

# **Linking research with practice: A local assessment toolkit to guide school leaders**



Karin K. Hess, Ed.D. | 2013

# Exploring cognitive rigor in curriculum, instruction, and assessment

## Introduction

The Common Core State Standards expect students to demonstrate deep conceptual understanding through the application of content knowledge and skills in new situations; however, “the specific content standards provide limited guidance as to how, when, or to what degree specific skills should be emphasized by educators in the classroom. Without a clear direction and use of rich, engaging learning tasks, important college and career readiness (CCR) skills and dispositions will be, at best, inconsistently or randomly addressed by teachers, or forgotten in the design of system-wide programs, curriculum, and instruction. What gets tested is what gets instructional attention. If assessments of CCR standards only test acquisition and basic application of academic skills and concepts, there will be little incentive for schools to focus instruction and assessment on deeper understanding and transfer of learning to new and authentic (real-world) contexts” (Hess & Gong, 2013, p.15).

Cognitive rigor encompasses the complexity of content, the cognitive engagement with that content, and the depth and scope of the planned learning activities. The Hess Cognitive Rigor Matrix (CRM) is a tool that was developed to enhance assessment planning and instructional practices at the classroom level (Hess, Carlock, Jones, & Walkup, 2009). The CRM superimposes two different cognitive complexity frameworks – Bloom’s (Revised) Taxonomy and Webb’s Depth of Knowledge levels – to produce a means of analyzing the emphasis placed on curricular materials, instructional focus, and classroom assessment. Bloom’s Taxonomy categorizes the cognitive skills required of the brain to perform a task, describing the “type of thinking processes” necessary to answer a question or complete a task. Webb’s Depth of Knowledge, on the other hand, relates more closely to the depth of content understanding and scope of a learning activity, which manifests in the skills required to complete a complex task from inception to finale (e.g., planning, researching, and drawing conclusions based on research). Each intersection of Bloom-Webb in the CRM provides a focus on differing complexity and engagement and offers a range of choices when planning instruction.

## Merging Bloom with Webb

In 1956, Bloom’s original taxonomy was developed as a way to classify intellectual behaviors important in learning and assessment. In 2001, Bloom’s revised taxonomy applied two dimensions - cognitive processes (the verbs) and the knowledge (the nouns) used – in order to articulate educational objectives. This restructuring of the original taxonomy recognizes the importance of the interaction between the content taught – characterized by factual, conceptual, procedural, and metacognitive knowledge – and the thought processes used in learning. Still, even the revised version of Bloom has some shortcomings: sometimes verbs/processes can seem similar in differing levels; and thinking process, even at higher levels, do not necessarily translate to deeper understanding of content. Compare-contrast (DOK 2) can be a much “lighter” form of analysis than analysis of theme development in one (DOK 3) or more texts (DOK 4). Most importantly, Bloom’s levels are somewhat generic to different content areas; yet we know that analyzing in reading, for example, does not require the same organizational schemas and mental engagement as analyzing in mathematics or science or the arts.

Webb’s Depth of knowledge (DOK) levels, therefore, form another important perspective of cognitive complexity (Webb, 1997, 2002). Webb describes his DOK framework as “nominative” rather than a taxonomy. DOK levels name four different ways students interact with content. Each level is dependent upon how deeply students understand and engage with the content in order to respond, not simply the type of thinking (verb) used. The Webb levels do not necessarily indicate degree of “difficulty” in that Level 1 can ask students to recall or restate simple or much more complex information, the latter being more difficult. Conversely, deeper understanding of a concept is required to be able to explain how/why a concept works (DOK 2), apply it to real-world phenomena with justification and supporting evidence (DOK 3), or to integrate one concept with other concepts or other perspectives (DOK 4) to produce novel ideas or solutions. DOK descriptors in the CRMs provide content-specific examples that illustrate how students might move towards deeper understanding with more complex or abstract content.

## Some Key Ideas

- Bloom's dimensions identify types of thinking that CAN become deeper when matched with increasingly more complex content: deeper application, deeper understanding, deeper analysis, etc.
- DOK descriptors reference the complexity of mental processing needed to answer a question, perform a task, or generate a product.
- An activity that aligns to a particular DOK level is not always "easier" than an activity that aligns to a DOK level above it. Complexity and difficulty are NOT the same. Difficulty refers to how easy or hard something is. An example: Once someone learns the "rules" of how to add, they should be able to add any numbers. Adding  $4 + 4$  is DOK 1 and is also easy to do. Adding  $4,678,895 + 9,578,885$  is still a DOK 1 but may be more "difficult." Or, a task where students recite a simple fact or a much more complex abstract theory are both DOK 1, even though the abstract theory is much more difficult to memorize and restate. Neither task asks for much depth of understanding of the content.
- The complexity of both the content (e.g., text complexity, number of texts) and the task are used to determine the DOK levels, not the grade level or innate ability of students.
- Verbs alone do not determine the complexity level of a task. DOK focus is on how deeply students need to know and interact with content to be able to generate a specific type of response. It is what comes after the verb that indicates complexity.
- If there is a question regarding which of two levels a standard addresses, such as Level 1 vs. Level 2, or Level 2 vs. Level 3, it is appropriate to assign the highest level as the "DOK ceiling" for the task, but also provide opportunities at the lower DOK levels as an instructional progression (e.g., summarizing a text/DOK 2 before analyzing a text/DOK 3; making observations/DOK 2 before drawing conclusions in an investigation/DOK 3) (Hess, 2004-2006).
- Descriptors in the CRM offer a common language to analyze the "rigor," or cognitive demand, in assessments, curricular units, lessons, and learning tasks across teachers, classrooms, and schools.
- Descriptors in the CRM provide educators a more sophisticated lens to systematically guide the creation of more cognitively engaging and challenging tasks.

