	Coordinating a series of physical acts in a sequence with harmony and timing.	Driving a vehicle while simultaneously checking mirrors and shifting gears.
5. Naturalization	The skill becomes automatic, instinctive, and second nature to the body.	An expert typing 90 words per minute without looking down at the keyboard.

5. The Affective Domain (Attitudes, Values, and Emotions)

Developed by **David Krathwohl (1964)**, this domain maps how human beings handle emotional growth, empathy, values, and behavioral changes.



A. Receiving

- The learner shows **willingness to attend to or notice** a particular stimulus or environmental event.
- **Key trait:** Passive attention without deep judgment.

B. Responding

- The learner **actively participates and reacts** to the stimulus rather than just observing.
- **Key trait:** Compliance and initial satisfaction in reacting.

C. Valuing

- The learner **attaches a specific worth or value** to an object, phenomenon, or behavior.
- **Key trait:** Internal commitment to an ideology or point of view.

D. Organization

- The learner **prioritizes values, resolves internal conflicts**, and begins constructing an internal value system.
- **Key trait:** Comparing, relating, and synthesizing separate values.

E. Characterization

- Represents the **highest level of emotional internalization**.
- The value system becomes **completely integrated into the person's lifestyle** and controls their everyday behavior naturally.
- **Key trait:** Ethical predictability and total personal alignment.
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6. Alternate Key Theories of Knowledge & Taxonomies

You must know these two highly popular alternative learning taxonomies:

A. SOLO Taxonomy (Structure of Observed Learning Outcomes)

Developed by **John Biggs and Kevin Collis (1982)**, this framework evaluates how a student's understanding of a specific topic grows in structural complexity.

- **1. Pre-Structural Level:** The student misses the point completely; has **no coherent understanding** of the topic.



- **2. Uni-Structural Level:** The student focuses on **only one relevant aspect or data point** of the topic.
- **3. Multi-Structural Level:** The student identifies **several separate aspects**, but treats them as isolated components without understanding their connection.
- **4. Relational Level:** The student **links the separate parts together** to see the integrated whole and understand its complete ecosystem.
- **5. Extended Abstract Level:** The student takes the integrated concept and **applies it to an entirely new area** or alternative conceptual level.

Knowledge Theory: Gagne's Hierarchy of Learning

Proposed by **Robert Gagne (1965 :**

Level 8: Problem Solving (Highest Level)

- Focuses on **combining previously learned rules and principles** to invent a solution to a brand-new, unencountered challenge.
- Develops **ultimate cognitive strategies** and independent thinking capabilities.
- **Example:** Devising a new operational strategy to improve a company's broken supply chain.

Level 7: Rule / Principle Learning

- Focuses on **understanding relationships between two or more concepts** to guide behavior or formulate laws.
- Relies heavily on the **“if-then” logic structures** found in science and mathematics.

Level 6: Concept Learning

- Focuses on **categorizing objects, events, or ideas** based on common structural properties or abstract features.
- Enables the learner to **respond to things as a class** rather than as isolated individuals.
- **Example:** Identifying a shape as a triangle because it has three sides, regardless of its size or color.

Level 5: Discrimination Learning

- Focuses on **distinguishing between closely resembling stimuli** and giving different responses to each.
- The learner filters out **similarities to identify unique differences**.
- **Example:** Telling the difference between a copy-paste error and a true formatting issue in a document processor.

Level 4: Verbal Association

- Focuses on **connecting separate verbal links** using linguistic chains.



- It is the foundation for **vocabulary acquisition and language development**.
- **Example:** Associating the spoken word "Car" with a physical four-wheeled vehicle and its written spelling.

Level 3: Chaining (Motor/Behavioral sequences)

- Focuses on **connecting two or more previously learned stimulus-response links** into a seamless, multi-step physical sequence.
- Relies on **non-verbal, motor-based habits**.
- **Example:** The sequential actions of unlocking a door, turning the knob, and pushing it open.

Level 2: Stimulus-Response (S-R) Learning

- Focuses on **forming a voluntary behavioral response** to a specific environmental stimulus based on reinforcement.
- Derived from **Skinner's operant conditioning** frameworks.
- **Example:** A student raising their hand immediately when the teacher finishes asking a question to earn praise.

Level 1: Signal Learning (Lowest Level)

- Focuses on **developing involuntary, conditional reflexes** to a generalized environmental trigger.
- Derived from **Pavlov's classical conditioning** experiments.
- **Example:** A student's heart rate increasing automatically when the loud morning school bell rings.

