

NEWSLETTER

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WHAT DEPTH OF KNOWLEDGE MEANS IN MATHEMATICS

Understanding the difference between task difficulty and mathematical reasoning.

In today's edition, we explore:

- **Depth of Knowledge:** what a task's level depends on
- **Classroom tips:** questions that examine student thinking
- **Difficulty and reasoning:** why a harder task is not always a deeper one

Educators!

A student correctly completes 25 multiplication problems in five minutes. Another student uses an array to represent multiplication but has difficulty explaining the relationship between the rows, columns, and product.

These responses provide different kinds of evidence. One student demonstrates accuracy and efficiency with the multiplication problems. The second student's response suggests that the teacher should examine how the student understands the quantities and relationships in the array. Depth of Knowledge (DOK) helps teachers consider the reasoning a mathematical task requires, not how difficult it feels or how long it takes.

Classroom Tips

1. **Name the quantities and the unit.** Ask, "What quantity does each number represent? What is the unit?"
2. **Connect the model to the relationship.** Ask, "How does the array show the factors and the product?"
3. **Ask what supports the conclusion.** Ask, "Can the strategy be used in another situation? What mathematical property supports it?" The DOK level depends on the work students must do, not the wording of the question.

Difficulty and Reasoning

A multiplication task involving large numbers may be difficult without requiring complex reasoning. Conversely, a task involving small numbers may require students to analyze relationships, select strategies, or justify a mathematical claim.

Procedural fluency and mathematical reasoning develop together and should both be emphasized during instruction. DOK helps teachers examine the thinking a task requires.

Understanding Cognitive Demand

Webb's DOK framework describes the cognitive complexity of tasks and assessments (Webb, 2002). In mathematics, teachers can examine whether a task requires students to recall a fact, apply a familiar procedure, interpret quantities, represent relationships, or develop a mathematical justification.

These forms of mathematical work have different purposes. A higher DOK level is not automatically a better task. The appropriate level depends on the mathematical objective and what students already know.

Mathematical task	Possible DOK
Compute 7×8 .	DOK 1
Interpret a multiplication situation with an unfamiliar quantitative relationship.	DOK 2
Construct an array and explain how it represents the factors and product.	Often DOK 2
Investigate whether reversing the factors always preserves the product and justify the conclusion.	Potentially DOK 3

DOK classifications depend on the reasoning required and the students' familiarity with the task.

What Does the Research Say?

Webb (1997) developed DOK to assess how well assessments align with student learning expectations. Research on retrieval practice and self-explanation provides additional guidance for instruction. Retrieval practice can support retention (Roediger & Karpicke, 2006), while explaining worked examples can support learning (Chi et al., 1989). These findings inform instruction but do not determine a task's DOK level.

When reviewing a lesson, consider the mathematical work students are being asked to do. Are they recalling, calculating, interpreting, representing, comparing, or justifying? Each has a purpose, and together they provide opportunities to develop mathematical understanding and procedural fluency.

Keep developing mathematical thinkers.

More Information

Read DMT Insight 44, watch the accompanying video, and download the Companion at mathsuccess.io/dmtinsights.

What questions help your students explain their reasoning? Share them with us at contact@dmtinstitute.com.

For more information on professional development and curricular resources, visit mathsuccess.io.

