



ARTICLE

A Well Articulated Knowledge Base

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A well-articulated knowledge base is a prerequisite for developing expertise in any systematic way within any domain. Ericsson et al. (1993) note that the knowledge base has increased and is continuing to increase in a variety of domains. This has resulted in an increased ability to develop experts in many fields:

As the level of performance in the domain increased in skill and complexity, methods to explicitly instruct and train individuals were developed. In all major domains there has been a steady accumulation of knowledge about the best methods to attain a high level of performance and the associated practice activities leading to this performance. (p. 368)

As is the case with most fields of study, education has experienced exponential growth in its knowledge base, particularly regarding effective pedagogy. There have been many attempts to codify this knowledge base (see Hattie, 1992; Hattie, Biggs, & Purdie, 1996; and Wang, Haertel, & Walberg, 1993). While these efforts have succeeded in listing the various strategies and activities that occur in effectively run classrooms, they have not attempted to articulate the context in which specific strategies should be used. Ericsson and Smith (1991) identify this as a necessary characteristic of expert performance—not only knowing the “moves” to be made in a given domain, but also knowing the “right move” for a specific situation. One challenge, then, in organizing the knowledge base on teaching to make it a viable tool for developing expertise is to classify it in a way that identifies the context or situations in which to employ specific strategies.

Drawing on a considerable amount of design theory (see Berliner, 1986; Doyle, 1986; Good, Grouws, & Ebmeier, 1983; Leinhardt & Greeno, 1986; and Stodolsky, 1983), Leinhardt (1990) proposes the *lesson segment* as a way of classifying the myriad strategies and behaviors (moves) employed by expert teachers:

This research-based information points to the fact that lessons are constructed with multiple parts, or lesson segments, each of which has important characteristics. Each segment contains different roles for teachers and students. Each segment has multiple goals, which can be more or less successfully met by a variety of actions. Further, these segments are supported by fluid, well-rehearsed routines. (pp. 21–22)

Following Leinhardt’s lead, this chapter organizes what is known about instructional strategies into lesson segments using the framework described in *The Art and Science of Teaching* (Marzano, 2007). That framework identifies nine types of segments that might occur in classrooms:

1. Communicating learning goals, tracking student progress, and celebrating success
2. Establishing or maintaining rules and procedures
3. Introducing new content (critical input lessons)
4. Knowledge practicing and deepening lessons
5. Hypothesis generating and testing lessons (knowledge-application lessons)
6. Increasing student engagement

7. Recognizing and acknowledging adherence and lack of adherence to classroom rules and procedures
8. Establishing and maintaining effective relationships with students
9. Communicating high expectations for every student

These nine segments are organized into three categories: segments involving routine events, segments involving academic content, and segments involving issues that must be addressed as they occur. The relationships between these categories are depicted in figure 1.

In figure 1, the first two of the nine lesson segments are organized into the “routine events” category. The next three segments all involve academic content. The last four segments involve issues that must be addressed as they occur. The following sections present the research supporting each segment along with a brief description of how the behaviors associated with the segment might manifest in the classroom along with a list of specific behaviors for each segment.

Segments Involving Routine Events

Every day in every classroom, teachers and students will exhibit certain routine behaviors regardless of the content being taught or the age of the students. As shown in figure 1, two segments are classified as routine events: (1) communicating learning goals, tracking student progress, and celebrating success; and (2) establishing or maintaining classroom rules and procedures.

