Abstract
Depth of Knowledge is a common measure of rigor used extensively at the state level to align assessments with state content standards. The use of Depth of Knowledge at the classroom level is now beginning. This article discusses ways in which Depth of Knowledge can be used in the English language arts classroom to teach content demanding higher-level thinking skills. The effect on student engagement and standards-based education is also discussed.

Key words
Cognitive Rigor, Depth of Knowledge, English language arts, reading, student engagement

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1. Introduction

Depth of Knowledge, originally developed by Norman Webb, can best be described as a tool for measuring the cognitive demand of instructional objectives and assessment items (Webb, 2002a,b). Webb first introduced Depth of Knowledge to align assessments to standards in the area of cognitive rigor. Using the Depth of Knowledge categories and descriptors, educators can more clearly delineate how they expect students to demonstrate higher-level thinking. Depth of Knowledge (DOK) has moved to the forefront as the analytical tool of choice to measure cognitive rigor, thus giving teachers a useful way to plan and deliver lessons and learning projects aligned for cognitive rigor with the targeted standard. Beyond the practicality of knowing Depth of Knowledge for No Child Left Behind compliance, teachers can develop learning activities that are more interesting, challenging, and creative. The results will help students, no matter their grade level, develop the higher-level cognitive skills that educators and the business community agree will fuel competitive success in the global, highly-connected information environment of the twenty-first century.

2. Depth of Knowledge levels

The structure of the Depth-of-Knowledge model comprises a hierarchy four layers deep with the lowest order of rigor (rote response) denoted DOK-1, as shown in Table 1. Unlike Bloom’s Taxonomy, which relates rigor to the type of thinking required to complete an activity, Depth-of-Knowledge levels pertain more closely to the complexity of the task. No direct mapping exists between Bloom’s Taxonomy and Depth of Knowledge—an activity requiring a particular type of thinking (as described by Bloom’s Taxonomy) can align to various levels of Depth of Knowledge (Hess, 2005).

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
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<tbody>
<tr>
<td>DOK-1</td>
<td>Recall of a fact, information, or procedure.</td>
</tr>
<tr>
<td>DOK-2</td>
<td>Use information or conceptual knowledge, two or more steps, etc.</td>
</tr>
<tr>
<td>DOK-3</td>
<td>Use information or conceptual knowledge, two or more steps, etc.</td>
</tr>
<tr>
<td>DOK-4</td>
<td>Requires investigation, time to think, and processing of multiple conditions.</td>
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Table 1: The four Depth-of-Knowledge levels (Webb, 2002c; Green et al., 2006).

The complexity of an activity correlates closely to the degree of planning, organizing, understanding, and time required to complete a task. For this reason, state agencies rely on Depth of Knowledge to write and evaluate assessment items. However, the Depth-of-Knowledge model lends itself nicely to the classroom setting and provides a framework for increasing the cognitive complexity of lesson plans and assignments. Indeed, because of its
close relationship to high-stakes testing, teachers should examine lesson plans and assessments in light of the Depth-of-Knowledge model. If students must master a standard that requires the type of cognitive demand associated with (say) DOK-3, then teachers need to instruct in such ways that their students can reach this mastery.

3. Standards-based education

Depth of Knowledge provides a cognitive processing ceiling, that is, the highest cognitive level at which students can be assessed on a particular item. For example, a DOK-3 English language arts standard requiring a cognitively challenging interpretation of a literary work will implicitly include DOK-1 (recall) and DOK-2 (summarization) activities to complete the DOK-3 (ceiling) interpretation task. Depth of Knowledge therefore provides a range of student work across this scale, which helps provide a better understanding of the operating levels of students.

To incorporate Depth of Knowledge in the classroom, teachers can start by examining what they currently teach. First, they should look at the standard they are addressing and closely examine its wording and dissembling (unpacking) the standard if it comprises multiple tasks. They can then begin to think about the Depth of Knowledge levels they would use to describe what they expect their students to know and perform. As they plan their lessons, they can look for ways to use Depth of Knowledge descriptors (the verbs and their context) to target the required cognitive rigor.

Naturally, teachers should also think about how they can assess students’ skills so that the students can demonstrate their understanding at the proper level. The following example analyzes the use of Depth of Knowledge through the eyes of an elementary school teacher. The standard listed corresponds to Nevada, but appears in one form or another throughout numerous states. The general purpose of the standard—students read literary text to comprehend, interpret, and evaluate authors, cultures, and themes—lists multiple sub-standards, for example:

- Part 1: Explain setting, sequence of events, conflict, climax, resolution, and turning point

The big picture of this standard expects students to “comprehend, interpret, and evaluate.” Students demonstrate DOK-3 skills whenever they must provide their own explanations and personal judgments. Therefore, the context of interpret and evaluate in this literary analysis sets a ceiling of DOK-3.
To reach this level of cognitive rigor, students will need to recall basic facts and concepts (DOK-1) and basic comprehension skills (DOK-2) as they develop abilities to respond at DOK-3. The vocabulary content of the above standard contains the concepts climax and turning point in addition to previously learned vocabulary. The verb has changed from describe in third grade to explain in fourth grade.

