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Welcome to the Dance: Partnering Up Taxonomies and Research

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Welcome to the Dance: Partnering Up
Taxonomies and Research

Handout: Integration of Taxonomies and Research
(Bloom, et al.; Gagne & Briggs, Marzano, & Webb; Gardner)

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Level 1: Knowledge and Simple Skills
Verbal Information
Concept Definitions
Comprehension
Procedural Knowledge

Level 2: Reasoning and Simple Rule Using
Cognitive Learning Strategies
Multiple Intelligences
Attitude Choices
Concept Classification
Routine Rules and Procedures
Procedure Applications
Motor Skills

Level 3: Strategic Thinking and Complex Reasoning
Metacognitive Thinking Strategies
Insight
Critical Thinking, Analysis, Synthesis & Evaluation

Level 4: Extended Thinking and Reasoning
Scientific Inquiry & Research
Problem Solving and Complex Rule Using
Creativity
Types of Learning Outcomes

### Level 1: Knowledge and Simple Skills

#### Verbal Information

**Description:** recalling any information, facts, or statements  
**Examples:** learning new vocabulary, terms, labels, descriptions, numerical values, facts, statements, formulas, names, procedures, criteria, or any other information

#### Concept Definitions

**Description:** recalling definitions of concepts  
**Examples:** learning names of concepts and the distinguishing features of the concepts

#### Comprehension

**Description:** understanding, explaining, organizing, using ideas and information relating new ideas to other information, summarizing, and restructuring information  
**Example:** learning the meaning and relevance of a topic or event

#### Procedural Knowledge

**Description:** recalling, restating, or describing steps, formulas, rules, or procedures (this knowledge level does not address whether someone can apply a procedure or use a rule; see the next section for application)  
**Examples:** listing and describing steps of problem solving, trouble shooting, scientific inquiry, social inquiry, jurisprudential reasoning, policy analysis, how to study, how to think, or any other set of procedures

### Level 2: Reasoning and Simple Rule Using—Description and Examples

#### Cognitive Learning Strategies

**Description:** learning how to learn  
**Examples:** learning how to use a mnemonic tool for learning or how to self-monitor and reflect on how well a memorizing task is working

#### Multiple Intelligences

**Description:** developing linguistic-verbal, logical-mathematics, spatial, musical, bodily-kinesthetic, interpersonal and intrapersonal abilities  
**Example:** learning to express ideas verbally, visually, and mathematically while working with other individuals on a team
Attitude Choices

Description: predispositions to behave in certain ways
Example: choosing to display courtesy or choosing a scholarly approach to learning

Concept Classifications

Description: recognizing and classifying: (1) real objects by their physical characteristics (concrete concepts) or (2) abstract ideas by their essential defined features (defined concepts)
Examples: (1) learning the differences in models of aircraft by distinguishing features of physical appearance (concrete concept) or (2) learning the differences in freedom and responsibility by contrasting their definitions and implications for behaviors (defined concepts)

Routine Rules and Principles

Description: applying a rule or principle in a routine way to obtain a correct answer or outcome
Examples: using a rule, formula, equation, or algorithm to solve a routine problem

Procedure Applications

Description: applying a procedure according to standards of performance
Example: execute a recovery from an aviation spin, or correctly perform a needle puncture across the infrarenal aorta

Motor Skills

Description: executing physical and mental processes that lead to skilled movement.
Example: learning to move according to a model of performance, becoming proficient in certain types of movement skills

Level 3: Strategic Thinking and Complex Reasoning—Description and Examples

Metacognitive Thinking Strategies

Description Assessment Strategy thinking about thinking; learning how to think using different methods; monitoring one’s own thinking; planning in response to thinking patterns; responding to feedback, personal reflection, and evaluating effectiveness of one’s actions
Example: comparing and contrasting the validity of ideas; figuring out the type of thinking that will help to solve different kinds of problems, or figuring out how mistakes were made in the process of thinking that led to a wrong conclusion
**Insight**

**Description:** after a period of study and reflection suddenly realizing the connections, patterns, or relevant cues between the different pieces, patterns, or elements in a way that leads to a solution or product

**Example:** recognizing cues in social problem situations; suddenly seeing responsible choices by observation, reasoning, and applying scientific methods; suddenly figuring out a solution or pattern; suddenly seeing a how a puzzle or or aspects of a problem fit together

