HIGHER-ORDER THINKING

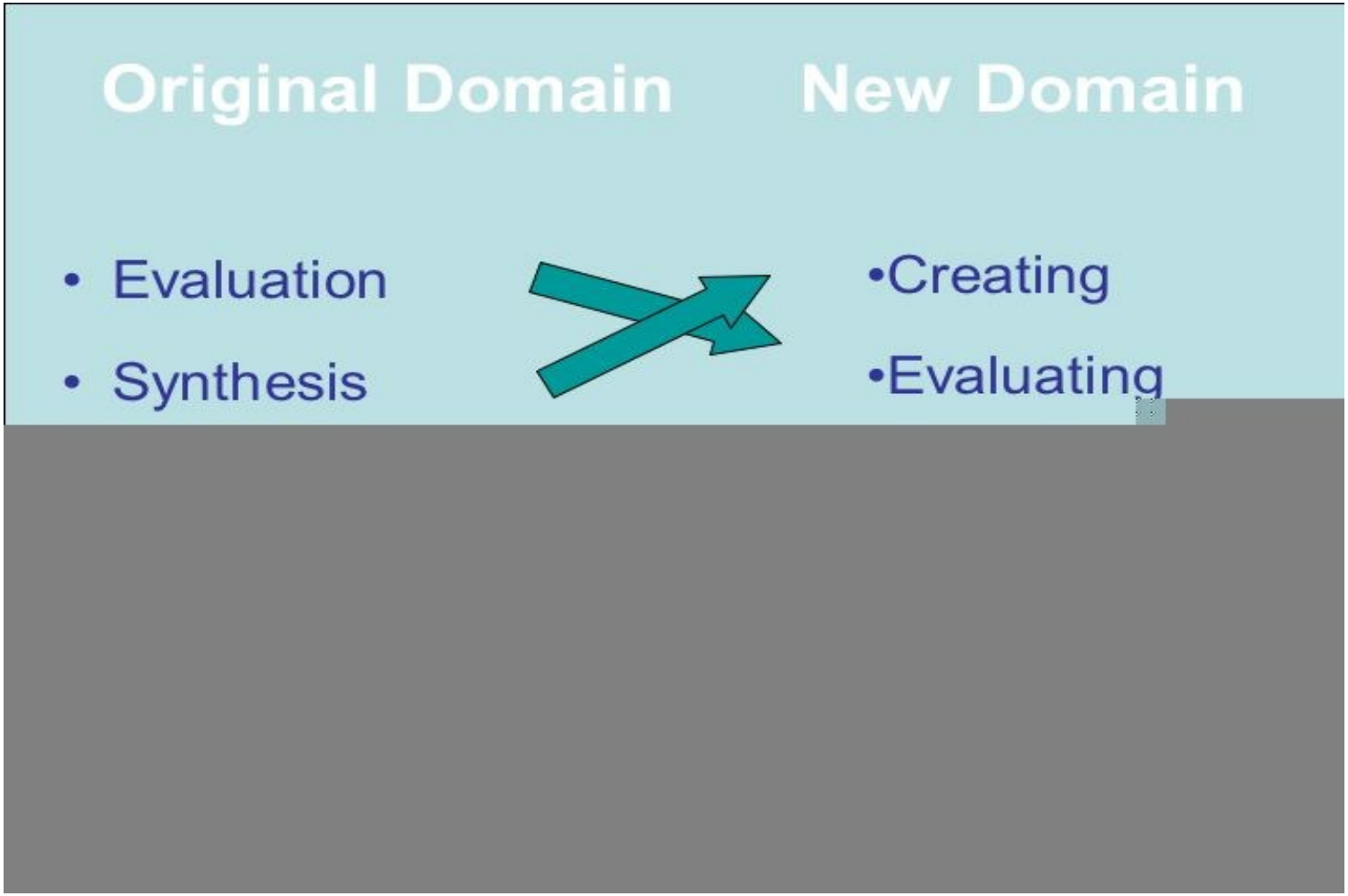
HOT

- **Higher-order thinking** is a concept of Education reform based on learning taxonomies such as Bloom's Taxonomy.
- The idea is that some types of learning require more cognitive processing than others, but also have more generalized benefits

HOT

- In Bloom's taxonomy, for example, skills involving analysis, evaluation and synthesis (creation of new knowledge) are thought to be of **a higher order**, requiring different learning and teaching methods, than the learning of facts and concepts

Bloom's Revised Taxonomy



HOT

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- Higher order thinking involves the learning of complex judgmental skills such as **critical thinking** and **problem solving**. Higher order thinking is more difficult to learn or teach but also more valuable because such skills are more likely to be usable in novel situations (i.e., situations other than those in which the skill was learned).

