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Mathematics DOK Definitions

DOK 1 (Recall)

DOK 1 expectations and tasks are defined by the rote recall of information or reproduction of a taught, routine procedure. For example, DOK 1 tasks may involve repeating a memorized fact, definition, or term, performing a simple algorithm, rounding a number, or applying a formula. Performing a one-step computation or operation, executing a well-defined multi-step procedure or a direct computational algorithm are also included in this category. Examples of well-defined multi-step procedures include finding the mean or median or performing long division. Reading information directly from a graph, plugging data into an electronic device to derive an answer, or simple paraphrasing are all tasks that are considered a level of complexity comparable to recall. DOK 1 items are typically those for which a student either knows the answer or does not: that is, the problem does not need to be "figured out."

Problems in context may be DOK 1 if they are straightforward and the solution path is obvious. For example, a problem may contain a keyword that indicates the operation needed. Other DOK 1 examples include plotting points on a coordinate system, using coordinates with the distance formula, or drawing lines of symmetry of geometric figures.

At more advanced levels of mathematics, symbol manipulation and solving a quadratic equation or a system of two linear equations with two unknowns are considered routine tasks, assuming students are expected or likely to use well-known procedures (e.g. factoring, completing the square, substitution, or elimination) to derive a solution. Operating on polynomials or radicals, using the laws of exponents, or simplifying rational expressions are considered routine procedures.

Verbs should not be classified as any category without considering what the verb is acting upon or the verb's direct object. "*Identifying"* attributes of a triangle is a definitional task, but "*identifying"* the most appropriate mathematical model for a particular context requires interpretation based on math concepts and a more complex analysis. To *describe* by listing the steps used to solve a problem is DOK 1 whereas to *describe* by providing a mathematical argument or rationale for a solution is more complex.

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DOK 2 (Skill/Concept)

DOK 2 expectations and tasks involve engaging in some mental processing beyond a habitual response as well as decision-making about how to approach the problem or activity. This category can require conceptual understanding and/or demonstrating conceptual knowledge by explaining thinking in terms of concepts.

DOK 2 tasks include distinguishing among mathematical ideas, processing information about the underlying structure, drawing relationships among ideas, deciding among and performing appropriate skills, applying properties or conventions within a relevant and necessary context, transforming among different representations, interpreting and solving problems and/or graphs, etc. When given a problem statement, formulating an equation or inequality, deriving a solution, and reporting the solution in the context of the problem fit within DOK 2. Processes such as classifying, organizing, and estimating that involve attending to multiple attributes, features, or properties also fall into this category.

Even the youngest students can engage in conceptual work. For example, verifying that the number of objects in one set is larger or fewer than the number of objects in a second set by matching pairs or forming equivalent groups is a DOK 2 activity for early elementary. Similarly, modeling a joining or separating situation pictorially or physically also is in this category for early elementary.

Skills and concepts include interpreting the meaning of critical features of a function, beyond just identifying or finding such features, as well as describing the effects of parameter changes. Note, however, that using a well-defined procedure to find features of a standard function, such as the slope of a linear function with one variable or a quadratic, is DOK 1. Graphing an irregular function is DOK 2. Basic computation, as well as converting between different units of measurement, are generally DOK 1, but illustrating a computation by different representations (e.g. equations and a base-ten model) to explain the results is DOK 2. Computing measures of central tendency (applying set procedures) is a DOK 1, but interpreting such measures for a data set within its context or using measures to compare multiple data sets is a DOK 2. Performing original formal proofs is beyond DOK 2, but explaining in one's own words the reasons for an action or application of a property is within DOK 2. Activities at a DOK 2 are not limited only to number skills but may involve visualization skills (e.g. mentally rotating a 3D figure or transforming a figure) and probability skills requiring more than simple counting (e.g. determining a sample space or probability of a compound event). Other DOK 2 activities include detecting or describing non-trivial patterns, explaining the purpose and use of experimental procedures, and carrying out experimental procedures.