	DOK Level Descriptions	Teacher's Role	Student's Role	Sample Tasks
Level 1	<b>Recall &amp; Reproduction</b> requires recognition of information, such as a fact, definition, term, principle, or performance of a simple process or procedure. Responding to a Level 1 task or question involves following a well-known rule, procedure, or formula. You either know it, or you don't know it.	<ul style="list-style-type: none"> <li>• Questions to direct or focus attention (<i>Who? What? Where? How? When?</i>)</li> <li>• Directs, leads, demonstrates, defines</li> <li>• Examines, breaks down</li> <li>• Uses concrete objects, nonverbal and visual cues to teach concepts, procedures, and vocabulary</li> <li>• Builds background knowledge to build upon later</li> <li>• Provides resources and procedures</li> <li>• Uses mentor texts as unambiguous models</li> </ul>	<ul style="list-style-type: none"> <li>• Learns rules (spells, decodes, edits for grammar, usage, mechanics, principles of design)</li> <li>• Learns processes (order of operations, evaluates expression, measures, key word searches)</li> <li>• Acquires vocabulary, facts</li> <li>• Memorizes, recites, quotes</li> <li>• Practices, restates</li> <li>• Locates/retrieves information</li> <li>• Identifies/names parts</li> <li>• Reports/shares solutions /findings</li> </ul>	<ul style="list-style-type: none"> <li>- Reads orally, reads fluently</li> <li>- Draws/labels/acts to illustrate an event, parts of the whole, phases in a cycle</li> <li>- Writes a variety of sentences</li> <li>- Represents math/fine arts relationships with words, symbols, objects, visuals</li> <li>- Recalls math facts, terms, dates, formulas, rules</li> <li>- Calculates, measures, follows steps</li> <li>- Uses tools, records data</li> <li>- Reads or reproduces maps, diagrams</li> <li>- Highlights key words</li> </ul>
Level 2	<b>Basic Application of Skills/Concepts</b> requires engagement of some mental processing beyond recall or reproduction - basic comprehension and subsequent processing of content. Students apply more than one concept and make some decisions about how to approach the question or problem, what tools to use, and how ideas relate.	<ul style="list-style-type: none"> <li>• Questions to differentiate/classify, draw out inferences, check conceptual understanding (<i>Why? What conditions? Give example?</i>)</li> <li>• Provides examples and non-examples to build conceptual understanding</li> <li>• Provides graphic organizers to show relationships or organizational schemas</li> <li>• Matches readers with texts</li> <li>• "Thinks aloud" to explore possible options or connections</li> </ul>	<ul style="list-style-type: none"> <li>• Explains relationships, sorts, classifies, compares</li> <li>• Makes predictions based on observations, estimates, proposes</li> <li>• Compiles and organizes information</li> <li>• Distinguishes relevant-irrelevant, fact-opinion, example-non-example</li> <li>• Selects appropriate strategy and applies it</li> <li>• Explains steps taken to complete a task</li> </ul>	<ul style="list-style-type: none"> <li>- Solves routine, multi-step math word problems</li> <li>- Makes science observations, organizes data (graph, table, spreadsheet, etc.)</li> <li>- Writes a caption, paragraph, summary</li> <li>- Creates a timeline of events</li> <li>- Makes and uses models</li> <li>- Interprets simple graphics, tables, etc.</li> <li>- Retrieves information and uses it to answer a question or solve a problem</li> <li>- Creates survey to research a topic</li> </ul>
Level 3	<b>Strategic Thinking/Reasoning</b> gets at deeper understanding of concepts within novel or new contexts. Students develop their reasoning underlying an interpretation, generalization, or connection, and provide supporting evidence for judgments made. Cognitive demands are more complex and abstract, often with more than one possible answer or approach.	<ul style="list-style-type: none"> <li>• Questions to probe reasoning and underlying thinking (<i>How do you know? What is the evidence? But what if? Is this supported by the facts?</i>)</li> <li>• Asks open-ended questions</li> <li>• Encourages varied approaches</li> <li>• Acts as a resource, coach, mentor</li> <li>• Provides criteria for making judgments</li> <li>• Guides how and what materials encourage in-depth explorations</li> <li>• Models and scaffolds complex thinking</li> </ul>	<ul style="list-style-type: none"> <li>• Uncovers relevant, accurate, and credible information</li> <li>• Uncovers flaws in a design</li> <li>• Develops supporting evidence for conclusions or claims</li> <li>• Tests ideas, predictions, hypotheses</li> <li>• Transfers knowledge to solve non-routine problems</li> <li>• Revises work to establish a progression of ideas or chain of reasoning</li> </ul>	<ul style="list-style-type: none"> <li>- Interprets complex graphics, tables, etc.</li> <li>- Sets up a data base</li> <li>- Conducts a designed investigation</li> <li>- Develops both sides of a fact-based argument for debate or speech</li> <li>- Creates a website, podcast, multi-media presentation matched to purpose</li> <li>- Critiques an essay, performance, or novel, using discipline-based criteria</li> <li>- Analyzes theme, perspective, author's craft in a piece of work</li> </ul>
Level 4	<b>Extended Thinking</b> requires complex reasoning, planning, and designing own research focus, probably over an extended time. Tasks require significant conceptual understanding and application of skills across disciplines, using multiple sources or resources.	<ul style="list-style-type: none"> <li>• Questions to extend thinking, explore sources, broaden perspectives (<i>What are the potential biases? Can you propose an alternative? Can you design a model? What is the importance/value?</i>)</li> <li>• Facilitates teaming, collaboration, self-monitoring</li> <li>• Models and scaffolds integrating sources</li> </ul>	<ul style="list-style-type: none"> <li>• Initiates learning focus and structures tasks needed to complete complex projects</li> <li>• Locates relevant and credible mentors and resources</li> <li>• Transfers and constructs knowledge</li> <li>• Modifies, creates, elaborates</li> <li>• Investigates real-world problems and issues</li> <li>• Revises work to establish a progression of ideas or chain of reasoning</li> </ul>	<ul style="list-style-type: none"> <li>- Produces a short film, play, or short story based on a theme or issue</li> <li>- Designs own research or investigation as an extension of concepts or issues studied</li> <li>- Critiques importance of policies or events from different perspectives (e.g., historical, social, economic, cultural)</li> <li>- Analyzes theme, perspectives, authors' craft across multiple pieces of work</li> </ul>