HOTS

- The concept of **higher order thinking skills (HOTS)** became a major educational agenda item with the 1956 publication of Bloom's taxonomy of educational objectives.
- Higher order thinking skills are those skills in the top three levels: analysis, synthesis, and evaluation. These three skill levels are important in critical thinking.

Truth and Knowledge

- Different approaches to thinking are used to solve different kind of problems or issues :

1. Analytical thinking : “How can I break this problem down into its constituent parts?”
2. Creative thinking : “ How might I approach this problem in new and inventive ways?”
3. Logical thinking : “ How can orderly, deductive reasoning help me think clearly?”
4. Critical thinking : “ What I am trying to accomplish here and how will I know when I’ve succeeded?”
5. Reflective thinking : “ What does it mean?”

COGNITIVE DOMAIN

- **Remembering**: Recall previous learned information
- **Examples**: Recite a policy. Quote prices from memory to a customer. Knows the safety rules.
- **Key Words**: defines, describes, identifies, knows, labels, lists, matches, names, outlines, recalls,

COGNITIVE DOMAIN

- **Understanding**: Comprehending the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words.
- **Examples**: Rewrites the principles of test writing. Explain in one's own words the steps for performing a complex task. Translates an equation into a computer spreadsheet.
- **Key Words**: comprehends, converts, defends, distinguishes, estimates, explains, extends, generalizes, gives an example, infers, interprets, paraphrases, predicts, rewrites, summarizes, translates.

COGNITIVE DOMAIN

- **Applying**: Use a concept in a new situation or unprompted use of an abstraction. Applies what was learned in the classroom into novel situations in the work place.
- **Examples**: Use a manual to calculate an employee's vacation time. Apply laws of statistics to evaluate the reliability of a written test.
- **Key Words**: applies, changes, computes, constructs, demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, shows, solves, uses.

COGNITIVE DOMAIN

- **Analyzing**: Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences.
- **Examples**: Troubleshoot a piece of equipment by using logical deduction. Recognize logical fallacies in reasoning. Gathers information from a department and selects the required tasks for training.
- **Key Words**: analyzes, breaks down, compares, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines, relates, selects, separates.

COGNITIVE DOMAIN

- **Evaluating**: Make judgments about the value of ideas or materials.
- **Examples**: Select the most effective solution. Hire the most qualified candidate. Explain and justify a new budget.
- **Key Words**: appraises, compares, concludes, contrasts, criticizes, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies, relates, summarizes, supports.

COGNITIVE DOMAIN

- **Creating**: Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.
- **Examples**: Write a company operations or process manual. Design a machine to perform a specific task. Integrates training from several sources to solve a problem. Revises and process to improve the outcome.
- **Key Words**: categorizes, combines, compiles, composes, creates, devises, designs, explains, generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, writes.

AFFECTIVE DOMAIN

- **Receiving Phenomena**: Awareness, willingness to hear, selected attention.
- **Examples**: Listen to others with respect. Listen for and remember the name of newly introduced people.
- **Key Words**: asks, chooses, describes, follows, gives, holds, identifies, locates, names, points to, selects, sits, erects, replies, uses.

AFFECTIVE DOMAIN

- **Responding to Phenomena**: Active participation on the part of the learners. Attends and reacts to a particular phenomenon. Learning outcomes may emphasize compliance in responding, willingness to respond, or satisfaction in responding (motivation).
- **Examples**: Participates in class discussions. Gives a presentation. Questions new ideals, concepts, models, etc. in order to fully understand them. Know the safety rules and practices them.
- **Key Words**: answers, assists, aids, complies, conforms, discusses, greets, helps, labels, performs, practices, presents, reads, recites, reports, selects, tells, writes.

