The Learning Diamond: A Systemic Perspective on Student Learning

Research Report

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Abstract

The Center for NextGen Learning & Assessment understands assessment as part of the larger system of education. We at the Center believe that successful design, development, and use of assessment requires understanding assessment as part of a larger system that, when working well, improves student learning. We label this system the Learning Diamond.

In this paper, we briefly describe the Learning Diamond. We describe the components of the Learning Diamond and how these components work with Principled Design for Efficacy (PDE), an assessment design and development approach. We cannot possibly provide a full discussion of all possible influences on student learning; therefore, in the Learning Diamond, we have decided to focus on the following six major components that have critical roles to play: curriculum, instruction, professional learning, assessment, theory of learning, and the ecosystem in which teachers teach and students learn. Paying special attention to the role of assessment, we focus on how assessment is influenced by—and how assessment, in turn, influences—the other components.

Keywords: Learning Diamond, assessment, theory of learning

What is a System?

A number of definitions have been offered from people working in the field of systems thinking. For an introduction to systems thinking, see Bertalanffy (1968) or Weinberg (1975). For example, a system has been defined by Kauffman (1980) as "a collection of parts which interact with each other to function as a whole" (p. 4). Our definition of a system builds on these definitions but emphasizes the goal of improving student learning. We define a system as a set of components which interact with each other to function as a whole with the intention of improving student learning. This definition implies a system perspective, or the adoption of systems thinking.

Systems Thinking

Systems thinking means being able to see the underlying web of *ongoing, reciprocal relationships* which are cycling to produce the patterns of behavior that a system is exhibiting. Systems thinking means being able to see the forest (of relationships) from the trees.

A number of obstacles get in the way of systems thinking. First, people may find it difficult to break from their personal frame of reference. This frame of reference includes assumptions about causes and effects and about what is more and less important. People find it difficult to step back from their own stand of trees and see the larger forest. They may not even be fully aware of their frame of reference and how it influences how they see and think about things.

Second, people tend to focus on objects and activities. People focus on tests, on materials, and on training sessions. But the core of systems thinking is the web of relationships among objects and activities. Systems thinking makes these relationships explicit among objects and activities.

Third, people tend to define boundaries around areas of expertise and authority. But systems thinking cuts across disciplinary and organizational boundaries. Systems thinking asks how the web of interdependent relationships across boundaries is creating the patterns of system behavior. Systems thinking can create "turf issues" by challenging the boundaries defining expertise and authority.

System Coherence

The complexity of a system presents a challenge to improving student learning. Successful implementation requires that all of the components cohere or work together in a harmonious way. This kind of system-wide coherence is difficult to achieve but is essential to the success of teachers and students.

According to the National Research Council (2012), the literature on education policy often uses the term "coherence" interchangeably with "alignment." However, the authors treat coherence as the broader concept and alignment as only one of its dimensions. They point out that a system for student learning can be coherent in the following ways:

- Horizontally coherent, in the sense that the curriculum-, instruction-, and assessment-related policies and practices are all aligned with the standards, target the same goals for learning, and work together to support students' development of the knowledge, skills, and abilities (KSAs).
- Vertically coherent, in the sense that there is a shared understanding at all levels of the system (classroom, school, school district, state, and national) of the learning goals (and for the curriculum) that underlie the standards.

- Developmentally coherent, in the sense that there is a shared understanding across time of what ideas are important to teach and of how children's understanding of these ideas should develop across time, e.g., the school year.

Our current research with the Learning Diamond focuses on horizontal coherence with assessment as a leverage point. We ask, "How can we design and develop assessments in a way that improves coherence among professional learning, curriculum, instruction, and assessment?" We believe horizontal coherence is improved through the use of a shared understanding of student thinking and learning. By improving horizontal coherence, we enable improved student learning.

What Are the System Components?

The key components of the Learning Diamond, shown in Figure 1, are theory of learning (T), curriculum (C), instruction (I), professional learning (P), assessment (A), and the teaching-learning ecosystem (S). No component should be considered by itself. The six components interact with each other to function as a whole.

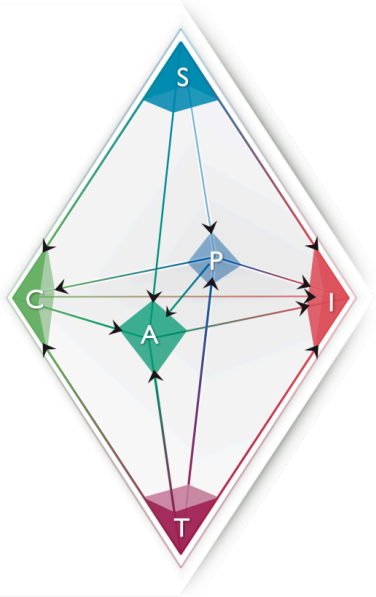

Figure 1. The Learning Diamond.

