

## **I See What You Mean: Using Visual Maps to Assess Student Thinking**

*"Almost all important questions are important precisely because they are not susceptible to quantitative answers"*

*Arthur Schlesinger, Jr.*

### **The Need for Change: Crisis as Opportunity**

During the last decade, voices echoing across the United States have declared a national crisis in education. This crisis, it is said, is evidenced by our nation's inability to maintain a competitive edge in a global economy, and by a workforce ill-prepared for the demands of employment. Today's youth face looming personal and social problems: the environment, unemployment, homelessness, health care and drug abuse. Their sense of powerlessness and difficulty in assuming social responsibility is compounded by their lack of preparation for thinking critically; they cannot understand many complex issues and they lack the ability to solve them by generating alternatives from multiple perspectives (People for the American Way, 1989; Berman, 1991). Too many students exit our public schools without the abilities to make critical decisions, to work as members of collaborative teams, and to solve the complex and difficult problems that are a part of life as a responsible adult.

It is interesting that the Chinese use the same ideograph to represent both danger and opportunity. Their idea that these concepts are perpetually connected suggests that while every crisis involves risk, each can also be viewed as an opportunity. Analogously, the problems in our nation's schools and the ensuing crisis in education is an opportunity for policymakers to review, reconsider and renew the fundamental ways in which schools operate. This type of critical self-examination has raised questions about the values of outcomes for students, indicating the need for change in curriculum, instruction and assessment. In particular, attention is being focused on assessment, requiring that it be able to get closer to student learning by employing multiple measures, including samples of student work which are collected in context and based on authentic tasks. These assessment measures direct teaching and learning toward the outcome of developing self-reliant, self-confident, reflective individuals; adults who can make decisions in a social context.

## Thinking Maps: A Shared Visual Language

As this view of measurement evolves, educators seek tools to complement and expand the information learned about students from standardized tests. While standardized tests provide a quantitative 'snapshot' of student achievement, assessment tools such as portfolios, performance tasks, and student exhibits offer a more qualitative 'videotape'.

One method of gaining entry into the ways that students are processing information is by using graphic organizers (or frames). Researchers describe graphic organizers as:

"...words on paper, arranged to represent an individual's understanding of the relationship between the words. Whereas conventions of sentence structure make most writing linear in form, graphic organizers take their form from the presumed structure of relationships among ideas" (Clarke, 1990, p.30).

Recently, there has been increased instructional use of graphic organizers in the areas of concept development (Novak & Gowin, 1984), reading comprehension (Jones, et. al, 1987; Sinatra, 1990), and developing students' thinking (Clarke, 1990; McTighe, 1989). Graphically organizing information "provides a visual crossroads of the content being expressed *within* the thinking processes which pattern this content" (Hyerle, 1990, p.21). Thus, graphic organizers offer a method for documenting student's developing thinking abilities. Previously, brainstorming techniques such as semantic maps and clustering have popularized the use of idiosyncratic graphic organizers, especially for prewriting purposes. Often, however, little consideration was given to what happened *after* the storm.

Thinking Maps (Hyerle, 1991) are a set of eight distinct graphic organizers. Presently, the Maps are being used as learning tools at urban and rural schools in such diverse areas as New York, NY; Winston-Salem and Ahsokie, NC; Jackson, MS; Chicago, IL; and Gainesville, FL (Expand Your Thinking Program, 1989). What distinguishes Thinking Maps from other, more generalized graphic organizers is that each Map support a specific thinking process such as qualifying, sequencing, comparing and contrasting, and classifying (see Figure 1). Thinking Maps move students beyond the brainstorm toward focused organization of information. Each Map provides a consistent, visual language for engaging with information using a specific method of processing. Thinking Maps are student centered and teacher mediated. Thus, everyone in the learning environment speaks a common visual language to allow for efficient communication and reflection about content and about process.

Using these eight Thinking Maps encourages students to ask fundamental questions about the ways in which they make sense of the world. Specifically, Thinking Maps visually connect and create patterns of content information which are instantly accessible and understandable.

