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Elida V. Laski

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Not Sure Which Rubric to Use? Consider Cognitive Science Principles of Learning

by Elida V. Laski

Abstract
The author describes two general principles of learning that have emerged from cognitive science and argues that analytic rubrics that capture these aspects may be particularly effective as instructional and assessment tools.
Key words: *cognitive science, learning, research, rubrics, student assessment*

With the introduction of the Common Core State Standards, the importance of rubrics as an assessment tool in elementary classrooms has increased. A seemingly endless number of rubrics are available online. While the Internet can be a helpful resource, it can also make the task of selecting a rubric among the many options daunting. This article encourages teachers to keep in mind general learning principles from cognitive science in order to identify which rubrics will be the most effective assessment and instructional tools.

Rubrics as an Assessment and Instructional Tool

A *rubric* is a guide for assessing student performance. Rubrics describe aspects critical to success in a given task and various levels of performance (Andrade, 2000). Their main purpose is to objectively evaluate student performance against an established standard (Schmoker, 2006). Rubrics help provide feedback to students, facilitate communication with parents, and inform instructional decisions.

There are two main types: holistic and analytic. *Holistic rubrics* consist of a single scale in which multiple criteria are considered simultaneously to generate an overall assessment of performance. *Analytic rubrics,* in contrast, delineate the dimensions relevant to performance, typically include descriptions of the dimensions for each level, and provide a separate score for each dimension. Analytic rubrics provide more information than holistic rubrics about a student's specific strengths or weaknesses—information that can be used for targeting instruction.

Not every analytic rubric provides equally useful information, however. For instance, the reading comprehension rubric shown in Figure 1 is an analytic rubric that provides little information about students' strengths and weaknesses. It does not specify the aspects that contribute to students' mastery of the standard—such as monitoring their own comprehension while reading or referencing the text—and uses vague terms like *sometimes* that do not adequately describe differences in levels of performance that could help a teacher determine how to target instruction. Thus, careful selection of rubrics is central to ensuring they are highly useful for informing instruction.

Figure 1. Example of Vague Rubric That Should Be Avoided

Second-Grade Reading Standard: Ask and answer questions to demonstrate understanding of key details in a text.			
1	**2**	**3**	**4**
Student *never* asks and answers questions.	Student *sometimes* asks and answers questions.	Student *frequently* asks and answers questions.	Student *consistently* asks and answers questions.

Why Consider Cognitive Science?

The ultimate goal in using rubrics is to document and support the learning process, so they should reflect the complexity and nuances of learning. Cognitive science has generated a considerable amount of knowledge about learning and cognition. In investigating differences between novices and experts in different content areas, researchers have identified the dimensions that contribute to mastery of a concept or skill (e.g., Hatano & Oura, 2003; Hmelo-Silver & Pfeffer, 2004)—the essence of an analytic rubric. Cognitive scientists also have studied the path learners take as they acquire particular concepts and skills and identified the kinds of behaviors and errors individuals exhibit during learning (e.g., Alibali & Goldin-Meadow; 1993; Collins & Laski, 2015), which is critical for determining various levels of mastery. Thus, cognitive research has yielded insights about how children learn that are relevant to analytic rubrics.

***Elida V. Laski** is an Associate Professor in the Lynch School of Education at Boston College where she teaches and conducts research on the application of cognitive science to educational practice. Formerly, she served as an elementary teacher and instructional coach. Email: laski@bc.edu*

Two Cognitive Principles of Learning Relevant for Analytic Rubrics

Principles of learning describe general phenomena related to learning that are true across many academic subject areas and tasks. Two principles of learning that are relevant for analytic rubrics are described here.

1. Even simple tasks involve multiple processes and skills.

Even seemingly simple tasks involve a host of different skills and knowledge (Bransford, Brown, & Cocking, 1999; Crandall, Klein, & Hoffman, 2006). For example, solving 25 + 46 = ? requires understanding place value, the carrying procedure, and equivalence, among other things. Similarly, determining which of two groups of objects is greater in number involves being able to count accurately and comprehension of the term *greater than* (see Figure 2). Most common core standards involve various cognitive processes, skills, and knowledge.

Ensuring rubrics capture the complexity of the standards they assess can make them more effective instructional tools. When selecting a rubric, a teacher should ask, "What are all the things a student needs to know or be able to do to achieve this standard? Are these dimensions clear in the rubric?" If so, the rubric can inform lesson planning. Students learn tasks and procedures best when they are broken into small parts (e.g., Mayer & Moreno, 2003). Breaking up tasks helps students manage their limited cognitive resources so they do not become overloaded. Knowing the dimensions involved in a task, a teacher can plan lessons for each and sequence lessons to build on one another. Rubrics that reflect the complexity of a standard also can make assessment more informative. They can help a teacher identify which particular aspect of a standard is problematic for a student and to individualize instruction accordingly.

