**Understanding Webb’s Depth of Knowledge Criteria**

*Produced by Vivayic for NASDCTEc 2009 Career Clusters Institute*

*Based on the research and work of Norman Webb, Wisconsin Center for Education Research*

The alignment of expectations for student learning with classroom instruction and assessments for measuring students’ attainment of these expectations is an essential attribute for an effective standards-based education system. Without adequate alignment between standards and assessments, teachers and students become confused about educational expectations.

Alignment is defined as “the degree to which expectations and assessments are in agreement and serve in conjunction with one another to guide the system toward students learning what they are expected to know and do. In other words, alignment is a quality of the relationship between expectations and assessments.

Understanding and Using the Depth-of-Knowledge (DOK) Levels

Interpreting and assigning DOK levels both to knowledge and skill statements and performance elements is an essential requirement of alignment analysis. Ultimately, depth-of-knowledge consistency between knowledge and skill statements/performance elements and assessment indicates alignment if what is elicited from the students on the assessment is as demanding cognitively as what students are expected to know and do as stated in the knowledge & skill statements and performance elements.

There are four different DOK levels:

|  |  |
| --- | --- |
| DOK Level | Title of Level |
| 1 | Recall |
| 2 | Skills and Concepts |
| 3 | Strategic Thinking |
| 4 | Extended Thinking |

The following guidelines are used when considering which DOK level to assign:

* The DOK level should be the level of work students are most commonly required to perform to successfully demonstrate their attainment
* The DOK level should reflect the *complexity* of the statement, rather than its *difficulty*. The DOK level describes the kind of thinking involved in a task, not the likelihood that the task will be completed correctly.
* If there is a question regarding which of two levels a statement addresses, such as Level 1 or Level 2, or Level 2 or Level 3, it is usually appropriate to select the higher of the two levels.

**Depth-of-Knowledge-Levels in Career and Technical Education**

***Level 1 (Recall and Reproduction)*** requires the recall of information, such as a fact, definition, term, or a simple procedure, as well as performance of a simple science process or procedure. Level 1 only requires students to demonstrate a rote response, use a well-known formula, follow a set procedure (like a recipe), or perform a clearly defined series of steps. A “simple” procedure is well defined and typically involves only one step. Verbs such as “identify,” “recall,” “recognize,” “use,” “calculate,” and “measure” generally represent cognitive work at the recall and reproduction level. Simple word problems that can be directly translated into and solved by a formula are considered Level 1. Verbs such as “describe” and “explain” could be classified at different DOK levels, depending on the complexity of what is to be described and explained.

A student answering a Level 1 item either knows the answer or does not: that is, the item does not need to be “figured out” or “solved.” In other words, if the knowledge necessary to answer an item automatically provides the answer to it, then the item is at Level 1. If the knowledge needed to answer the item is not automatically provided in the stem, the item is at least at Level 2. Some examples that represent, but do not constitute all of, Level 1 performance are:

* Recall or recognize a fact, term, or property.
* Represent in words or diagrams a scientific concept or relationship.
* Provide or recognize a standard scientific representation for simple phenomenon.
* Perform a routine procedure, such as measuring length.

***Level 2 (Skills and Concepts)*** includes the engagement of some mental processing beyond recalling or reproducing a response. The content knowledge or process involved is **more complex** than in Level 1. Items require students to make some decisions as to how to approach the question or problem. 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**. For example, to compare data requires first identifying characteristics of the objects or phenomena and then grouping or ordering the objects. Level 2 activities include making observations and collecting data; classifying, organizing, and comparing data; and organizing and displaying data in tables, graphs, and charts. Some action verbs, such as “explain,” “describe,” or “interpret,” could be classified at different DOK levels, depending on the complexity of the action. For example, interpreting information from a simple graph, requiring reading information from the graph, is a Level 2. An item that requires interpretation from a complex graph, such as making decisions regarding features of the graph that need to be considered and how information from the graph can be aggregated, is at Level 3. Some examples that represent, but do not constitute all of, Level 2 performance, are:

* Specify and explain the relationship between facts, terms, properties, or variables.
* Describe and explain examples and non-examples of science concepts.
* Select a procedure according to specified criteria and perform it.
* Formulate a routine problem, given data and conditions.
* Organize, represent, and interpret data.