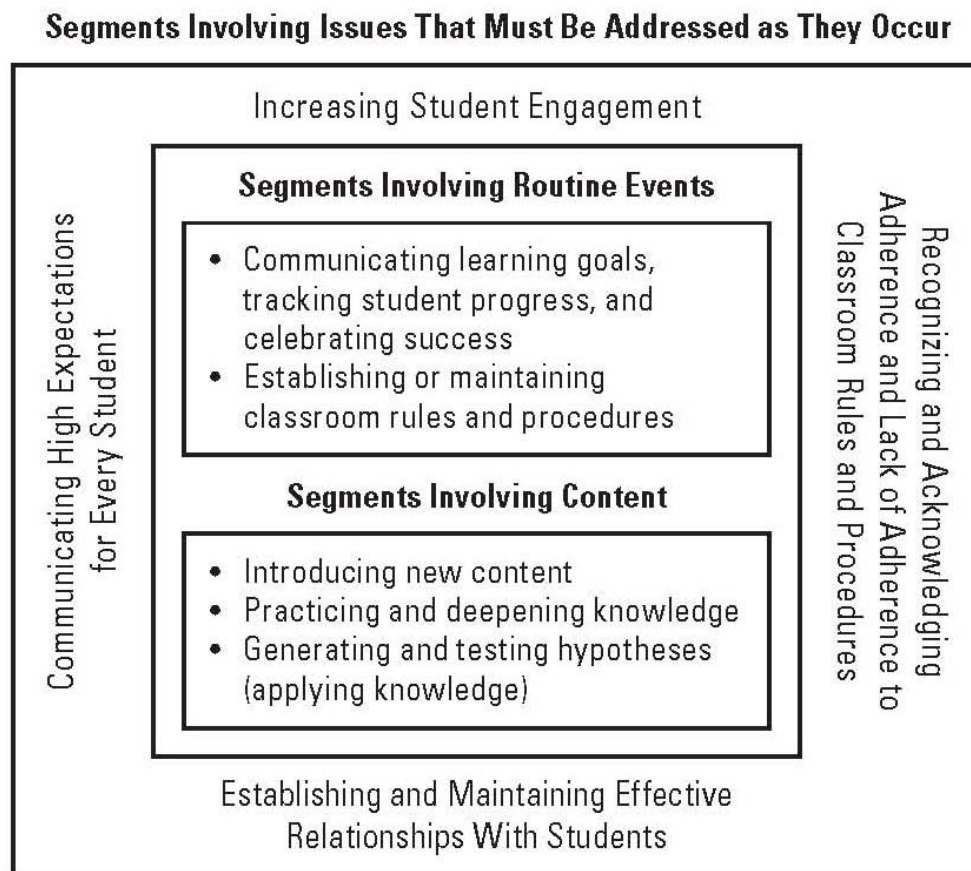


Figure 1: Categories of lesson segments.

Communicating learning goals, tracking student progress, and celebrating success. Each of the nine segments identified in *The Art and Science of Teaching* (Marzano, 2007) are themselves an amalgamation of a number of instructional strategies and behaviors. The segment involving communicating learning goals, tracking student progress, and celebrating success is supported by research on the effects of goal setting (Lipsey & Wilson, 1993; Walberg, 1999; Wise & Okey, 1983), feedback (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Haas, 2005; Hattie & Timperley, 2007; Kumar, 1991), reinforcing effort (Hattie et al., 1996; Kumar, 1991; Schunk & Cox, 1986), use of praise (Bloom, 1976; Wilkinson, 1981), and use of rewards (Deci, Ryan, & Koestner, 2001).

Specific behaviors associated with this segment include the following (Marzano, 2008):

- The teacher reminds students about learning goals or introduces new learning goals.
- The teacher provides formative feedback to students (through quizzes, tests, informal forms of assessment) relative to their individual progress on learning goals.
- The teacher provides students with some form of recognition for their progress on learning goals.

To illustrate how these behaviors might interact, consider a middle school science teacher who daily reminds students of the learning goals for the unit. In addition, using formative assessments, the teacher helps students track their progress regarding the learning goals for the unit. This is done routinely if not daily. Finally, as a matter of course, the teacher provides opportunities for students to celebrate their knowledge gain as well as their achievement status at any given moment.

Establishing or maintaining classroom rules and procedures. Another segment that is classified as a type of routine behavior involves establishing or maintaining classroom rules and procedures. This segment draws from the research on establishing rules and procedures early on in the school year and addressing those rules and procedures in a logical and systematic fashion throughout the school year (Anderson, Evertson, & Emmer, 1980; Brophy & Evertson, 1976; Eisenhart, 1977; Emmer, Evertson, & Anderson, 1980; Good & Brophy, 2003; Moskowitz & Hayman, 1976).