Imagine a kindergartner who incorrectly responds that a set of 6 objects is greater than a set of 7, but accurately responds that 6 is greater than 3. Using a rubric that delineates the components of the task (as shown in Figure 2), a teacher notes that the student has mastered enumeration

Figure 2. Example Rubric That Captures the Complexity of the Standard and Denotes Common Setbacks or Errors

Kindergarten Math Standard: Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group.

Level	Enumeration	Magnitude	Vocabulary	Equal
3 Proficient	Accurately counts sets visually or through tagging Demonstrates strategies for organizing objects while counting (e.g., moving aside)	Accurately compares number neighbors with a difference of one (e.g., 5 vs. 6)	Explains answer using formal terms *greater than, less than,* and *equal to*	Identifies and creates two equal groups Makes two groups equal by adding/subtracting from one group
2 Basic	Accurately counts sets <5 visually or through tagging	Accurately compares numbers with a distance between 2 and 4 (e.g., 5 vs. 7 or 4 vs. 8)	Explains answers using terms *bigger* and *smaller* Able to produce formal terms after prompting (e.g., What is the math word?)	Identifies two equal groups Creates equal sets, but does not have a clear strategy (i.e., the student may add/subtract from both groups searching for a visual balance)
1 Novice	Performs coordination (double tag) or partitioning errors (double count) when counting	Accurately compares numbers with a distance >4 (e.g., 5 vs. 10, 2 vs. 8)	Does not produce vocabulary, but shows an understanding of terminology by correctly identifying (through gestures) which set is *greater than* or *less than*	Has trouble with *equal*, but may respond to *same* Needs assistance to create two equal groups

and the vocabulary, but not magnitude comparison. With this information, the teacher would know not to ask the child to practice counting objects, but rather provide number line practice.

2. Setbacks often reflect and generate learning.

Learning often does not progress directly from knowing less to knowing more. Instead, children can do fairly well on a task, then perform poorly, and then improve again with time; these setbacks, errors, and misconceptions are important indicators of progress (Carlucci & Case, 2013). This U-shaped pattern is apparent in many tasks, including learning to solve equivalence problems (e.g., 7 + 4 + 5 = 7 + __) and spell words (Critten, Pine, & Steffler, 2007; McNeil, 2007).

Consider a second grader who has been correctly spelling "soft" phonetically and, all of a sudden, starts spelling it "sofed." This apparent regression, or error, actually indicates important progress in the child's spelling development. The child has learned the *–ed* ending for spelling past-tense verbs and is generalizing the spelling pattern more broadly than is appropriate. It would be wrong to evaluate this child as poorer at spelling than a child who is spelling *soft* correctly but not using any *–ed* endings in his spelling.

Unfortunately, many rubrics use a series of comparison words that suggest a steady increase in understanding or skill (e.g., *none, few, some, all; never, inconsistently, consistently, always*). Instead, a rubric that acknowledges the value of setbacks for learning should describe common regressions and errors that occur in the progression from novice to proficient performance. For example, a rubric for evaluating children's decoding skills might indicate that a novice is likely to "guess words based only on initial letter sounds" rather than use a vague phrase such as "reads some words correctly." The number sense rubric discussed earlier (see Figure 2) provides another example. In the magnitude comparison column, it identifies the kinds of magnitude comparisons that students should be able to make (i.e., gross magnitude comparisons) as well as the kinds in which errors are likely to occur (i.e., number neighbors) during the early learning process.

Specificity about the errors, misconceptions, and setbacks students typically have in the course of mastering a standard can increase the instructional value of rubrics. These details can help teachers plan lessons that confront the errors, perhaps even before they occur. Teachers could ask students to compare correct and incorrect approaches. Asking students to explain both correct and incorrect approaches to problems produces more learning than just having them explain the reasoning for a correct approach (e.g., Durkin & Rittle-Johnson, 2012; Siegler, 2002). This strategy also can provide teachers a "map" for pinpointing the source of individual students' difficulty and targeting instruction accordingly.

Conclusion

The value of an analytic rubric depends on how well it captures student learning and understanding. Rubrics that use vague language (e.g., *some, frequently*) or numeric indicators (e.g., 50% of problems) fall short of describing key differences between those students with more or less mastery of skills and the progression of learning over time. Cognitive science research points to two aspects of learning that could be useful to capture in analytic rubrics: (a) Even simple tasks involve various processes and skills, and (b) setbacks reflect and generate learning. Rubrics that capture these aspects can provide a more complete picture of students' progress toward mastery of the standards than those that do not and, thus, can provide important information for instructional planning.

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