***Level 3 (Strategic Thinking)*** requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. The cognitive demands at Level 3 are complex and abstract. The complexity does not result only from the fact that there could be multiple answers, a possibility for both Levels 1 and 2, but because the multi-step task requires more demanding reasoning. In most instances, requiring students to explain their thinking is at Level 3; requiring a very simple explanation or a word or two should be at Level 2. An activity that has more than one possible answer and requires students to justify the response they give would most likely be a Level 3. Experimental designs in Level 3 typically involve more than one dependent variable. 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 non-routine problems. Some examples that represent, but do not constitute all of Level 3 performance, are:

* Identify research questions and design investigations for a scientific problem.
* Solve non-routine problems.
* Develop a scientific model for a complex situation.
* Form conclusions from experimental data.

***Level 4 (Extended Thinking)*** involves high cognitive demands and complexity. Students are required to make several connections—relate ideas within the content area or among content areas—and have to select or devise one approach among many alternatives to solve the problem. Many on-demand assessment instruments will not include any assessment activities that could be classified as Level 4. However, standards, goals, and objectives can be stated in such a way as to expect students to perform extended thinking. “Develop generalizations of the results obtained and the strategies used and apply them to new problem situations,” is an example of a Level 4. Many, but not all, performance assessments and open-ended assessment activities requiring significant thought will be Level 4.

Level 4 requires complex reasoning, experimental design and planning, and probably will require an extended period of time either for the science investigation required by an objective, or for carrying out the multiple steps of an assessment item. However, the extended time period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding and higher-order thinking. For example, if a student has to take the water temperature from a river each day for a month and then construct a graph, this would be classified as a Level 2 activity. However, if the student conducts a river study that requires taking into consideration a number of variables, this would be a Level 4. Some examples that represent, but do not constitute all of, a Level 4 performance are:

* Based on data provided from a complex experiment that is novel to the student; deduct the fundamental relationship between several controlled variables.
* Conduct an investigation, from specifying a problem to designing and carrying out an experiment, to analyzing its data and forming conclusions.

**Sample of DOK applied to CTE**

|  |  |
| --- | --- |
| **DOK Level** |  |
| **Level 1 – Recall** | Identify the structure and function of the major parts of plant cells |
|  |  |
| **Level 2 – Skills and Concepts** | Identify and demonstrate methods of asexual/sexual plant propagation. |
|  |  |
| **Level 3 – Strategic Thinking** | Understand the role of asexual propagation and explain the uses in the major areas of the horticulture industry. |
|  |  |
| **Level 4 – Extended Thinking** | Investigate and demonstrate the effects of biotechnology on plant propagation in order to provide a safe and sustainable food supply for the world. |

**Aligning CTE Knowledge and Skills with Technical Skill Assessments**

The Depth of Knowledge rating on the Knowledge and Skills and Performance Elements is an important first step in alignment with an assessment tool. Ultimately, there are five criterion to assure alignment is in place.

Norman Webb’s alignment system is one of several alignment systems developed during the last decade (Webb, 1997). In this system, there are five criteria for alignment between standards and assessments.

* **Categorical Concurrence** --- This criterion measures the extent to which the same or consistent categories of content appear in the standards and the assessments. The criterion is met for a given standard if there are more than five assessment items targeting that standard.
* **Depth-of-Knowledge Consistency** --- This criterion measures the degree to which the knowledge elicited from students on the assessment is as complex within the context area as what students are expected to know and do as stated in the standards. The criterion is met if more than half of targeted objectives are hit by items of the appropriate complexity.
* **Range-of-Knowledge Correspondence** --- This criterion determines whether the span of knowledge expected of students on the basis of a standard corresponds to the span of knowledge that students need in order to correctly answer the corresponding assessment items/activities. The criterion is met for a given standard if more than half of the objectives that fall under that standard are targeted by assessment items.
* **Balance of Representation** --- This criterion measures whether objectives that fall under a specific standard are given relatively equal emphasis on the assessment.
* **Source of Challenge** --- This criterion is met if the primary difficulty of the assessment items is significantly related to students’ knowledge and skill in the content area as represented in the standards.