Specific behaviors associated with this segment include the following (Marzano, 2008):

- The teacher has clear routines and procedures that contribute to the effective functioning of the class.
- The teacher has organized the classroom for effective learning with appropriate traffic patterns and bulletin boards that display student work.

To illustrate the interplay of these behaviors in the classroom, consider an elementary language arts teacher who takes time at the beginning of the school year to establish clear rules and procedures regarding appropriate behavior in the classroom. Additionally, as a matter of routine, the teacher systematically reviews these rules and procedures, making changes as necessary. Finally, the teacher helps establish routine and order by organizing classroom materials, displays, and traffic patterns in a manner that facilitates learning.

Segments Involving Content

There are three types of content segments: (1) segments that involve the introduction of new content, (2) segments that involve reviewing content or practicing content, and (3) segments that involve applying content. Each of these typically manifest as a distinct lesson, although more than one type of content

segment may be addressed in a single class period—especially when classes are extended due to block scheduling.

Introducing new content. Some lessons are devoted to the introduction of new content. Marzano (2007) refers to these lessons as critical input lessons—students are being introduced to new content that is critical to their ability to attain learning goals. The behaviors important to these types of lessons draw from the research on presentation formats that enhance retention of new knowledge (Nuthall, 1999), previewing new content (Ausubel, 1968; Mayer, 1989, 2003; West & Fensham, 1976), organizing new knowledge for efficient processing (Linden et al., 2003; Rosenshine, 2002), summarizing new information (Anderson & Hidi, 1988/1989; Hidi & Anderson, 1987), representing new knowledge in multiple ways (Alvermann & Boothby, 1986; Aubusson, Foswill, Barr, & Perkovic, 1997; Druyan, 1997; Newton, 1995; Sadoski & Paivio, 2001; Welch, 1997), teacher questioning (Pressley et al., 1992; Reder, 1980; Redfield & Rousseau, 1981), and student self-reflection (Cross, 1998).

Specific behaviors associated with introducing new content include the following (Marzano, 2008):

- The teacher engages students in activities that help them preview the new content (such as overt linkages, preview questions, brief teacher summary, skimming, teacher-prepared notes, and asking, “What do you think you know?”).
- When appropriate, the teacher presents new content in ways that involve a variety of mediums (such as lecture, demonstration, and video).
- When appropriate, the teacher augments new content with narratives and anecdotes.
- The teacher presents new content in small, digestible “chunks.”
- After each chunk, students are asked to process the new content by generating brief summaries and making predictions, or the teacher uses some formal type of group-interaction technique (such as reciprocal teaching, jigsaw, or concept attainment).
- After presenting new content, teachers ask students to elaborate on the content by addressing inferential questions and defending their answers.
- After presenting new content, teachers ask students to record and represent their understanding of the new content (such as by summarizing their understanding, creating graphic representations of the new content, generating notes on the new content, or drawing pictures representing the new content).
- When appropriate, the teacher engages students in the use of dramatic enactments or mnemonic devices to help them remember and better understand the new content.
- At the end of the lesson (or segment), the teacher asks students to reflect on their understanding and their learning process (for example, “What are you clear about?” “What are you unclear about?”).
- The teacher uses grouping effectively to help students process the new content (for example, students are organized in small groups as they process new content).