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**Critical Thinking, Analysis, Synthesis & Evaluation**

**Description:** reflecting and evaluating information, evidence or situations; seeking accuracy and clarity; keeping an open mind; analyzing, inferring, and justifying through systematic reasoning; making decisions in complex situations by using criteria for judgments; detecting relationships, patterns, and errors; restraining impulsivity

**Example:** learning to determine the validity of arguments; responding appropriately to others’ feelings

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**Level 4: Extended Thinking and Reasoning—Description and Examples**

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**Scientific Inquiry & Research**

**Description:** searching and describing phenomena; cause and effect relationships, correlations, probabilities, and axiomatic relationships forming and testing hypotheses

**Example:** constructing concepts by working with basic content and then observing what happens in a chemical reaction

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**Problem Solving & Complex Rule Using**

**Description:** using more than one rule or strategy to solve a complex problem; analyzing and evaluating complex problems or systems; predicting outcomes

**Examples:** forming predictions, inferences, logical endings, or conclusions

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**Creativity**

**Description:** generating, inventing, visualizing, or reframing ideas, solutions, products, associations, analogies, relationships; finding or reframing problems and solutions; persevering, pushing limits of knowledge and skills; generating, trusting and maintaining personal standards of evaluation

**Example:** generating new ways to view and approach a product or solution for an old problem
Instructional and Assessment Strategies

Level 1: Knowledge and Simple Skills

Verbal Information

Instructional Strategy
- meaningful context and connection with related information
- coherent organization and themes
- clearly identified key words, concepts, main ideas, and patterns
- opportunities for practice, feedback, and reinforcement
- enrichment activities to encourage mastery

Assessment Strategy
Students should be asked to recall or restate information.

Concept Definitions

Instructional Strategy
- clear definitions
- labels or names for concepts
- distinguishing attributes or main ideas
- comparison of similarities and differences
- strategies for recall of verbal information (above)

(This instructional approach focuses only on learning the definitions, not on using concepts because the type of learning is “concept definitions,” not “concept classifications” or “concept applications.”)

Assessment Strategy
Students should be asked to:
- define concepts or match concepts and definitions, and
- recall how to classify previously seen (not new) examples and nonexamples of the concepts into correct concept categories

(This assessment approach only tests students’ recall—such recall stops short of the application of concepts, but often is the first stage of learning how to apply them.)
Comprehension

**Instructional Strategy**
- preview of key points or “big ideas”
- outline or visual to show key relationships among ideas
- concrete examples, questions, or metaphors to elaborate on important issues
- activities that require students to paraphrase, find main ideas, relate new information to what they already know, construct their own diagrams of relationships, and to add their own details, explanations, and examples
- activities that ask students to apply ideas and information in routine situations

**Assessment Strategy**
Students should be asked to:
- summarize, restate, and explain ideas and information in new contexts
- identify the correct meaning from new descriptions of the same ideas or information
- place ideas or information into new charts, categories or graphs
- describe new situations in which ideas and information may be applied

(This approach to assessment only tests students’ comprehension of the meaning of verbal information—such assessment stops short of the actual application of knowledge to a rule or problem.)

Procedural Knowledge

**Instructional Strategy**
- introduction of the type of procedure (this could be any procedure such as a learning strategy, thinking strategy, problem solving strategy, policy analysis, or other performance tasks)
- explanation of goals of the procedures
- definition of context or facts that apply to use of procedures, and problems or situations for which procedures are appropriate
- explanation of the process, methods, or steps in typical solution procedures
- review of the concepts, the rules, and principles that are being used in the procedures
- explanation of the reasons that procedures work for different types of situations
- practice on choosing procedures with corrective feedback on how and when to apply them

**Assessment Strategy**
Students should be asked to:
- restate or summarize different types of procedures
- explain definitions and situations in which to use different procedures
- choose which procedures to apply in different situations
- describe procedures

(This assessment approach only tests students’ recall of procedures such recall stops short of the actual use of procedures, but often is the first stage of learning how to perform them.)
Level 2: Reasoning and Simple Rule—Instructional and Assessment Strategies

Cognitive Learning Strategies

Instructional Strategy
- review of when and how to paraphrase, summarize, self-question, use reference skills, organize, highlight, outline, use mnemonic devices, use imagery/analogies/metaphors/key words, and other study skills
- provide situations for practice of the appropriate cognitive skills

Assessment Strategies
Students should be asked to identify and explain what strategies to use for learning for different purposes.