TOOL 1

# HESS COGNITIVE RIGOR MATRIX (READING CRM):

Applying Webb's Depth-of-Knowledge Levels to Bloom's Cognitive Process Dimensions



Revised Bloom's Taxonomy	Webb's DOK Level 1 Recall & Reproduction	Webb's DOK Level 2 Skills & Concepts	Webb's DOK Level 3 Strategic Thinking/Reasoning	Webb's DOK Level 4 Extended Thinking
<p><b>Remember</b></p> <p>Retrieve knowledge from long-term memory, recognize, recall, locate, identify</p>	<ul style="list-style-type: none"> <li>o Recall, recognize, or locate basic facts, terms, details, events, or ideas explicit in texts</li> <li>o Read words orally in connected text with fluency &amp; accuracy</li> </ul>	<p>Use these Hess CRM curricular examples with most close reading or listening assignments or assessments in any content area.</p>		
<p><b>Understand</b></p> <p>Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion), predict, compare/contrast, match like ideas, explain, construct models</p>	<ul style="list-style-type: none"> <li>o Identify or describe literary elements (characters, setting, sequence, etc.)</li> <li>o Select appropriate words when intended meaning/definition is clearly evident</li> <li>o Describe/explain who, what, where, when, or how</li> <li>o Define/describe facts, details, terms, principles</li> <li>o Write simple sentences</li> </ul>	<ul style="list-style-type: none"> <li>o Specify, explain, show relationships; explain why (e.g., cause-effect)</li> <li>o Give non-examples/examples</li> <li>o Summarize results, concepts, ideas</li> <li>o Make basic inferences or logical predictions from data or texts</li> <li>o Identify main ideas or accurate generalizations of texts</li> <li>o Locate information to support explicit-implicit central ideas</li> </ul>	<ul style="list-style-type: none"> <li>o Explain, generalize, or connect ideas using supporting evidence (quote, example, text reference)</li> <li>o Identify/ make inferences about explicit or implicit themes</li> <li>o Describe how word choice, point of view, or bias may affect the readers' interpretation of a text</li> <li>o Write multi-paragraph composition for specific purpose, focus, voice, tone, &amp; audience</li> </ul>	<ul style="list-style-type: none"> <li>o Explain how concepts or ideas specifically relate to other content domains (e.g., social, political, historical) or concepts</li> <li>o Develop generalizations of the results obtained or strategies used and apply them to new problem-based situations</li> </ul>
<p><b>Apply</b></p> <p>Carry out or use a procedure in a given situation; carry out (apply to a familiar task), or use (apply) to an unfamiliar task</p>	<ul style="list-style-type: none"> <li>o Use language structure (pre/suffix) or word relationships (synonym/antonym) to determine meaning of words</li> <li>o Apply rules or resources to edit spelling, grammar, punctuation, conventions, word use</li> <li>o Apply basic formats for documenting sources</li> </ul>	<ul style="list-style-type: none"> <li>o Use context to identify the meaning of words/phrases</li> <li>o Obtain and interpret information using text features</li> <li>o Develop a text that may be limited to one paragraph</li> <li>o Apply simple organizational structures (paragraph, sentence types) in writing</li> </ul>	<ul style="list-style-type: none"> <li>o Apply a concept in a new context</li> <li>o Revise final draft for meaning or progression of ideas</li> <li>o Apply internal consistency of text organization and structure to composing a full composition</li> <li>o Apply word choice, point of view, style to impact readers' /viewers' interpretation of a text</li> </ul>	<ul style="list-style-type: none"> <li>o Illustrate how multiple themes (historical, geographic, social, artistic, literary) may be interrelated</li> <li>o Select or devise an approach among many alternatives to research a novel problem</li> </ul>
<p><b>Analyze</b></p> <p>Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct (e.g., for bias or point of view)</p>	<ul style="list-style-type: none"> <li>o Identify whether specific information is contained in graphic representations (e.g., map, chart, table, graph, T-chart, diagram) or text features (e.g., headings, subheadings, captions)</li> <li>o Decide which text structure is appropriate to audience and purpose</li> </ul>	<ul style="list-style-type: none"> <li>o Categorize/compare literary elements, terms, facts/details, events</li> <li>o Identify use of literary devices</li> <li>o Analyze format, organization, &amp; internal text structure (signal words, transitions, semantic cues) of different texts</li> <li>o Distinguish: relevant-irrelevant information; fact/opinion</li> <li>o Identify characteristic text features; distinguish between texts, genres</li> </ul>	<ul style="list-style-type: none"> <li>o Analyze information within data sets or texts</li> <li>o Analyze interrelationships among concepts, issues, problems</li> <li>o Analyze or interpret author's craft (literary devices, viewpoint, or potential bias) to create or critique a text</li> <li>o Use reasoning, planning, and evidence to support inferences</li> </ul>	<ul style="list-style-type: none"> <li>o Analyze multiple sources of evidence, or multiple works by the same author, or across genres, time periods, themes</li> <li>o Analyze complex/abstract themes, perspectives, concepts</li> <li>o Gather, analyze, and organize multiple information sources</li> <li>o Analyze discourse styles</li> </ul>
<p><b>Evaluate</b></p> <p>Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique</p>	<p>"UG" – unsubstantiated generalizations = stating an opinion without providing any support for it!</p>		<ul style="list-style-type: none"> <li>o Cite evidence and develop a logical argument for conjectures</li> <li>o Describe, compare, and contrast solution methods</li> <li>o Verify reasonableness of results</li> <li>o Justify or critique conclusions drawn</li> </ul>	<ul style="list-style-type: none"> <li>o Evaluate relevancy, accuracy, &amp; completeness of information from multiple sources</li> <li>o Apply understanding in a novel way, provide argument or justification for the application</li> </ul>
<p><b>Create</b></p> <p>Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, produce</p>	<ul style="list-style-type: none"> <li>o Brainstorm ideas, concepts, problems, or perspectives related to a topic, principle, or concept</li> </ul>	<ul style="list-style-type: none"> <li>o Generate conjectures or hypotheses based on observations or prior knowledge and experience</li> </ul>	<ul style="list-style-type: none"> <li>o Synthesize information within one source or text</li> <li>o Develop a complex model for a given situation</li> <li>o Develop an alternative solution</li> </ul>	<ul style="list-style-type: none"> <li>o Synthesize information across multiple sources or texts</li> <li>o Articulate a new voice, alternate theme, new knowledge or perspective</li> </ul>