The change is significant because the verb explain demands a more complex response than describe. Whereas describe may only require reproduction of a previously learned definition (DOK-1) or a simple display of comprehension in context (DOK-2), explain requires another step in the thinking process in which the students add their personal response. Now teachers can think about the best lesson strategies to

1. check for comprehension of the new vocabulary and
2. give students models for ways to explain the meanings of all the terms in a literary context.

A DOK-1 fill-in-the-blank or short-answer response may suffice as a vocabulary check, but students need to learn how to explain relationships and connections. Therefore, teachers could ask students to show cause-and-effect relationships, or write sentences about how the author used a dramatic setting to lead up to a turning point. To respond adequately, the student, must employ DOK-2 cognitive skills. At this point, another sub-standard manifests:

• Part 5: Make inferences and draw conclusions about setting and plot based on evidence.

Students have practiced these skills with assistance from Kindergarten to second grade, and on their own since third grade (at least in Nevada). Fourth-grade standards expect them to support their inferences and conclusions with evidence. Students achieve skills associated with DOK-3 when they explain their thinking and provide logical arguments. Since the myriad thoughts about inferences and conclusions among students will diverge, teachers should provide guidance/modeling and practice on how to explain the ways that the evidence offered by their students links to the inference or conclusion.

For example, teachers can meet this need by modeling the thought processes associated with inferences drawn from a short piece of writing that shows how the evidence supports the inference or conclusion. In formal groups, students can then practice making inferences, drawing conclusions, and then finding supportive evidence. The assessment would then apply their newly-learned skills to a particular piece of literature they have been reading. Teachers
should not, however, expect students to demonstrate mastery of levels DOK-3 and DOK-4 on assessments unless the standard calls for it.

Teachers should strive to support, guide, and practice their student’s use of higher levels of Depth of Knowledge until mastery requires it. Just carefully analyzing the cognitive rigor of one standard, and how Depth of Knowledge levels inform instructional planning, is apparently often quite complex. Such analysis reaps considerable benefits, however. Naturally, understanding Depth of Knowledge to a fundamental level takes time, but it all starts with a teacher’s openness to try something new.

4. Student engagement

Every teacher has experienced those magical moments when his or her classroom comes to life and buzzes with electricity. During those times one can almost feel the energy as students eagerly participate in the topic at hand. Most teachers live for those moments, yet they are achingly fleeting. By incorporating the Depth of Knowledge in their teaching, however, teachers can make engaged time the norm and not the exception.

Research shows that students want supportive teachers who care about their learning (Certo et al., 2008; Intrator, 2004). Students consistently say that the most engaging teachers encourage classroom discussion and debate, tie instruction to students’ own lives, and allow students to experience a degree of autonomy. On the other hand, students reported high levels of disengagement in classes where teachers placed emphasis on note taking and worksheets at the expense of classroom dialogue.

According to the findings in the Certo study, DOK-1 activities hold little interest for students. Questions that lie at DOK-1 necessitate only memorization and recall, and so do not promote higher-level thinking. Students reported feeling bored with this type of instruction and they felt that teachers who relied heavily on low-level (DOK-1) activities cared little about student learning. If students “tune out” when little is expected of them, students “tune in” when challenged to take a more active role in their learning. Intrator reported that “students were most vibrant when creating or thinking about something new . . . students tuned in when they felt ownership over ideas expressed in class and felt they were in a safe place to share their own ideas. They yearned to be listened to and taken seriously.”
5. Driving student engagement with Depth of Knowledge

Teachers who want to bring that spark of life to their classrooms on a consistent basis should employ strategies that involve higher Depth-of-Knowledge levels. Instead of asking questions that have only one correct answer, teachers could use open-ended “how,” “why,” and “what if” questions that allow students to stretch their imaginations, flex their problem-solving muscles, and make connections across disciplines and to their own lives. The DOK-2 level requires mental processing beyond rote response. For example, one can imagine that a class has just finished reading Romeo and Juliet. To incorporate DOK-2 activities into the classroom discussion, the teacher could consider employing the following devices and questions:

- Locate a passage that requires students to use context clues to determine its meaning, and then have them rephrase the dialogue into modern-day language.
- Ask students, “Can you think of any celebrity families that are similar to the Capulets and/or the Montagues? How are they alike?”
- What if Romeo and Juliet had owned cell phones? Would the play have ended differently? Why or why not?” At DOK-3, teachers encourage students to exhibit a deeper understanding of material. Questioning that requires students to infer and generalize across entire passages and amply justify their responses signify this level, such as the following:
  - “What are some of the themes in the play and why did you choose them?”
  - “How do those themes connect to other literature we’ve read in class or to something you’ve read on your own?”
  - “Which character do you most identify with and why?”
  - “Suppose you’re working for a TV network and you’re asked to rewrite this play as a comedy for television. What are some of the major changes you’d need to make to the script?”