To illustrate the interaction of these behaviors, consider a high school mathematics teacher who designs a lesson to introduce new information about the concept of function. The teacher begins by briefly previewing the concept. She asks students what they think they know about functions. As students volunteer answers, she records their responses on the whiteboard. Next, she shows a video that describes and illustrates defining characteristics of various types of functions. Prior to showing the video, the teacher has organized students into groups of three to facilitate interaction about the information in the video. She plays about two minutes and then stops. She then asks one student in each group of three to summarize what they have seen so far. The other two students in each group pose questions that are either answered in the triad or posed to the teacher. Next, the teacher plays another two minutes of the video and repeats the same process by having one student in each triad summarize the

content. When the video is completed, the teacher asks some inferential questions of the entire class to provide a different perspective on the content. Next, each triad is asked to develop a summary of the content in the video along with a graphic or pictographic representation of the content. The lesson ends with students reflecting on their understanding of the content as presented in the lesson. They do so by answering the following question in their academic notebooks: What am I still confused about?

Practicing and deepening knowledge. Once the teacher has introduced the knowledge, one or more lessons are typically devoted to helping students practice a new skill or deepen their understanding of information. The behaviors important to these types of lessons draw from the research on practice (Kumar, 1991; Ross, 1988), revising and analyzing errors (Halpern, 1984; Hillocks, 1986; Rovee-Collier, 1995), examining similarities and differences (Halpern, Hansen, & Reifer, 1990; McDaniel & Donnelly, 1996), and homework (Cooper, Robinson, & Patall, 2006). When considering lessons that involve practicing and deepening knowledge, it is important to keep in mind the distinction between declarative and procedural knowledge. *Procedural knowledge* includes skills, strategies, and processes. *Declarative knowledge* includes details, sequences of information, generalizations, and principles.

Specific behaviors associated with segments devoted to practicing and deepening knowledge include the following (Marzano, 2008):

- The teacher engages students in a brief review of the content.
- The teacher asks students to review and revise notes they have taken on the new content.
- Teachers use grouping in ways that help students deepen their understanding (for declarative knowledge) or move toward fluency (for procedural knowledge).
- When appropriate, the teacher assigns homework that helps students deepen their understanding (for declarative knowledge) or move toward fluency (for procedural knowledge).

If the content is information based (declarative):

- The teacher engages students in activities that require them to examine similarities and differences regarding content (such as comparison activities, classification activities, metaphor activities, and analogy activities).
- The teacher engages students in activities that require students to examine their own logic regarding the new content or the logic underlying the presentation of the new content.

If the content is skill or process based (procedural):

- The teacher involves the students in practice activities that are appropriate to their level of development toward fluency.

To illustrate these behaviors, consider two teachers. The first is a primary language arts teacher who has previously presented a strategy for editing a composition to make sure there is a clear beginning, middle, and end (procedural knowledge). This strategy would have been presented earlier in a lesson specifically designed for introducing new knowledge (a critical input lesson). The second teacher is a middle school history teacher who has previously presented students with information about republics as a form of government (declarative knowledge). Both would begin their knowledge practice and deepening lesson with a brief review of the content presented in the earlier introductory lesson. Both might also organize students into small groups to facilitate the processing of information. Because the language arts teacher is dealing with procedural knowledge, she would engage students in some type of practice activity. For the initial practice activity, she might provide students with a set of sample

compositions, none of which have clear beginnings, middles, and ends. Individually or in small groups, students would use these contrived examples to practice the revising strategy by rewriting the compositions to include an effective beginning, middle, and end. Because the middle school teacher is dealing with declarative knowledge, she might have students engage in a comparison activity designed to help students contrast republics with other forms of government. For example, the teacher might ask students to contrast republics with democracies and monarchies. Finally, both teachers would determine if the activities begun in class would be extended as homework.

Generating and testing hypotheses (applying knowledge). Ultimately, knowledge must be applied in some meaningful situation. In the classroom, these situations typically manifest as projects. Marzano (2007) provides evidence that to maximize the instructional effect of these projects, students must generate and test hypotheses. Strategies for these types of lessons that focus on applying knowledge draw on the research from problem-based learning (Gijbels, Dochy, Van den Bossche, & Segers, 2005) and hypothesis generation and testing (Hattie et al., 1996; Ross, 1988).