TOOL 2

# HESS COGNITIVE RIGOR MATRIX (MATH-SCIENCE CRM):

Applying Webb's Depth-of-Knowledge Levels to Bloom's Cognitive Process Dimensions



Revised Bloom's Taxonomy	Webb's DOK Level 1 Recall & Reproduction	Webb's DOK Level 2 Skills & Concepts	Webb's DOK Level 3 Strategic Thinking/Reasoning	Webb's DOK Level 4 Extended Thinking
<p><b>Remember</b></p> <p>Retrieve knowledge from long-term memory, recognize, recall, locate, identify</p>	<ul style="list-style-type: none"> <li>o Recall, observe, &amp; recognize facts, principles, properties</li> <li>o Recall/ identify conversions among representations or numbers (e.g., customary and metric measures)</li> </ul>	<p>Use these Hess CRM curricular examples with most mathematics or science assignments or assessments.</p>		
<p><b>Understand</b></p> <p>Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion, predict, compare/contrast, match like ideas, explain, construct models</p>	<ul style="list-style-type: none"> <li>o Evaluate an expression</li> <li>o Locate points on a grid or number on number line</li> <li>o Solve a one-step problem</li> <li>o Represent math relationships in words, pictures, or symbols</li> <li>o Read, write, compare decimals in scientific notation</li> </ul>	<ul style="list-style-type: none"> <li>o Specify and explain relationships (e.g., non-examples/examples; cause-effect)</li> <li>o Make and record observations</li> <li>o Explain steps followed</li> <li>o Summarize results or concepts</li> <li>o Make basic inferences or logical predictions from data/observations</li> <li>o Use models /diagrams to represent or explain mathematical concepts</li> <li>o Make and explain estimates</li> </ul>	<ul style="list-style-type: none"> <li>o Use concepts to solve non-routine problems</li> <li>o Explain, generalize, or connect ideas using supporting evidence</li> <li>o Make and justify conjectures</li> <li>o Explain thinking/reasoning when more than one solution or approach is possible</li> <li>o Explain phenomena in terms of concepts</li> </ul>	<ul style="list-style-type: none"> <li>o Relate mathematical or scientific concepts to other content areas, other domains, or other concepts</li> <li>o Develop generalizations of the results obtained and the strategies used (from investigation or readings) and apply them to new problem situations</li> </ul>
<p><b>Apply</b></p> <p>Carry out or use a procedure in a given situation; carry out (apply to a familiar task), or use (apply) to an unfamiliar task</p>	<ul style="list-style-type: none"> <li>o Follow simple procedures (recipe-type directions)</li> <li>o Calculate, measure, apply a rule (e.g., rounding)</li> <li>o Apply algorithm or formula (e.g., area, perimeter)</li> <li>o Solve linear equations</li> <li>o Make conversions among representations or numbers, or within and between customary and metric measures</li> </ul>	<ul style="list-style-type: none"> <li>o Select a procedure according to criteria and perform it</li> <li>o Solve routine problem applying multiple concepts or decision points</li> <li>o Retrieve information from a table, graph, or figure and use it solve a problem requiring multiple steps</li> <li>o Translate between tables, graphs, words, and symbolic notations (e.g., graph data from a table)</li> <li>o Construct models given criteria</li> </ul>	<ul style="list-style-type: none"> <li>o Design investigation for a specific purpose or research question</li> <li>o Conduct a designed investigation</li> <li>o Use concepts to solve non-routine problems</li> <li>o Use &amp; show reasoning, planning, and evidence</li> <li>o Translate between problem &amp; symbolic notation when not a direct translation</li> </ul>	<ul style="list-style-type: none"> <li>o Select or devise approach among many alternatives to solve a problem</li> <li>o Conduct a project that specifies a problem, identifies solution paths, solves the problem, and reports results</li> </ul>
<p><b>Analyze</b></p> <p>Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct</p>	<ul style="list-style-type: none"> <li>o Retrieve information from a table or graph to answer a question</li> <li>o Identify whether specific information is contained in graphic representations (e.g., table, graph, T-chart, diagram)</li> <li>o Identify a pattern/trend</li> </ul>	<ul style="list-style-type: none"> <li>o Categorize, classify materials, data, figures based on characteristics</li> <li>o Organize or order data</li> <li>o Compare/ contrast figures or data</li> <li>o Select appropriate graph and organize &amp; display data</li> <li>o Interpret data from a simple graph</li> <li>o Extend a pattern</li> </ul>	<ul style="list-style-type: none"> <li>o Compare information within or across data sets or texts</li> <li>o Analyze and draw conclusions from data, citing evidence</li> <li>o Generalize a pattern</li> <li>o Interpret data from complex graph</li> <li>o Analyze similarities/differences between procedures or solutions</li> </ul>	<ul style="list-style-type: none"> <li>o Analyze multiple sources of evidence</li> <li>o Analyze complex/abstract themes</li> <li>o Gather, analyze, and evaluate information</li> </ul>
<p><b>Evaluate</b></p> <p>Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique</p>	<p>"UG" – unsubstantiated generalizations = stating an opinion without providing any support for it!</p>		<ul style="list-style-type: none"> <li>o Cite evidence and develop a logical argument for concepts or solutions</li> <li>o Describe, compare, and contrast solution methods</li> <li>o Verify reasonableness of results</li> </ul>	<ul style="list-style-type: none"> <li>o Gather, analyze, &amp; evaluate information to draw conclusions</li> <li>o Apply understanding in a novel way, provide argument or justification for the application</li> </ul>
<p><b>Create</b></p> <p>Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, produce</p>	<ul style="list-style-type: none"> <li>o Brainstorm ideas, concepts, or perspectives related to a topic</li> </ul>	<ul style="list-style-type: none"> <li>o Generate conjectures or hypotheses based on observations or prior knowledge and experience</li> </ul>	<ul style="list-style-type: none"> <li>o Synthesize information within one data set, source, or text</li> <li>o Formulate an original problem given a situation</li> <li>o Develop a scientific/mathematical model for a complex situation</li> </ul>	<ul style="list-style-type: none"> <li>o Synthesize information across multiple sources or texts</li> <li>o Design a mathematical model to inform and solve a practical or abstract situation</li> </ul>



# HESS COGNITIVE RIGOR MATRIX (WRITING/SPEAKING CRM):

Applying Webb's Depth-of-Knowledge Levels to Bloom's Cognitive Process Dimensions