Theory of Learning

The theory of learning corresponds to the understanding of student thinking and learning at the grain size that is the focus of instruction and the curriculum. A number of approaches to student thinking and learning are candidates for the theory of learning. We cannot review all available approaches, so we focus on three widely known approaches: learning progressions, misconceptions, and associations.

Learning Progressions

A learning progression is one possible approach. A set of mental models are ordered from less sophisticated mental models to more sophisticated mental models. Student learning is represented as developing along this sequence of increasingly sophisticated models until students attain the target conception.

Misconceptions

A set of misconceptions offers a second approach. Misconceptions may be flawed mental models or procedures. The misconceptions in a set are treated as equal in sophistication or accuracy. Student learning is represented as starting from their current misunderstanding and directly acquiring the target conception without any intervening stages.

Associations

A third approach may be described as an associationist approach. Though not current as a model of learning, an associationist approach is included in this discussion because it is consistent with popular psychometric models, such as item response theory (Nichols, 1994). Under this approach, students learn by "adding up" or assembling elemental, prerequisite component knowledge and skills.

The theory of learning influences the other components in the Learning Diamond through its description of how students' think and how thinking changes as students learn. Ideally, professional learning, curriculum, instruction, and assessment would reflect a shared theory of learning. A shared approach to student learning creates coherence so that all the components are working together to support students' development of the KSAs.

Professional Learning

Another component of the Learning Diamond is *professional learning*. Professional learning includes two subcomponents: teacher preparation at schools of education and professional development for practicing teachers. During initial teacher preparation, teachers should gain a strong understanding of the subject they are expected to teach. Furthermore, teachers should learn the initial ideas students bring to school, how students learn in the subject, how to gauge what students have learned, and the range of instructional strategies that can support further student learning.

But teachers' professional learning does not stop once teachers enter the classroom. Teacher preparation alone cannot fully prepare teachers to be successful. Research has shown that continuing professional development with teachers is one of the keys to improving student learning (Borko & Putnam, 1995; Desimone, 2009). During professional development, teachers can learn new insights into how students think and learn and acquire additional approaches to gauge what students know and support further student learning.

Professional learning can act as a catalyst along with the other components of the Learning Diamond to change classroom practice. Research shows that professional learning paired with the other components has a greater impact on classroom practice than changes in the one component alone. For example, Cohen & Hill (2000) found that receiving professional

development in conjunction with a new curriculum enhanced innovation in teachers' instructional practice over just introducing new curriculum materials.

Coherence of teacher preparation and professional development with the theory of learning is critical to improving student learning. Initial teacher preparation and later professional development is where teachers learn the instruction and assessment practices used in the classroom. Introduction of coherence at these points is critical to all the components working together to improve student learning.

Curriculum

In the Learning Diamond, *curriculum* consists of the knowledge and skills in subject areas that teachers are expected to teach and students are expected to learn. The curriculum generally encompasses a scope or breadth of content in a given subject area and a sequence for learning. The curriculum is often communicated through the organization of a textbook or other instructional materials.

Different approaches to curriculum cohere with different approaches to the theory of learning. A common approach for current curricula is a flatly organized "catalogue of desirable outcomes" (Black, Wilson, & Yao, 2011). A subject or content area is presented as a set of discrete knowledge and skills. An understanding of these component knowledge and skills is wholly correct or entirely wrong with no intermediate stages of learning. This kind of an approach coheres closely with an associationist theory of learning.

A second approach that has recently become more popular presents the knowledge and skills in a subject area as an ordered sequence from less to more sophisticated understanding. These knowledge and skills are described as interdependent and overlapping and are used together in context. This kind of an approach coheres closely with a learning progression.

Curriculum influences instruction and assessment in the Learning Diamond. Curriculum commonly impacts instruction through the materials used in the classroom. The textbook is an example of curriculum material that has great influence on teachers' practice (Obara & Sloan, 2009). Teachers often use textbooks for guidance when making instructional decisions because textbooks provide lists of topics to be covered, assignments to be completed, and class activities to be explored (Borko, Davinroy, Bliem, & Cumbo, 2000), and teachers frequently use textbooks to plan their lessons (Remillard, 2005).

Curriculum commonly influences both what is assessed and when it is assessed. The curriculum describes the knowledge and skills covered by assessment at a specific time. The curriculum also influences the timing of the assessment of the knowledge and skills.