AFFECTIVE DOMAIN

- **Valuing**: The worth or value a person attaches to a particular object, phenomenon, or behavior. This ranges from simple acceptance to the more complex state of commitment. Valuing is based on the internalization of a set of specified values, while clues to these values are expressed in the learner's overt behavior and are often identifiable.
- **Examples**: Demonstrates belief in the democratic process. Is sensitive towards individual and cultural differences (value diversity). Shows the ability to solve problems. Proposes a plan to social improvement and follows through with commitment. Informs management on matters that one feels strongly about.
- **Key Words**: completes, demonstrates, differentiates, explains, follows, forms, initiates, invites, joins, justifies, proposes, reads, reports, selects, shares, studies, works.

AFFECTIVE DOMAIN

- **Organization**: Organizes values into priorities by contrasting different values, resolving conflicts between them, and creating an unique value system. The emphasis is on comparing, relating, and synthesizing values.
- **Examples**: Recognizes the need for balance between freedom and responsible behavior. Accepts responsibility for one's behavior. Explains the role of systematic planning in solving problems. Accepts professional ethical standards. Creates a life plan in harmony with abilities, interests, and beliefs. Prioritizes time effectively to meet the needs of the organization, family, and self.
- **Key Words**: adheres, alters, arranges, combines, compares, completes, defends, explains, formulates, generalizes, identifies, integrates, modifies, orders, organizes, prepares, relates, synthesizes.

AFFECTIVE DOMAIN

- **Internalizing values** (characterization): Has a value system that controls their behavior. The behavior is pervasive, consistent, predictable, and most importantly, characteristic of the learner. Instructional objectives are concerned with the student's general patterns of adjustment (personal, social, emotional).
- **Examples**: Shows self-reliance when working independently. Cooperates in group activities (displays teamwork). Uses an objective approach in problem solving. Displays a professional commitment to ethical practice on a daily basis. Revises judgments and changes behavior in light of new evidence. Values people for what they are, not how they look.
- **Key Words**: acts, discriminates, displays, influences, listens, modifies, performs, practices, proposes, qualifies, questions, revises, serves, solves, verifies.

PSYCHOMOTOR DOMAIN

- **Perception**: The ability to use sensory cues to guide motor activity. This ranges from sensory stimulation, through cue selection, to translation.
- **Examples**: Detects non-verbal communication cues. Estimate where a ball will land after it is thrown and then moving to the correct location to catch the ball. Adjusts heat of stove to correct temperature by smell and taste of food. Adjusts the height of the forks on a forklift by comparing where the forks are in relation to the pallet.
- **Key Words**: chooses, describes, detects, differentiates, distinguishes, identifies, isolates, relates, selects.

PSYCHOMOTOR DOMAIN

- **Set**: Readiness to act. It includes mental, physical, and emotional sets. These three sets are dispositions that predetermine a person's response to different situations (sometimes called mindsets).
- **Examples**: Knows and acts upon a sequence of steps in a manufacturing process. Recognize one's abilities and limitations. Shows desire to learn a new process (motivation). NOTE: This subdivision of Psychomotor is closely related with the "Responding to phenomena" subdivision of the Affective domain.
- **Key Words**: begins, displays, explains, moves, proceeds, reacts, shows, states, volunteers.

PSYCHOMOTOR DOMAIN

- **Guided Response**: The early stages in learning a complex skill that includes imitation and trial and error. Adequacy of performance is achieved by practicing.
- **Examples**: Performs a mathematical equation as demonstrated. Follows instructions to build a model. Responds hand-signals of instructor while learning to operate a forklift.
- **Key Words**: copies, traces, follows, react, reproduce, responds

PSYCHOMOTOR DOMAIN

- **Mechanism**: This is the intermediate stage in learning a complex skill. Learned responses have become habitual and the movements can be performed with some confidence and proficiency.
- **Examples**: Use a personal computer. Repair a leaking faucet. Drive a car.
- **Key Words**: assembles, calibrates, constructs, dismantles, displays, fastens, fixes, grinds, heats, manipulates, measures, mends, mixes, organizes, sketches.