The **Circle Map** supports representing and seeing things in context. This tool enables students to *generate and identify*

relevant contextual information about the topic written in the center of the circle.

The **Bubble Map** is designed for *describing* something. Unlike an open-ended cluster map, the Bubble Map is used to generate only characteristics, qualities and attributes.

The **Double Bubble** is an extension of the Bubble Map; it analyzes two things by *comparison and contrast*.

The **Tree Map** enables students to do both *inductive and deductive classification*. To use it, students learn to consider general ideas, or categories, as well as specific details, or items within the categories. These frames compel students to question how a given category was derived, and to appreciate the subjectiveness of categorization, including what are often the fuzzy boundaries between categories.

Physical structures are more easily understood with the **Brace Map**. By representing *part-whole relationships*, this Map supports students' spatial reasoning and allows them to develop a better understanding of the complexity of physical boundaries.

The **Flow Map** enables visual *sequencing*: it helps students to order events, cycles, actions, directions, and so on.

The **Multi-flow Map** provides a tool for linking causes and effects to events, promoting the understanding that there may be multiple causes and effects, including feedback effects in a dynamic system.

The **Bridge Map** provides a concrete pathway for understanding the relating factors within analogies and for investigating conceptual metaphors. This Map develops and transfers concepts from one universe of thought to another; within the classroom, this is often from one content area to another.

### **Seeing Multiple Perspectives with the Frame Map**

Thinking Maps present information as connected and contextual. They are generated from the belief that "knowledge is not given; knowledge is made" (Hyerle, 1991, p. 17); and, as such, knowledge is always open to interpretation. Because Thinking Maps organize information always in relation to other information, they focus students' thinking on their own organizing patterns. For instance, the frame around the Circle Map in Figure 1 focuses students' attention on the subjective nature of understanding. The frame can represent only one particular personal or cultural perspective; therefore, by comparison, it helps students to identify factors influencing how they themselves understand the topic in the center of the circle. The Circle Map necessitates that students begin to see information from different perspectives (see, for example, Figure 2).

## Thinking Maps As Assessment Tools

*"Beginners' knowledge is spotty and superficial, but as learning progresses, understanding becomes integrated and structured. Thus, assessment should tap the connectedness of concepts and the student's ability to access "interrelated chunks" (Shepard, 1989).*

Thinking Maps access how and what a student is thinking. They make what is implicit explicit by providing a graphic artifact of a student's cognition; these can be used to monitor and mediate the student's developing complexity of conceptual understanding and his or her level of sophistication with specific thinking processes. Further, Thinking Maps document one's ability to organize patterns of information, choose from a range of patterns, and illustrate relationships based on these understandings. They enable both teachers and students to reflect upon and discuss ways of processing information. When multiple patterns of thinking within distinct frames of reference are expressed visually, all present are able to say "I see what you mean".

Assessment is necessarily multidimensional; it must incorporate the daily interaction among teachers and students in classrooms with the formal component of the teacher's professional knowledge in order to document each student's progress. "In such a view, tests may contribute to the program, but they should not define it" (Chittenden, 1991, p. 24). As instructional decision makers, teachers need information which affords them flexibility to shift instructional focus as need demands. Thinking Maps allow teachers to gather information about their students formally and informally, through the observation of products and process. Thinking Maps can help inform decisions about instruction, whether for the whole class, for groups of students, or for individuals. They can support instructional planning for the next day, the next week, or the next month. They provide powerful, graphic information for students and parents, charting individual progress(see Figure 3; teacher reflection page). In addition, Thinking Maps support assessment of curricular objectives, and provide data when restructuring is necessary.

Classroom discussion, students' questions, and student enthusiasm provide a "wide-angle lens" through which to view student thinking. Thinking Maps add a "telephoto lens" through which to zoom in on an individual's development in thinking. Both views are critical to ensure that effective thinking is occurring (Baron, 1986). Thinking Maps are open-ended, allowing for a variety of responses. They draw upon students' experience, connecting what is known to what is not yet known. Much like tools in a toolbox, Thinking Maps can be used independently or in combination; their usefulness depends upon one's purpose. The Maps can be used to process thinking in any content area, as well as to link interdisciplinary themes. They can be used for a range of tasks, from simple to complex; thus they are ideal for the classroom context, enabling one to incorporate simple tasks to achieve desired instructional outcomes. Each Thinking Map clearly correlates to classroom questions which promote content learning and reflective thinking (see Figure 1).