Revised Bloom's Taxonomy	Webb's DOK Level 1 Recall & Reproduction	Webb's DOK Level 2 Skills & Concepts	Webb's DOK Level 3 Strategic Thinking/Reasoning	Webb's DOK Level 4 Extended Thinking
<b>Remember</b> Retrieve knowledge from long-term memory, recognize, recall, locate, identify	<ul style="list-style-type: none"> <li>o Complete short answer questions with facts, details, terms, principles, etc. (e.g., label parts of diagram)</li> </ul>	<b>Use these Hess CRM curricular examples with most writing and oral communication assignments or assessments in any content area.</b>		
<b>Understand</b> Construct meaning, clarify, paraphrase, represent, translate, illustrate, give examples, classify, categorize, summarize, generalize, infer a logical conclusion), predict, compare/contrast, match like ideas, explain, construct models	<ul style="list-style-type: none"> <li>o Describe or define facts, details, terms, principles, etc.</li> <li>o Select appropriate word/phrase to use when intended meaning/definition is clearly evident</li> <li>o Write simple complete sentences</li> <li>o Add an appropriate caption to a photo or illustration</li> <li>o Write "fact statements" on a topic (e.g., spiders build webs)</li> </ul>	<ul style="list-style-type: none"> <li>o Specify, explain, show relationships; explain why, cause-effect</li> <li>o Provide and explain non-examples and examples</li> <li>o Take notes; organize ideas/data (e.g., relevance, trends, perspectives)</li> <li>o Summarize results, key concepts, ideas</li> <li>o Explain central ideas or accurate generalizations of texts or topics</li> <li>o Describe steps in a process (e.g., science procedure, how to and why control variables)</li> </ul>	<ul style="list-style-type: none"> <li>o Write a multi-paragraph composition for specific purpose, focus, voice, tone, &amp; audience</li> <li>o Develop and explain opposing perspectives or connect ideas, principles, or concepts using supporting evidence (quote, example, text reference, etc.)</li> <li>o Develop arguments of fact (e.g., Are these criticisms supported by the historical facts? Is this claim or equation true?)</li> </ul>	<ul style="list-style-type: none"> <li>o Use multiple sources to elaborate on how concepts or ideas specifically draw from other content domains or differing concepts (e.g., research paper, arguments of policy – should this law be passed? What will be the impact of this change?)</li> <li>o Develop generalizations about the results obtained or strategies used and apply them to a new problem or contextual scenario</li> </ul>
<b>Apply</b> Carry out or use a procedure in a given situation; carry out (apply to a familiar task), or use (apply) to an unfamiliar task	<ul style="list-style-type: none"> <li>o Apply rules or use resources to edit specific spelling, grammar, punctuation, conventions, or word use</li> <li>o Apply basic formats for documenting sources</li> </ul>	<ul style="list-style-type: none"> <li>o Use context to identify/infer the intended meaning of words/phrases</li> <li>o Obtain, interpret, &amp; explain information using text features (table, diagram, etc.)</li> <li>o Develop a (brief) text that may be limited to one paragraph, précis</li> <li>o Apply basic organizational structures (paragraph, sentence types, topic sentence, introduction, etc.) in writing</li> </ul>	<ul style="list-style-type: none"> <li>o Revise final draft for meaning, progression of ideas, or logic chain</li> <li>o Apply internal consistency of text organization and structure to a full composition or oral communication</li> <li>o Apply a concept in a new context</li> <li>o Apply word choice, point of view, style, rhetorical devices to impact readers' interpretation of a text</li> </ul>	<ul style="list-style-type: none"> <li>o Select or devise an approach among many alternatives to research and present a novel problem or issue</li> <li>o Illustrate how multiple themes (historical, geographic, social) may be interrelated within a text or topic</li> </ul>