DOK 3 (Strategic Thinking)

DOK 3 expectations and tasks require reasoning and analyzing using mathematical principles, ideas, structure, and practices. DOK 3 includes solving involved problems; conjecturing; creating novel solutions and forms of representation; devising original proofs, mathematical arguments, and critiques of arguments; constructing mathematical models; and forming robust inferences and predictions. Although DOK 2 also involves some problem solving, DOK 3 includes situations that are non-routine, more demanding, and more abstract than DOK 2. Such activities are characterized by producing sound and valid mathematical arguments when solving problems, verifying answers, developing a proof, or drawing inferences. Note that the sophistication of a mathematical argument that would be considered DOK 3 depends on the prior knowledge and experiences of the person. Students can engage in DOK 3 tasks across grades, while the sophistication of the mathematical thinking (and corresponding tasks) develops across the K-12 trajectory. In addition, problems that could be solved using mathematical logic and reasoning may be more simply and efficiently solved in later grades with use of a taught procedure. Thus, primary school student arguments for number problems can be a DOK 3 activity (e.g., finding shortest route from home to school) as can abstract reasoning in developing an appropriately sophisticated argument by students across grades (e.g., critically evaluating the mathematical rationale behind a claim). DOK 3 problems are those for which it is not evident from the first reading what is needed to derive a solution and so require demanding reasoning to work through. Such problems usually can be solved in different ways and may even have more than one correct solution based on different stated assumptions. Paraphrasing in one's own words or reproducing a proof that was previously demonstrated is a DOK 2. Applying properties and producing arguments in proving a theorem or identity not previously seen is a DOK 3. Also within the DOK 3 category: creating a mathematical model of a situation considering contextual constraints, deriving a new formula, designing and conducting an experiment, and interpreting findings.

DOK 4 (Extended Thinking)

Unlike DOK 3 tasks, DOK 4 tasks cannot be completed in one sitting. A main factor that distinguishes DOK 4 from DOK 3 is that DOK 4 tasks require days or weeks to complete. The extended time that accompanies this type of activity allows for creation of original work via iterative processes and requires metacognitive awareness that increases the complexity of a DOK 4 task overall, in comparison with DOK 3 activities. The extended time period is not a distinguishing factor if the required work is only repetitive and does not require applying significant conceptual understanding, strategic decision-making, and higher-order thinking. For example, collecting water temperature from a river each day for a month, organizing the data, and then reporting the findings by constructing a graph is a DOK 2 task. Developing a mathematical model of the flow of water for a particular time period with consideration of a number of variables would be a DOK 4 task.

DOK Category 4 activities require complex reasoning, planning, research, and verification of work. Conducting a research project, performance task, an experiment, or a design project as well as creating a new theorem and proof fit within DOK 4. Similarly, DOK 4 tasks require selecting an appropriate approach among many alternatives to produce a product, conclusion, or finding, such as critiquing a body of work, synthesizing ideas in a new way, or creating an original model. It is likely that a DOK 4 activity will require making connections among a number of ideas or variables within the subject area of mathematics or among a number of different subject areas.

General Guidelines for Assigning DOK:

- The DOK definitions can be applied to standards, prompts, questions, or tasks.
- Consider the complexity of the cognitive demands, not the difficulty for students.
- Separate the learning process from the intended learning outcome or goal; focus on the goal, recognizing that students may take many different pathways to reach that goal.
- Consider the prior knowledge and grade-level expectations of a typical student.
- Do not rely on verbs (describe, explain, evaluate, etc.). Instead, consider the type of cognitive engagement required to produce a correct answer or successfully complete a task.
- For multiple-choice assessment items, consider the item as a whole—including all answer choices—to judge complexity.
- An expectation or task that is confusing due to error or wording does not reflect increased complexity—it simply means editorial revisions are needed.

Webb, N. L. *Alignment study in language arts, mathematics, science, and social studies of state standards and assessments for four states*. A study of the State Collaborative on Assessment & Student Standards (SCASS) Technical Issues in Large-Scale Assessment (TILSA). Washington, D. C.: Council of Chief State School Officers, December 2002. Revised in 2014; 2026 by Norman Webb and Sara Christopherson with the help of Lynn Raith.