Current literature shows that students crave academic challenges and the opportunity for their teacher and peers to hear their voices. Planning for and implementing higher-level questions into the taught curriculum each day can satisfy both teacher and student. Teachers should, however, continuously monitor the concepts and skills addressed in assigned activities to ensure that their lesson plans do not drift too far from the learner outcomes specified for each grade level and specified in the state content standards.
6. Teaching higher cognition with think-alouds

One way teachers can acclimate students to higher Depth-of-Knowledge activities is by using think-alouds, a simple cognitive strategy developed to help students access meaning associated with higher-level thinking processes and skills. For reading comprehension lessons, teachers can use think-alouds as a teaching strategy in which they share the thought processes they undertake while comprehending text. Think-alouds can therefore help model how good readers think before, during, and after reading.

According to author Jeffrey Wilhelm, “Think-alouds make invisible mental processes visible to children” (Wilhelm, 2001). Eventually, students can use think-alouds as a learning strategy, either in collaborative group settings or independently. According to Wilhelm: “While reading, teachers model their thinking by voicing all the things they are noticing, doing, seeing, feeling, and asking as they process text. Students can then ‘borrow’ the various strategies teachers use and apply them in their own reading.” To help students achieve at all four Depth-of-Knowledge levels, teachers can share their thoughts that correspond to the thinking processes required at each level. The goal is to model for students cognitive thought processes so that students can eventually master higher levels.

The following examples illustrate think-alouds and questioning strategies using the story The Quiltmaker’s Gift (Brumbeau, 2000). When reading these examples, teachers should keep in mind that the mere act of listening to their teachers model thinking processes does not constitute a higher Depth-of-Knowledge activity on the part of students; rather, think-alouds provide a cognitive strategy to model for students how they can engage in such thinking on their own. The following example models recall of simple and literal information. As stated earlier, such modeling of DOK-1 activities is probably unnecessary.

- **DOK 1**: I see that the quiltmaker sews. I can tell from the pictures and also the book says that she was “sewing away day after day.” What else do I know so far? I know where she lives. In the mountains. It says that she had a house in the “mountains up high,” and I can see her house in the picture. The next example shows the use of context clues to determine meanings of unknown words. Students are interpreting text but knowledge remains at the literal level and does not go “beyond” the text.

- **DOK 2**: The king was frowning. Hmmmm... I don’t really know what “frowning” means. When I don’t know what a word means, I use clues from the story to help me. The clues I use are pictures and other words in the story. So, I’m going to try that now to figure out what that word means. I can see in the picture that the king looks sad. And it says here that
“still, the king did not smile.” So, those clues make me think that “frowning” looks like this (teacher makes a frown imitating the king). The examples now turn to abstract theme identification using reasoning. Students go beyond the text and make connections. There are also several different answers.

- **DOK 3**: Now that I have finished reading the story, I’m going to figure out the theme. Now I remember that a theme is an idea that reappears throughout a story. When I try to identify a theme, I think about the things that happened in the beginning, middle, and end. And I also pay close attention to the pictures and the things that characters say or do. In the beginning of this story, the king did not like her. But in the end, when she gave the king a quilt, they became friends. How do I know this? Well, I think about my own experiences and friends. I know that I often give them things. She also made friends with other characters in the story like the bear and the sparrow. She treated them kindly and lovingly, which I know from my own life is what friends do. So, I think one of the themes of this story is friendship, because acts of friendship appear throughout the story. The final example below shows complex analysis of the connections among texts—complex considering the grade level of the students. It also shows students examining common themes found across texts, including text from other cultures. Student activities centered on such DOK-4 thinking would be large-scale projects extending over a lengthy time period.

- **DOK 4**: I notice that the themes of friendship, kindness, generosity, and love are similar. And gifts, smiles, and hugs, which I saw in the story, all have to do with all of the themes. I have read other books where there are gifts, smiles, or hugs. The Quiltmaker’s Gift made me think of them. One book is even from another country, Russia. But I think the themes are the same, and the characters are like the ones in The Quiltmaker’s Gift. And even though the stories have the same themes, they were written by different people. Now, let’s examine some books we’ve read. What are some books that have these themes in them? Yes, Stellaluna, Thundercake, and Officer Buckle and Gloria all have similar themes. Why do you think so many different authors write about these themes? What about Thundercake, which takes place in Russia? Do people in Russia also experience friendship and kindness?

The reader should keep in mind that, although the think-aloud that illustrates the thought processes involved in responding to DOK-4 activities is relatively short, the actual time needed by the students to complete a DOK-4 activity will typically require multiple classroom sessions. In summary, think-alouds are a powerful teaching strategy that teachers can use more often in the classroom. By incorporating Depth of Knowledge into the think-aloud strategy, teachers can
equip students with the tools needed for higher-level critical thinking, thus enhancing their understanding of Depth of Knowledge and strengthening their teaching effectiveness.

7. Conclusion
Depth of Knowledge will forge an increasing presence in future classrooms. Existing teaching strategies, such as think-alouds, can accommodate this new paradigm of curricular rigor and advance the incorporation of higher Depth-of-Knowledge content into the lesson planning process. Enhanced student engagement will fortunately result.

References