Specific strategies associated with lessons devoted to applying knowledge include the following (Marzano, 2008):

- The teacher engages students in a brief review of the content.
- The teacher asks students to work individually or in groups on their hypothesis generation and testing tasks.
- The teacher assumes the role of resource provider and facilitator.

To illustrate the interaction of these strategies, consider a physical education teacher who has previously introduced and had students practice a variety of stretching techniques, each with its own unique purpose. To apply this procedural knowledge in tasks, students might carry out three very different types of physical activities—one involving lifting weights, another involving running slowly for an extended distance, and the third involving sprinting short distances. Students would be asked to construct warm-up and cool-down stretching protocols for each of the three types of activities using the techniques they had previously learned. Prior to executing their protocols, students would generate hypotheses regarding the specific effects of their protocols and then examine their findings in light of these hypotheses.

Segments Involving Issues That Must Be Addressed as They Occur

A number of teacher behaviors must be used as specific situations occur. They involve instructional elements that might not be a part of every lesson. However, when they are called for, a teacher must attend to them immediately or the learning environment will quickly erode. As depicted in figure 1 on page 219, there are four segments that fit into this category: (1) increasing student engagement, (2) recognizing and acknowledging adherence and lack of adherence to classroom rules and procedures, (3) establishing and maintaining effective relationships with students, and (4) communicating high expectations for every student.

Increasing student engagement. Segments devoted to increasing student engagement might be called for at any point in time during a lesson. If students are not engaged in the classroom activities, then they have little if any chance of taking advantage of the instruction that is occurring. Consequently, effective teachers continuously scan their classrooms to determine if students are engaged and then act deliberately to reengage students if they are not. This type of lesson segment draws from the research on the nature of engagement and ways that engagement can be elicited (Connell, Spencer, & Aber, 1994; Connell & Wellborn, 1991; Reeve, 2006).

Specific behaviors associated with segments devoted to increasing student engagement include the following (Marzano, 2008):

- When appropriate, the teacher involves students in academic games that include inconsequential competition.
- When appropriate, the teacher manages response rates through use of wait time, response cards, choral response, or response chaining.
- When appropriate, the teacher engages students in activities that require physical movement.
- The teacher maintains a lively and appropriate pace throughout the lesson.
- When appropriate, the teacher demonstrates intensity and enthusiasm for the content.
- When appropriate, the teacher engages students in friendly controversy.
- When appropriate, the teacher provides opportunities for students to talk about themselves.
- When appropriate, the teacher provides students with unusual information regarding the content.

To illustrate how these behaviors might be used, consider a technology teacher who notices that her students are simply not paying attention to her presentation on ways to determine the accuracy of information on websites. Noting this lack of engagement, the teacher selects from a list of prepared activities designed to reenergize and reengage students. For example, the teacher might ask questions that require students to answer using response cards, thus ensuring that all students are engaged in responding to each question. Alternatively, the teacher might engage students in a brief physical activity that helps increase their short-term energy, thus increasing engagement.

Recognizing and acknowledging adherence and lack of adherence to classroom rules and procedures. Segments devoted to acknowledging students' adherence to rules and procedures and acknowledging lack of adherence to rules and procedures may be required throughout the course of a lesson or a day. This type of segment draws from the general research on classroom management (Wang, Haertel, & Walberg, 1993) and discipline (Marzano, Marzano, & Pickering, 2003).

Specific behaviors associated with this segment include the following (Marzano, 2008):

- When appropriate, the teacher provides positive consequences for student adherence to rules and procedures (such as simple verbal and nonverbal acknowledgments, tangible recognition, and involving the home).
- When appropriate, the teacher provides negative consequences for lack of adherence to classroom rules and procedures (such as being proactive about possible classroom disruptions, occupying the entire room, noticing potential problems, using a series of graduated actions when rules and procedures have been broken, using direct consequences, using overcorrection, and using home contingency or group contingency).

To illustrate the use of these behaviors, consider a primary teacher who notices that students are not following the procedure for putting away materials after a science lesson. The teacher points this out to students and takes some time to briefly review the procedure. On another occasion, the teacher notices that students have done a particularly good job at following the rule for raising their hands to ask a question. Again, the teacher points this out to students noting how smoothly the class went and thanking students for their efforts.