PSYCHOMOTOR DOMAIN

- **Complex Overt Response**: The skillful performance of motor acts that involve complex movement patterns. Proficiency is indicated by a quick, accurate, and highly coordinated performance, requiring a minimum of energy. This category includes performing without hesitation, and automatic performance. For example, players are often utter sounds of satisfaction or expletives as soon as they hit a tennis ball or throw a football, because they can tell by the feel of the act what the result will produce.
- **Examples**: Maneuvers a car into a tight parallel parking spot. Operates a computer quickly and accurately. Displays competence while playing the piano.
- **Key Words**: assembles, builds, calibrates, constructs, dismantles, displays, fastens, fixes, grinds, heats, manipulates, measures, mends, mixes, organizes, sketches.
- NOTE: The Key Words are the same as Mechanism, but will have adverbs or adjectives that indicate that the performance is quicker, better, more accurate, etc.

PSYCHOMOTOR DOMAIN

- **Adaptation**: Skills are well developed and the individual can modify movement patterns to fit special requirements.
- **Examples**: Responds effectively to unexpected experiences. Modifies instruction to meet the needs of the learners. Perform a task with a machine that it was not originally intended to do (machine is not damaged and there is no danger in performing the new task).
- **Key Words**: adapts, alters, changes, rearranges, reorganizes, revises, varies.

PSYCHOMOTOR DOMAIN

- **Origination**: Creating new movement patterns to fit a particular situation or specific problem. Learning outcomes emphasize creativity based upon highly developed skills.
- **Examples**: Constructs a new theory. Develops a new and comprehensive training programming. Creates a new gymnastic routine.
- **Key Words**: arranges, builds, combines, composes, constructs, creates, designs, initiate, makes, originates.

CRITICAL THINKING

Truth and Knowledge

- Different approaches to thinking are used to solve different kind of problems or issues :

1. Analytical thinking : “How can I break this problem down into its constituent parts?”
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Critical Thinking Skill

- Critical thinking **is a skill**
- Critical thinking is the capacity to **distinguish** between **beliefs** (what we think is true) and **knowledge** (facts that are backed by accurate observation) ------> helps us separate judgment from facts
- Critical thinking involves subjecting facts and conclusions to careful analysis, looking for weaknesses in logic and other errors or reasoning
- There is **no single formula** on how to think critically

CONCEPTS & RULES

Concept 1:

Critical thinking requires one to know as much information about an issue as possible before rendering an opinion or making a decision

Rule 1:

Gather All Information :

- Dig deeper
- Learn all you can before you decide
- Don’t mistake ignorance for perspective

CONCEPTS & RULES

Concept 2:

To think critically about an issue, one must understand the terms and concepts related to it

Rule 2 :

Understand all terms

- Define all terms you use
- Be sure you understand terms and concepts others use

CONCEPTS & RULES

Concept 3:

Critical thinking requires that we know how information has been acquired and that we question the methods by which it was derived

Rule 3 :

Question how information is derived.

- Were they derived from scientific study ?
- Were the studies well conceived and carried out ?
- Were there an adequate number of subjects ?
- Was there a control group and an experiment group?
- Has the study been repeated successfully?
- Is the information anecdotal?

CONCEPTS & RULES

Concept 4:

Critical thinking requires one to search for hidden biases and assumptions that may influence one's understanding of an issue or interpretation of data

Rule 4 :

Question the source of information

- Is the source invested in the outcome of the issue?
- Is the source biased?
- Do underlying assumptions affect the viewpoint of the source?

CONCEPTS & RULES

Concept 5 :

Critical thinking requires us to question the conclusion drawn from facts to see if other interpretations might be possible

Rule 5 :

Question the conclusion

- Do the facts support the conclusion?
- Correlation does not necessarily mean causation

CONCEPTS & RULES

Concept 6 :

Our knowledge of the world around us is evolving, so it is necessary to accept uncertainty as an inevitable fact of life and make decisions with the best information possible.

Rule 6 :

Expect and tolerate uncertainty

- Hard and fast answers aren't always possible
- Learn to be comfortable with not knowing

CONCEPTS & RULES

Concept 7 :

To become a critical thinker it is necessary to examine the big picture - relationships and entire system

Rule 7 :

Examine the big picture

- Study the whole system
- Look for hidden causes and effects
- Avoid simplistic thinking
- Avoid dualistic thinking