Multiple Intelligences

Instructional Strategy
- verbal-linguistic activities requiring reasoning with language, rhythms, inflections, determining meaning and order of words (stories, readings, humor, rhyme, song)
- logical-mathematical activities requiring reasoning with patterns or strings of symbols (pattern blocks, activities to form numbers and letters)
- musical activities requiring appreciation and production of musical pitch, melody and tone
- spatial activities requiring the learner to perceive and transform perceptions
- bodily-kinesthetic activities requiring use and control of the body and objects
- interpersonal activities requiring sense needs, thoughts, and feelings of others;
- intrapersonal activities to recognize and respond to one’s own needs, thoughts, and feelings

Note. Some recent research shows that when students work against their preferred modality, they actually learn more.

Assessment Strategy
Students should be asked to demonstrate performance in the various intelligence modalities.

Attitude Choices

Instructional Strategy
- information on consequences of choices, behaviors
- use of influential human/social models

Assessment Strategy
Students should be asked to freely make choices in different situations.

(Assessment must allow free choice in order to clearly assess a predisposition to behave in a certain way.)
### Concept Applications

**Instructional Strategy**
- review of knowledge level of concepts (descriptions, definitions, similarities, differences, and distinguishing attributes)
- sets of labeled *examples* and *nonexamples* of the concepts
- think sheets, concept maps (diagrams that show concepts and their linkages or hierarchy) other visual-spatial displays of concepts
- practice with a wide range of examples, starting with close examples and moving to far examples/sequential presentation of more complex examples
- practice in analyzing borderline examples of concepts
- feedback on correct identification and classification of concepts
- emphasis on building relationships between concepts

**Assessment Strategy**
Students should be asked to:
- examine previously unseen (new) examples and nonexamples of the concepts
- identify or classify them into the correct concept categories

(If instruction uses only previously seen examples, then only the knowledge level will be assessed.)

### Routine Rules and Principles

**Instructional Strategy**
- statement and explanation of the rule or principle to be used
- review of vocabulary and concepts used in formation of principles such as cause-and-effect, correlational, probability, axiomatic, or fundamental principles
- instructive examples with explanations, from simple to complex
- practice in applying rule or principle, from simple to complex
- presentation of several examples and nonexamples with guided discovery of the principle or rule followed by opportunities for application and feedback on performance

**Assessment Strategy**
Students should be given situations or routine problems and be asked to demonstrate correct use of the rule or principle.
Procedure Applications

Instructional Strategies
- review of knowledge level of procedures (type of procedure, purposes, context for using, definitions, steps)
- review of critical features of procedural performance and standards of performance
- learning and guidance through demonstration or application with explanations
- repeated safe practice on performance of procedures with corrective feedback on how to avoid mistakes and to improve steps of procedures
- development of psychomotor skills when these must be combined with the performance of procedures

Assessment Strategy
Students should be asked to:
- review standards of performance
- examine situations and conditions for performance
- perform procedures according to provided standards

Motor Skills

Instructional Strategy
- mental and physical models of the desired performance
- verbal description of the steps in the performance
- practice with kinesthetic and corrective feedback (coaching)

Assessment Strategy
Students should be provided with situations and resources for performance of the skill, including checklists for success, and be asked to perform the motor skill(s).

(Checklists for success may come in a variety of formats.)
**Level 3: Strategic Thinking and Complex Reasoning—Instructional and Assessment Strategies**

### Metacognitive Thinking Strategies

**Instructional Strategy**
- introduction and review of thinking strategies **Assessment Strategy** steps, lists, strategies, prompts, or tips on how to think
- review of conditions or context for applying different type of thinking strategies and steps development of reading and learning strategies together with thinking strategies
- encouragement of questioning of thinking processes, of self-evaluation **Assessment Strategy** to get students to wonder why they are doing what they are doing
- challenges to preexisting ideas, beliefs, thoughts, concepts, and misconceptions with paradoxes, dilemmas, perplexities, ethical perspectives and behaviors
- questions to prompt synonyms and examples of thinking strategies
- demonstrations or examples of how to apply open-mindedness, responsibility for thinking, and seeking of accuracy
- emphasis on persisting when answers are not apparent
- guidance in formulating hypotheses, speculating on consequences, guessing, brainstorming, and discussing how students’ thinking processes have worked for them
- guidance in systematic inquiry and thinking independently, while avoiding dead ends and simplistic answers
- practice in planning self-reflection and regulating self-monitoring of progress
- lots of guided application, transfer, and elaboration with guided practice in new situations, and gradual autonomous use of thinking skills