## **Thinking Maps: Specific Applications for Assessment**

The Thinking Maps students create foster discussion and reflection about their growing content understanding, affording both a formative and summative view of students' thinking. Thinking Maps offer multiple ways to assess student thinking. Four particularly powerful applications include maps as:

- 1) pre-/post-instruction measures of students' thinking about a given topic or concept;
- 2) artifacts for inclusion in a student's portfolio;
- 3) a basis for student interviews or conferences and
- 4) a reflective tool for student self-assessment.

### **1) Pre-/Post- Measures**

By examining Maps made by students before and after instruction, teachers can document growth in students' abilities to clarify, expand upon and remember specific content and concepts (see Figure 4; pre/post thinking pages). The Maps enable one to discern whether students are: increasing their use and variety of details; discarding irrelevant and unsupported information; expanding the number and complexity of links between disparate pieces of content information; making cross discipline connections; integrating previously known with new information; making novel applications; generating creative ideas; and considering multiple perspectives (Novak & Gowan, 1984).

### **2) Portfolios**

By including Maps in students' portfolios, teachers capture the development of students' thinking abilities during the course of the school year (see Figure 5; sample student work). Teachers can look for the sustained use of various thinking strategies as well as improvements in the students' control over their learning. Teachers can assess students' abilities to use Thinking Maps and thinking processes as the subject matter increases in difficulty, determining whether students are able to transfer their learning to new situations.

### **3) Student Conferences**

Metacognition is the ability to formulate a plan of action, monitor progress as the plan unfolds, identify any gaps in thinking or understanding, detect and recover from error, thoughtfully evaluate actions taken, and learn from one's experience through reflection (Costa, 1991). One important method of gauging students' metacognitive abilities is to ask them to think out loud. One-to-one interviews, or conferencing, helps to determine the level of self-confidence, consciousness and flexibility that students bring to their own learning. Thinking Maps provide a vehicle for discussion and a tangible portrait of how students are relating and connecting information. When a student brings one or several Thinking Maps to the conference, he or she bring a visual representation of thinking. Maps provide the opportunity to both discuss the quality of this thinking as it applies to meaning making and to set new goals for learning.

#### **4) Student Self-Assessment**

Student self-assessment promotes personal responsibility for learning, encourages questioning and reflection, and develops respect for the process of learning. By examining their own work against the clear set of criteria embedded in the Maps, students can evaluate the developing quality of their thinking. With teacher mediation, students will adopt a developmental perspective on learning. They can review the Thinking Maps in their portfolios and reflect on their strengths and areas for growth, and then use the Maps as the foundation from which to develop new learning goals. "With time, experience and conversation, students' ability to read their own portfolios with depth and understanding also develops" (Schwartz, 1990).

### **Instruction and Assessment to Promote Thinking**

Renewing our schools means that education must become more responsive to the needs, interests and complexity of the children in our classrooms. "Education is not just about making a living; it is also about making a life" (America 2000, p. 29). It requires that we develop curriculum and instruction which helps to instill a love of learning and the courage and skill needed to face difficult and complex problems. It demands that we design assessment which provides the means to measure progress based on developmental, process-oriented, relevant instruction.

Thus, we are faced with an opportunity, and a danger. Standardized tests have provided us with objective measurements. However, they test outcomes that are easy to measure; not necessarily outcomes which we should value for our students. Danger lies in responding to accountability demands by simply increasing what we are already doing. Opportunity exists, however, in embracing new methods of assessment to measure valued outcomes. Thinking maps support students' abilities to organize, synthesize and communicate patterns of information by using a common visual language. They enable students to explore multiple perspectives and to develop metacognitive strategies for planning, monitoring and reflecting. Thinking maps offer a powerful addition to the growing repertoire of assessment tools which foster a more formative, developmental qualitative view of student growth.

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