Cognitive Complexity

from Depth-of-Knowledge Levels for Four Content Areas, Norman L. Webb, March 28, 2002

“Level 1 (Recall) includes the recall of information such as a fact, definition, term, or a simple procedure, as well as performing a simple algorithm or applying a formula. That is, in mathematics a one-step, well-defined, and straight algorithmic procedure should be included at this lowest level. Other key words that signify a Level 1 include “identify,” “recall,” “recognize,” “use,” and “measure.” Verbs such as “describe” and “explain” could be classified at different levels depending on what is to be described and explained.

“Level 2 (Skill/Concept) includes the engagement of some mental processing beyond a habitual response. A Level 2 assessment item requires students to make some decisions as to how to approach the problem or activity, whereas Level 1 requires students to demonstrate a rote response, perform a well-known algorithm, follow a set procedure (like a recipe), or perform a clearly defined series of steps. Keywords that generally distinguish a Level 2 item include “classify,” “organize,” “estimate,” “make observations,” “collect and display data,” and “compare data.” These actions imply more than one step. ... Caution is warranted in interpreting Level 2 as only skills because some reviewers will interpret skills very narrowly, as primarily numerical skills, and such interpretation excludes from this level other skills such as visualization skills and probability skills, which may be more complex simply because they are less common. Other Level 2 activities include explaining the purpose and use of experimental procedures; carrying out experimental procedures; making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts.

“Level 3 (Strategic Thinking) requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. In most instances, requiring students to explain their thinking is a Level 3. Activities that require students to make conjectures are also at this level. The cognitive demands at Level 3 are complex and abstract. The complexity does not result from the fact that there are multiple answers, a possibility for both Levels 1 and 2, but because the task requires more demanding reasoning. An activity, however, that has more than one possible answer and requires students to justify the response they give would most likely be a Level 3. Other Level 3 activities include drawing conclusions from observations; citing evidence and developing a logical argument for concepts; explaining phenomena in terms of concepts; and using concepts to solve problems.

“Level 4 (Extended Thinking) requires complex reasoning, planning, developing, and thinking most likely over an extended period of time.” (This level is best assessed at the classroom level and not relevant to this on-demand assessment.)
**Level One Activities**
- Recall elements and details of story structure, such as sequence of events, character, plot and setting.
- Conduct basic mathematical calculations.
- Label locations on a map.
- Represent in words or diagrams a scientific concept or relationship.
- Perform routine procedures like measuring length or using punctuation marks correctly.
- Describe the features of a place or people.

**Level Two Activities**
- Identify and summarize the major events in a narrative.
- Use context cues to identify the meaning of unfamiliar words.
- Solve routine multiple-step problems.
- Describe the cause/effect of a particular event.
- Identify patterns in events or behavior.
- Formulate a routine problem given data and conditions.
- Organize, represent and interpret data.

**Level Three Activities**
- Support ideas with details and examples.
- Use voice appropriate to the purpose and audience.
- Identify research questions and design investigations for a scientific problem.
- Develop a scientific model for a complex situation.
- Determine the author’s purpose and describe how it affects the interpretation of a reading selection.
- Apply a concept in other contexts.

**Level Four Activities**
- Conduct a project that requires specifying a problem, designing and conducting an experiment, analyzing its data, and reporting results/solutions.
- Apply mathematical model to illuminate a problem or situation.
- Analyze and synthesize information from multiple sources.
- Describe and illustrate how common themes are found across texts from different cultures.
- Design a mathematical model to inform and solve a practical or abstract situation.

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