**Assessment Strategy**
Students should be asked to:
- identify types of thinking strategies that would be best for different situations or problems
- detect open- v. closed mindedness, biases in thinking, responsible and irresponsible thinking processes, and accuracy’s as well as inaccuracies in thinking or assumptions
- analyze and evaluate their own thinking about specific situations or problems according to specific criteria
- apply particular thinking strategies in specific situations

**Insight**

**Instructional Strategy**
- inquiry and discovery activities
- challenging thinking situations with concrete data to manipulate
- coaching to promote careful observation, analysis, description, definition

**Assessment Strategy**
Ask students to:
- make inferences or draw conclusions through inquiry, discovery, and manipulation of data or information
- provide rationales for inferences or conclusions
Critical Thinking, Analysis, Synthesis & Evaluation

**Instructional Strategy**
- information that conflicts with or challenges preexisting ideas, beliefs, concepts and misconceptions
- practice in defining and applying criteria for judgments, detecting mistakes in logic, calculations, procedures, “buggy algorithms,” and other fallacies or contradictions, biases, prejudices
- practice in making inferences from observations and discussions, predicting from limited information, verifying statements through research, surveys, other means
- explanation of and practice in recognizing factors that influence choice and interpretation such as culture, experience, preferences, desires, interests, passions and systematic thinking processes
- emphasis on recognizing and generating systematic proof, logic and argument
- practice in distinguishing relevant from irrelevant issues
- practice in writing, telling or discussing the formation of judgments, how and why present judgments differ from previously existing ideas, opinions or approaches

**Assessment Strategy**
Students should be asked to:
- inquire, discover, and manipulate data and situations
- evaluate information or situations by using analysis and research insight
- provide rationales for evaluations

**ASSESSMENT Level 4: Extended Thinking and Reasoning**

**Scientific Inquiry & Research**

**Instructional Strategy**
- review of knowledge level including process/methods of scientific inquiry and typical solution procedures
- guidance in how to do systematic inquiry, think independently and work dead ends or simplistic answers
- explanations and examples of how to form hypotheses, speculations or consequences, guess, brainstorm and discuss potential outcomes
- hands-on activities to allow students to observe and explain experiences and results
- constructivist approaches to learning (especially important in correcting misconceptions immune to traditional teaching)

**Assessment Strategy**
Students should be asked to conduct inquiry, speculate, form hypotheses, do research, and form conclusions from provided situations or problems.
Problem Solving & Complex Rule Using

**Instructional Strategy**
- strengthening comprehension of related concepts, rules, principles, procedures, decision-making processes, and problem-solving strategies
- teaching of systematic, broad problem-solving methods and models of decision making
- teaching of thinking strategies
- practice in reframing problems
- challenging situations that create perplexity, state of doubt, difficulty to be overcome, paradoxes or dilemmas
- presentation of problems that can be solved in a variety of ways
- background knowledge for understanding problem situations
- opportunities for students to share and discuss various approaches and strategies
- practice in solving non-routine, complex problems
- opportunities for students to explore, state, and restate questions, and to devise/explain methods/steps for approaching problem-solving processes
- practice in solving different types of problems; starting with clearly structured problems and proceeding to more unstructured ones
- practice in finding incompleteness, anomaly, trouble, inequities, contradictions and difficulty
- questions to guide thinking in defining and clarifying problems, stating goals, observing and gathering information, formulating questions to clarify issues, and generating solutions
- practice of problem-solving strategies and steps until they are fast, effortless and consistently applied (compare this strategy to psychomotor learning)

**Assessment Strategy**
Students should be asked to:
- choose types of problem-solving strategies for *previously unseen* situations (using previously seen situations will assess only the knowledge level)
- solve *previously unseen* structured and unstructured, simple and complex problems (using previously seen problems will assess only the knowledge level)
Creativity