<b>Analyze</b> Break into constituent parts, determine how parts relate, differentiate between relevant-irrelevant, distinguish, focus, select, organize, outline, find coherence, deconstruct (e.g., for bias or point of view)	<ul style="list-style-type: none"> <li>o Decide which text structure is appropriate to audience and purpose (e.g., compare-contrast, proposition-support)</li> <li>o Determine appropriate, relevant key words for conducting an Internet search or researching a topic</li> </ul>	<ul style="list-style-type: none"> <li>o Compare/contrast perspectives, events, characters, etc.</li> <li>o Analyze/revise format, organization, &amp; internal text structure (signal words, transitions, semantic cues) of different print and non-print texts</li> <li>o Distinguish: relevant-irrelevant information; fact/opinion (e.g., What are the characteristics of a hero's journey?)</li> <li>o Locate evidence that supports a perspective/differing perspectives</li> </ul>	<ul style="list-style-type: none"> <li>o Analyze interrelationships among concepts/ issues/problems in a text</li> <li>o Analyze impact or use of author's craft (literary devices, viewpoint, dialogue) in a single text</li> <li>o Use reasoning and evidence to generate criteria for making and supporting an argument of judgment (Was FDR a great president? Who was the greatest ball player?)</li> <li>o Support conclusions with evidence</li> </ul>	<ul style="list-style-type: none"> <li>o Analyze multiple sources of evidence, or multiple works by the same author, or across genres, or time periods</li> <li>o Analyze complex/abstract themes, perspectives, concepts</li> <li>o Gather, analyze, and organize multiple information sources</li> <li>o Compare and contrast conflicting judgments or policies (e.g., Supreme Court decisions)</li> </ul>
<b>Evaluate</b> Make judgments based on criteria, check, detect inconsistencies or fallacies, judge, critique	"UG" – unsubstantiated generalizations = stating an opinion without providing any support for it!		<ul style="list-style-type: none"> <li>o Evaluate validity and relevance of evidence used to develop an argument or support a perspective</li> <li>o Describe, compare, and contrast solution methods</li> <li>o Verify or critique the accuracy, logic, and reasonableness of stated conclusions or assumptions</li> </ul>	<ul style="list-style-type: none"> <li>o Evaluate relevancy, accuracy, &amp; completeness of information across multiple sources</li> <li>o Apply understanding in a novel way, provide argument or justification for the application</li> <li>o Critique the historical impact (policy, writings, discoveries, etc.)</li> </ul>
<b>Create</b> Reorganize elements into new patterns/structures, generate, hypothesize, design, plan, produce	<ul style="list-style-type: none"> <li>o Brainstorm facts, ideas, concepts, problems, or perspectives related to a topic, text, idea, issue, or concept</li> </ul>	<ul style="list-style-type: none"> <li>o Generate conjectures, hypotheses, or predictions based on facts, observations, evidence/observations, or prior knowledge and experience</li> <li>o Generate believable "grounds" (reasons) for an opinion-argument</li> </ul>	<ul style="list-style-type: none"> <li>o Develop a complex model for a given situation or problem</li> <li>o Develop an alternative solution or perspective to one proposed (e.g., debate)</li> </ul>	<ul style="list-style-type: none"> <li>o Synthesize information across multiple sources or texts in order to articulate a new voice, alternate theme, new knowledge or nuanced perspective</li> </ul>



LINK 1

## CURRICULAR EXAMPLES ILLUSTRATING WRITING TYPES

(Use with CRM Tools)