Comparison Table: Learning Taxonomies and Frameworks

Taxonomy / Framework	Primary Focus	Key Proponents	Core Levels / Dimensions	Best Suited For
Bloom's Cognitive Domain	Mental processing, intellectual skills, and core thinking mechanics.	Benjamin Bloom, Anderson & Krathwohl	Remembering, Understanding, Applying, Analyzing, Evaluating, Creating	Academic testing, objective knowledge evaluation, and classroom syllabus planning.
Bloom's Knowledge Dimension	The specific type or structure of the content being learned.	Lorin Anderson, David Krathwohl	Factual, Conceptual, Procedural, Metacognitive	Distinguishing between simple rote data and high-level student self-



Taxonomy / Framework	Primary Focus	Key Proponents	Core Levels / Dimensions	Best Suited For
Dave's Psychomotor Domain	Physical coordination, motor-skill development, and muscular execution.	R.H. Dave	Imitation, Manipulation, Precision, Articulation, Naturalization	awareness. Technical lab training, sports education, computing skills, and vocational fields.
Krathwohl's Affective Domain	Emotional growth, internal feelings, empathy, values, and attitudes.	David Krathwohl	Receiving, Responding, Valuing, Organization, Characterization	Assessing behavioral changes, ethics instruction, and institutional value education.
SOLO Taxonomy	Structural complexity of student learning outcomes on a single topic.	John Biggs, Kevin Collis	Pre-structural, Uni-structural, Multi-structural, Relational, Extended Abstract	Qualitative assessment of open-ended essay answers, theses, and independent research.
Gagne's Hierarchy of Learning	Sequential behavioral and cognitive steps of learning conditions.	Robert Gagne	8 Levels (from Signal Learning to Problem Solving)	Step-by-step instructional design, training manuals, and structured skill mastery.

Quick Concept Remember Table

1. Bloom's Cognitive Domain

Level	Quick Remember Keyword	Quick Practical Exam Example
Remembering	Recall, State, Define	Reciting a scientific definition or formula verbatim.
Understanding	Explain, Translate, Summarize	Explaining an economic concept in your own words.
Applying	Execute, Solve, Implement	Calculating interest rates using a mathematical formula.



Level	Quick Remember Keyword	Quick Practical Exam Example
Analyzing	Break Down, Compare, Contrast	Finding structural differences between two research designs.
Evaluating	Judge, Critique, Defend	Reviewing a published research article for logical flaws.
Creating	Design, Formulate, Construct	Writing a completely new research proposal framework.

2. Bloom's Knowledge Dimension

Level	Quick Remember Keyword	Quick Practical Exam Example
Factual	Labels, Symbols, Basic Details	Memorizing chemical symbols (O , H₂O) or historical dates.
Conceptual	Theories, Schemas, Principles	Thoroughly understanding the laws of thermodynamics.
Procedural	Methods, Algorithms, Routines	Following the exact sequence to complete a chemical titration.
Metacognitive	Self-awareness, Strategy	Knowing that you learn better through diagrams than plain text.

3. Dave's Psychomotor Domain

Level	Quick Remember Keyword	Quick Practical Exam Example
Imitation	Watch and Copy	Watching an instructor use a pipette and copying the technique.
Manipulation	Follow Written Directions	Operating a new microscope by reading the instruction manual.
Precision	Error-Free, Exact Accuracy	Drawing a perfectly scaled and accurate cell diagram.
Articulation	Sequence, Harmony, Timing	Shifting gears smoothly while driving a vehicle.
Naturalization	Automatic, Second Nature	Typing 90 words per minute without looking at the keyboard.

4. Krathwohl's Affective Domain

Level	Quick Remember Keyword	Quick Practical Exam Example
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Level	Quick Remember Keyword	Quick Practical Exam Example
Receiving	Notice, Listen, Accept	Paying careful attention to a guest lecture on climate change.
Responding	Participate, React, Comply	Voluntarily participating in a campus cleanliness drive.
Valuing	Internal Commitment	Choosing to avoid plastic due to personal environmental values.
Organization	Prioritize, Resolve Conflicts	Revising career goals to align with ethical principles.
Characterization	Integrated Lifestyle	Naturally following a sustainable, zero-waste lifestyle.

5. SOLO Taxonomy

Level	Quick Remember Keyword	Quick Practical Exam Example
Uni-structural	One Single Aspect	Mentioning only one cause of global warming.
Multi-structural	Many Separate Aspects	Listing several causes of global warming without connecting them.
Relational	Connect Parts into a Whole	Explaining how pollution affects weather patterns.
Extended Abstract	Generalize to New Situations	Applying climate knowledge to predict future economic impacts.

6. Gagne's Hierarchy of Learning

Level	Quick Remember Keyword	Quick Practical Exam Example
Signal Learning	Involuntary Reflex	Heart rate increasing immediately after hearing a loud bell.
Stimulus–Response (S-R) Learning	Rewarded Voluntary Action	Raising your hand in class to receive the teacher's praise.
Chaining	Multi-Step Habit	Unlocking a door and opening it through a sequence



Level	Quick Remember Keyword	Quick Practical Exam Example
		of actions.
Discrimination Learning	Distinguish Differences	Identifying a peer-reviewed journal versus a predatory journal.
Rule Learning	If-Then Principles	Applying the rule that heat causes metals to expand.
Problem Solving	Novel Application of Principles	Designing a new strategy to reduce traffic congestion in a city.

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