Instruction

Instruction refers to methods of teaching and the learning activities used to help students learn the content and objectives specified by a curriculum. Instruction encompasses the activities of both teachers and students. It can be carried out by a variety of methods, sequences of activities, and topic orders.

Instruction is where the teacher interacts with the student. The interactions between teachers and students are important in determining whether students learn successfully. Instruction is influenced by every other component in the Learning Diamond. Consequently, poor coherence between instruction and other components of the Learning Diamond directly impacts student learning.

Assessment

Assessment is the means used to measure the outcomes of education and the achievement of students with regard to important competencies. Assessment may include both formal

methods, such as large-scale state summative assessments and interim assessments, and less formal classroom-based formative procedures and practices, such as quizzes, class projects, and teacher questioning.

The assessment component is where the Learning Diamond meets PDE. PDE is an assessment design and development approach created with four goals in mind: (a) support thoughtful design decisions; (b) facilitate the development of more innovative assessment types, such as games and simulations; (c) collect strong efficacy and validity evidence for PDE and the intended interpretation and use of assessment results; and (d) make item and task development more efficient and effective. We don't have room for a full description of PDE here but you can learn more about PDE in *What is PDE?*.

Through the assessment component, PDE connects to the other components of the Learning Diamond such as the theory of learning. The first activity in PDE is to get a deep understanding of what we are trying to assess and, in the Learning Diamond, what we want students to learn. Our understanding of what we are trying to assess—the KSAs—drives most of the design and development decisions we make as we are creating an assessment.

Several other ideas from PDE are especially important for the Learning Diamond. One important idea from PDE is the concept of evidence, or *How do you know what you are assessing when you see it?* For the Learning Diamond, the assessments must be designed and developed in a way that provides evidence of the KSAs that is coherent or in harmony with the other components. Several examples may drive the point home:

- If the theory of learning is a learning progression, the assessment should provide evidence of students' stage in a sequence of increasingly sophisticated mental models;

- If the theory of learning concerns misconceptions, the assessment should provide evidence that students have adopted a particular misconception or the target conception;
- If the theory of learning is an associationist approach, the assessment should provide evidence of the component knowledge and skills the student has mastered and those that remain missing.

Incoherence is created and student learning is impaired when the evidence from assessment is based on one theory of learning but the curriculum, assessment, and professional learning is based on another theory of learning. A common example is when the assessment is based on an associationist approach and evidence is provided in terms of number correct or some similar score for standards and substandards. In contrast, the curriculum is organized around a progression of increasingly sophisticated mental models and teachers have learned instructional methods that encourage students to build on current understanding and develop a more sophisticated mental model.

A second important idea from PDEs the concept of communication or *How do you talk to people about what you are assessing?* An example is when assessment results are intended to be used formatively to make instructional decisions and improve student learning. As Nichols, Meyers, and Burling (2009) point out, there is no such thing as a formative assessment, only a formative system of assessment, curriculum, instruction, and professional learning. For the Learning Diamond, assessment results must be communicated to teachers in a way that teachers can use the results to make good instructional decisions. Incoherence is created when assessment results are presented in ways that teachers don't readily understand or can connect with available instructional approaches and progress through the curriculum.

Teaching-Learning Ecosystem

Teachers do not teach in isolation from the students in their classroom or independent of the school, school system, community, and broader state and national educational policy environment in which their classroom resides. Some views consider that teacher-student interactions matter more than the other elements in a classroom's larger ecosystem, for example, *Waiting for 'Superman'* (Guggenheim, 2010). Others have recognized that the larger system in which classroom teaching and learning resides is crucial to the effectiveness of the local classroom system. For example, Cuban (1984) reviewed research on effective schools and illustrated that local school system superintendents and district policies create pre-conditions that enable or hinder school improvement efforts led by principals, teacher teams, and individual teachers. Marzano (2003) reviewed research and highlighted school, teacher, and student factors that influence student achievement. More broadly, Bronfenbrenner (1994) stipulates microsystems (e.g., classrooms), mesosystems (e.g., classrooms and school environments in interaction), exosystems (e.g., external district policies and supports), macrosystems (e.g., schools' surrounding communities, state and national education and social policies), and chronosystems (i.e., the evolution of the four other systems over time) in his Ecological Systems Theory. In short, teacher effectiveness in the classroom is influenced by the classroom's larger ecosystem, and student learning is influenced by the classroom ecosystem.

Where Can I Learn More?

This has been a brief introduction to the Learning Diamond. For more information, we encourage you to contact the staff of the Center for NextGen Learning & Assessment or email Paul Nichols at paul.nichols@pearson.com.

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