Sample Topics		Informational Writing	Arguments of Fact	Arguments of Judgment	Arguments of Policy
		Sample Prompts to illustrate how informational writing differs from opinions-arguments of fact	Sample Writing Prompts <i>(must support reasons/ reasoning with facts/evidence)</i>	Sample Writing Prompts <i>(must define criteria for decision using facts/ evidence)</i>	Sample Writing Prompts <i>(must define the problem/issue and implications using facts/ evidence)</i>
Social Studies	FDR	Who was he? What did he do (e.g., major initiatives)? What were the historical, social, and political contexts when he became president? How does history remember him?	FDR had tremendous support from the Jewish community throughout his presidency; however critics say he did not do much to support them and their issues. Are these criticisms supported by the historical facts within the historical context?	Was FDR a great president?  Should ... be named as one TIME's 100 most influential people of (year)?	What has been the historical impact of a major FDR policy?
	Cabinet appointments	What does the Constitution say about cabinet appointments and requirements for cabinet positions? What does the (labor secretary) do?	Is Tom Perez qualified to be the next labor secretary? What additional factors, if any, should be considered in making this appointment?		
	Smart guns	What are they? How do they work? What do they cost? Who is developing them? Have they been tested?	Do smart guns have the potential to reduce gun violence in this country?		
	Gun violence	What is gun violence? What do we know about gun violence (e.g., most likely victims) in the US and in other countries (and its impact) over the past 50 years? What are the current and proposed laws related to gun violence?  How do gun laws vary from state to state?  How have gun laws changed over the years?	Do the current concerns about increased gun violence and the status of gun violence in this country warrant the need for new laws?  Will this law ..... address current gun violence issues?  What factors should be considered when developing new gun violence legislation (common good-individual rights)	Is this law ..... a fair law? Is this law ..... needed? Is this law ..... outdated?  Do we need another law....?	Should this law ..... be passed? What problems does it address? What are the implications if it is or is not passed?



LINK 2

## CURRICULAR EXAMPLES ILLUSTRATING WRITING TYPES

(Use with CRM Tools)

Sample Topics		Informational Writing	Arguments of Fact	Arguments of Judgment	Arguments of Policy
		Sample Prompts to illustrate how informational writing differs from opinions-arguments of fact	Sample Writing Prompts <i>(must support reasons/ reasoning with facts/evidence)</i>	Sample Writing Prompts <i>(must define criteria for decision using facts/ evidence)</i>	Sample Writing Prompts <i>(must define the problem/issue and implications using facts/ evidence)</i>
ELA and Literacy	<b>Text(s) read &amp; Movies viewed</b>	<p>What is this topic/story /text about? How does this compare with other texts written by this author or other texts on the same topic? Or from the same time period? Or same genre?</p> <p>What is (nonfiction, poetry, fantasy, etc.)? How is it different from or similar to other genre of writing?</p> <p><i>Lincoln: who was he? What did he do (e.g., major initiatives)? What were the historical, social, and political contexts when he became president? How does history remember him?</i></p>	<p>Is this text written in the same style as ... ?</p> <p>Is the information in this article accurate?</p> <p>What is the author's message/ theme/perspective?</p> <p>If the ending were changed (to ...), how would this impact the overall theme?</p> <p>What historical/ social/political events of the time are likely to have influenced this author's writing?</p> <p><i>Is this movie (Lincoln) historically accurate? Do the inaccuracies affect the overall theme or viewer interpretation of history?</i></p>	<p>Is rap music poetry?</p> <p>Is this (still) a compelling message for our time?</p> <p>What is Lincoln's legacy?</p>	
	<b>Holidays, celebrations, traditions</b>	<p>What are they? Who celebrates them? How? When? Are the same holidays celebrated in all countries (e.g., Thanksgiving)?</p> <p>How does a holiday become a national holiday (MLK Day, Presidents' Day, etc.)</p>	<p>What is your favorite – or not so favorite holiday?</p>	<p>Should .... become a national holiday?</p> <p>Has commercialization coinciding with national holidays caused people to forget why we celebrate them in the first place (shopping versus honoring a hero)?</p>	



LINK 3

## CURRICULAR EXAMPLES ILLUSTRATING WRITING TYPES

(Use with CRM Tools)

Sample Topics		Informational Writing	Arguments of Fact	Arguments of Judgment	Arguments of Policy
		Sample Prompts to illustrate how informational writing differs from opinions-arguments of fact	Sample Writing Prompts <i>(must support reasons/ reasoning with facts/evidence)</i>	Sample Writing Prompts <i>(must define criteria for decision using facts/ evidence)</i>	Sample Writing Prompts <i>(must define the problem/issue and implications using facts/ evidence)</i>
Science	<b>Biomes</b>	What is (a desert, rain forest, tundra, grassland, etc.)? What is the climate like? Where do you find them? What are some characteristics of the habitat? What are some organisms that live there? How have they adapted to be able to live there? How does one habitat (biome) compare with another?	Would this animal be able to survive in ..... habitat? Why or why not?  How would life/survival needs be different for ... if moving from ... to ..... ?	What is the most appropriate habitat for this organism?  Would .... be able to survive here?	
	<b>Habitats/ Biomes</b>	Compare/contrast fresh and salt water habitats.  What do organisms need to survive here?  What laws currently exist to protect fish habitats?	What factors might be causing the fish population to decline?	Is this river/lake/ocean healthy?	Do we need a new law...?  What will be the likely impact of this change?
Mathematics	<b>Analyzing Equations</b>	What does it mean to be equivalent? What is an equivalent fraction?  How would you solve this problem?	Is this equation true?  Is this equation true all of the time, some of the time? Or never?		
	<b>Applying Statistics</b>	What statistics are used for (describing a player's performance, Hall of Fame)?  What do top earning players have in common in their performances?	Is ... eligible to be voted into the Hall of Fame?	Who was the greatest ball player?  Based on their lifetime careers, how should these 5 players be ranked?	