**Instructional Strategy**
- use of models, metaphors, analogies
- unstructured problems, opportunities for intensive study, and expression of original ideas
- freedom from formal evaluation with opportunities for ungraded, unevaluated creative performance and behavior
- opportunities to confront questions with multiple answers
- practice in turning a problem statement upside down or inside out
- examples of creative applications
- encouragement of novel approaches to situations
- directions, examples, practice in brainstorming, and changing perceptual sets (such as reversing the statement of a problem)
- activities to allow independent, individual study and approaches to problems or challenges
- problem-solving competitions for individuals and team

**Assessment Strategy**
Students should be asked to:
- create re-statements of problems to “turn upside down” a problem descriptions
- provide new problems to study and resolve
- Assessment Strategy: these could be puzzles, dance performances, drama performances, products to create to match particular functions and resources
- provide situations requiring novel approaches

References for classification of types of learning outcomes:
Anderson & Krathwohl (2001); Bloom (1956); Gagné (1965); Gagné & Briggs (1979); Gagné, Briggs, & Wager (1988); Krathwohl, Masia, & Bloom (1965); Simpson (1972); Webb (2002)

References for targeted instructional and assessment strategies:

**Verbal Information or Knowledge**
Crowl, Kaminisky & Podell, 1997; Martorella, 1982; Marzano, Brandt, Hughes, Jones, Presseisen, Rankin & Suhor, 1988; McREL, 1997; Montague & Knirk, n.d.; Wager, Polkinghorne & Powley, 1992, 1992

**Comprehension**
Crowl, Kaminisky, & Podell, 1997; Huot, 1997; McDavitt, 1993; Marzano, Brandt, Hughes, Jones, Presseisen, Rankin & Suhor, 1988; Montague & Knirk, n.d.

**Procedural Knowledge**
Crowl, Kaminisky, & Podell, 1997; Huot, 1997; Mandl, Schnotz, & Tergan, 1984; McREL, 1997; Wager, Polkinghorne, & Powler, 1992

**Rule Using, Applying Principles, Applying Procedures**
Gagné, Briggs, & Wager, 1988; Marzano, Brandt, Hughes, Jones, Presseisen, Rankin, & Suhor, 1988; McDavitt, 1993; McREL, 1997

Ludwika A. Goodson, Senior Instructional Designer, Embry-Riddle Aeronautical University, Welcome to the Dance: Partnering Up Taxonomies and Research, SoTL Commons Conference, Georgia Southern University, March 12, 2009
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Concepts
Gagné, 1985; Gagné, Briggs, & Wager, 1988; Harniss, Hollenbeck, Crawford, & Carnine, 1994; Martorella, 1982; Marzano, Brandt, Hughes, Jones, Presseisen, Rankin, & Suhor, 1988; 6-7; Maryland State Department of Education, 1990; McREL, 1997; Slavin, 1997; Wager, Polkinghorne, & Powley, 1992

Attitudes
Gagné & Briggs, 1979; Gagné, Briggs, & Wager, 1985; Krathwohl & Masia, 1965

Multiple Intelligences

Cognitive Strategies
Butyniec-Thomas & Weloshyn, 1997; Gagné, Briggs, & Wager, 1985; McREL, 1997; Osborn, Jones, & Stein, 1985; Wager, Polkinghorne, & Powley, 1992, 1992

Problem Solving & Complex Rule Using
Clarke, 1990; Crowl, Kaminsky, & Podell, 1997; Dewey, 1933; Gagné, 1985; Gagné, Briggs, & Wager, 1988; Glaser, 1941; King, Rohani, & Goodson, 1997; Marzano, 1990; Marzano, Brandt, Hughes, Jones, Presseisen, Rankin, & Suhor, 1988; Maryland State Department of Education, 1990; Wager, Polkinghorne, & Powley, 1992

Critical Thinking, Analysis, Synthesis & Evaluation

Insight
Kahneman, Slovic & Tversky, 1982; Maryland State Department of Education, 1990; Sternberg & Davidson, 1995

Metacognition
Osborn, Jones & Stein, 1985

Scientific Inquiry & Research
Crowl, Kaminsky, & Podell, 1997; Davitt, 1993; Marzano, Brandt, Hughes, Jones, Presseisen, Rankin, & Suhor, 1988; Maryland State Department of Education, 1990; McREL, 1997; Mestre, 2001

Psychomotor Skills

See additional Webb citations in separate handout.