Establishing and maintaining effective relationships with students. Perhaps a necessary but not sufficient condition for effective instruction is effective teacher/student relationships. If sound

relationships exist between teacher and students, classroom activities progress more smoothly than if sound relationships are not in place. Lesson segments that address teacher/student relationships draw on the research regarding the need for a balance between student perceptions that the teacher is in control of the classroom and student perceptions that the teacher is their advocate (Brekelmans, Wubbels, & Creton, 1990; Wubbels, Brekelmans, den Brok, & van Tartwijk, 2006).

Specific behaviors associated with segments devoted to enhancing teacher/student relationships include the following (Marzano, 2008):

- When appropriate, the teacher demonstrates knowledge of students' interests and backgrounds.
- When appropriate, the teacher engages in verbal behaviors that indicate affection for students (for example, compliments, humor, and informal conversations).
- When appropriate, the teacher engages in physical behaviors that indicate affection for students (for example, smiles, appropriate physical proximity, and contact).
- When appropriate, the teacher brings students' interest into the content.
- When appropriate, the teacher demonstrates a demeanor of emotional objectivity and a cool exterior.

To illustrate the use of these behaviors, consider a middle school teacher who notices that while he has behavioral issues well under control, there is little levity in his classroom. Additionally, students seem reluctant to approach him regarding problems they are having with the content. In response, the teacher decides that he must enhance the perception that he is there to help students, not just to keep them under control. He, therefore, decides to lighten up the classroom atmosphere using humor and good-natured banter with students.

Communicating high expectations for every student. The final type of lesson segment involves communicating high expectations for all students. Directly or indirectly, students pick up messages that they are expected to do well or poorly academically and then behave in accordance with these expectations (Rosenthal & Jacobson, 1968). Behaviors for this type of lesson segment draw from the research on establishing an appropriate affective tone with all students and providing equal opportunities for complex academic interactions (Weinstein, 2002).

Specific behaviors associated with segments devoted to communicating high expectations include the following (Marzano, 2008):

- The teacher provides low-expectancy students with verbal and nonverbal indications that they are valued and respected (for example, makes eye contact, smiles, makes appropriate physical contact, maintains appropriate proximity, and engages in playful dialogue).
- The teacher asks questions of low-expectancy students.
- When low-expectancy students do not answer a question correctly or completely, the teacher stays with them.

To illustrate how these behaviors might manifest, consider a high school AP calculus teacher who realizes that she asks questions almost exclusively of students who readily participate in class and seem to be doing quite well with the content. In contrast, she leaves other students alone not wishing to embarrass them or force them to respond to questions with which they are not comfortable. Realizing that her behavior is communicating high expectations for some students and low expectations for others, she institutes a policy of asking difficult questions of every student in class. At first, this is challenging for some students since it represents a dramatic shift in her previous behavior. However,

over time, students accept the fact that all students are expected to address complex content, and their thinking will be respected even if it has some flaws in it.

Using the Knowledge Base to Identify Areas of Greatest Pedagogical Need

The nine segments organized into three categories depicted in figure 1 (page 219) provide an organizational scheme that allows teachers seeking improvement in their pedagogical expertise to pinpoint their areas of strength and their areas of weakness. For example, upon introspection and feedback from instructional coaches and superiors, a teacher might determine that her area of greatest need pedagogically is routines. Another teacher might identify critical input lessons as an area on which to work. Still a third teacher might identify student engagement as a focus of personal improvement.

Complete the questions below. Provide support or rationale for your answers with insight from prior teaching or from experiences in your current classroom.

1. Compare your current lesson development process to the lesson segment framework process. What are the implications for your lesson development?

2. Which lesson segment would you consider as the least addressed in your planning and delivery? Why do you believe that to be true?

3. Which lesson segment could you plan for in your next lesson? Describe how you would plan and implement the process.