## Related Resources

- Anderson, L., Krathwohl, D., Airasian, P., Cruikshank, K., Mayer, R., Pintrich, P., Raths, J., & Wittrock, M. (Eds) (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Addison Wesley Longman, Inc.
- Hess, K., Carlock, D., Jones, B., & Walkup, J. (2009). What exactly do “fewer, clearer, and higher standards” really look like in the classroom? Using a cognitive rigor matrix to analyze curriculum, plan lessons, and implement assessments. In *Hess' Local Assessment Toolkit: Exploring Cognitive Rigor*. Available [online] [http://www.nciea.org/cgi-bin/pubspage.cgi?sortBy=pub\\_date](http://www.nciea.org/cgi-bin/pubspage.cgi?sortBy=pub_date)
- Hess, K. (2004). “*Applying Webb's Depth-of-Knowledge (DOK) Levels in Reading.*” [online] available: [http://www.nciea.org/publications/DOKreading\\_KH08.pdf](http://www.nciea.org/publications/DOKreading_KH08.pdf)
- Hess, K. (2005). “*Applying Webb's Depth-of-Knowledge (DOK) Levels in Social Studies.*” [online] available: [http://www.nciea.org/publications/DOKsocialstudies\\_KH08.pdf](http://www.nciea.org/publications/DOKsocialstudies_KH08.pdf)
- Hess, K. (2005). “*Applying Webb's Depth-of-Knowledge (DOK) Levels in Writing.*” [online] available: [http://www.nciea.org/publications/DOKwriting\\_KH08.pdf](http://www.nciea.org/publications/DOKwriting_KH08.pdf)
- Hess, K. (2006). “*Applying Webb's Depth-of-Knowledge (DOK) Levels in Science.*” [online] available: [http://www.nciea.org/publications/DOKscience\\_KH11.pdf](http://www.nciea.org/publications/DOKscience_KH11.pdf)
- Hess, K. (2010). *CRM and Little Red Riding Hood Template* [http://www.nciea.org/publications/Little%20Red%20Riding%20Hood-CRM\\_KH11.pdf](http://www.nciea.org/publications/Little%20Red%20Riding%20Hood-CRM_KH11.pdf)

- Hess, K. & Gong, B. (2013). *Beyond the standards: Supporting deeper, student-centered learning for college and career readiness*. Commissioned white paper.
- Hillocks, G. (2012). *Teaching argument writing grades 6-12: Supporting claims with relevant evidence and clear reasoning*. Portsmouth, NH: Heinemann.
- National Research Council. (2001). *Knowing what students know: The science and design of educational assessment*. J.W. Pellegrino, N. Chudowsky, and R. Glaser, (eds.). Committee on the Foundations of Assessment, Board on Testing and Assessment, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, D.C.: National Academy Press.
- Newmann, F. M., King, M. B. and Carmichael, D. L. (2007). *Authentic instruction and assessment: Common standards for rigor and relevance in teaching academic subjects*. Des Moines, IA: Iowa Department of Education.
- Paige, D. D., Sizemore, J. M., & Neace, W. P. (2013). *Working inside the box: Exploring the relationship between student engagement and cognitive rigor*. NASSP Bulletin, June 2013 97: 105-123, first published on January 28, 2013.
- Petit, M. & Hess, K. (2006). “*Applying Webb's Depth-of-Knowledge (DOK) and NAEP Levels of Complexity in Mathematics.*” [online] available: [http://www.nciea.org/publications/DOKmath\\_KH08.pdf](http://www.nciea.org/publications/DOKmath_KH08.pdf)
- Webb, N. (March 28, 2002). “*Depth-of-Knowledge levels for four content areas.*” White paper.
- Webb, N. (1997). Research Monograph Number 6: “*Criteria for alignment of expectations and assessments on mathematics and science education.*” Washington, D.C.: CCSSO.

## Biography

**Karin Hess**, Senior Associate with the National Center for the Improvement of Educational Assessment (NCIEA) since 2002, brings to the Center's work over 30 years of deep experience in curriculum, instruction, and assessment. She has assisted numerous states in development of state content standards and in creating detailed assessment specifications aligned to content standards that are both educationally and technically sound. Dr. Hess is nationally recognized for her research and work with cognitive rigor, learning progressions, text complexity, and performance assessment. In addition to over 20 years as a classroom teacher and school administrator, Dr. Hess has worked as a program evaluator for the Vermont Mathematics Project; as a content specialist for development of the Vermont Science assessment and New England Common Assessment Programs (NECAP); as developer and editor of Science Exemplars K-8 performance assessments; and as the N.J. state director for gifted education. Dr. Hess is the principal author of the Smarter Balanced Assessment Consortium content specifications for assessment of the Common Core ELA and Literacy standards and a contributor to the SBAC mathematics content specifications.

