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ABSTRACT

The purpose of this paper is to examine the ways in which teachers and students can leverage the power and potential of visuals to encode information and experiences as personalized meanings, and to help people create their own timeless images as ways to understand the world. The foundation is laid for conducting research to test the assertion that visual constructions can be used to help learners construct highly personalized meanings to information. The cognitive potentials of visual constructions are summarized and examples are offered that might be useful to students and teachers. Four visual construction types are defined: page organization, visualization methods, concept diagrams, and notetaking teaching processes. Teacher and student strategies are suggested, for appropriate grade ranges (K-5, middle school, and high school), to implement these visual constructions. Three broad research goals to consider in order to establish some basis for the cognitive potentials of visual construction are: (1) How do personalized meanings via visual constructions create understanding? (2) What are the effects of possible cognitive-motivational variable links when visual constructions are used by teachers and students? and (3) Which teacher and students strategies using visual constructions contribute to the development of self-directed learning characteristics? Four tables and two figures illustrate study concepts. (Contains 23 references.) (MAS)

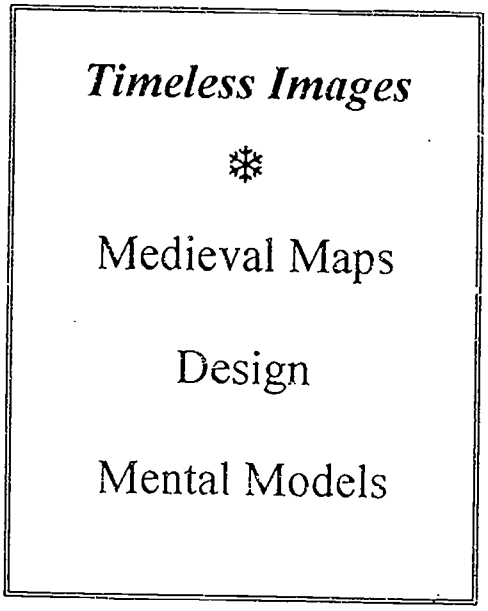
Timeless Images: Past and Present

R. Neal Shambaugh

Timeless Images:

Past & Present

Visuals capture the wonders of the world and document our full range of understandings of this world. Consider the following three examples. In the middle ages pictures were invaluable tools as memory maps of important information before book making became widespread. Ramon Lull's 1515 depiction of the whole range of human knowledge on a tree, provides an example of the practice, that can be traced back to the Greeks, of placing a word or an idea on an image (Yates, 1966). Leonardo da Vinci's notebooks (the *Madrid Codices*) contain some of the richest and most diverse examples of visuals that document not only the realities of his time, but also the representations and models of what he believed might be. However, the world required about 200 years to adequately appreciate and understand these meaning-rich representations (Reti, 1974). The thought experiments of Heisenberg and Einstein, a third visual example, used mental visualization examples to demonstrate new concepts, which transformed our views on Newtonian mechanics (Zukav, 1979).



The images of today are no less timeless, as this paper hopes to persuade. However, the images of students' personal memory maps, designs, and models go largely unused and unacknowledged in the classroom. The purpose of this paper is to examine ways that teachers and students can leverage the power and potential of visuals to encode information and experiences as "personalized meanings;" in essence, help people to create their own timeless images as ways to understand the world.

The full range of ways that we have developed over the years to represent the world can be referred to as world knowledge. But in school, through lectures and textbooks, learners encounter only a small slice of world knowledge. This school knowledge, consisting of linear "bits" of information and structured for efficient delivery, eliminates many of

the vital connections that human inquiry have built up into world knowledge over time (Eisenburg & Dreyfus, 1991). These links and interconnections contain much of the richness of our documented world -- interrelationships of facts, understandings from multiple contexts, useful ideas from other fields, and the heritage of the knowledge-building process. Without these connections, how are learners to construct frameworks of significant, useful, and meaningful information? Ultimately, students unknowingly face impoverished information and provide weak and temporary structures into which to organize this information.

Scope of Paper

Clark (1989) has recommended that researchers spend more time conceptualizing the research necessary to test their positions. This paper is the second of two that lay out the foundations for conducting research to test the assertion that visual constructions can be used to help learners construct highly personalized meanings to information. This paper will summarize from the initial paper the *cognitive potentials* of visual constructions and examples of visual constructions that might be useful to teachers and students. This paper will suggest at approximate grade levels *teacher and student strategies* to implement these visual constructions. Identifying teacher and student strategies with particular visual construction types suggests relevant learning settings in which to formulate research goals, which might be studied using an appropriate mix of quantitative and qualitative approaches.

Cognitive Potentials

Visual constructions represent any visual scheme to organize information. Such constructions can range from the common practice of highlighting information in an article or textbook to the use of concept maps to visually represent one's understanding of the relationships between information.

An earlier paper (Shambaugh, February 1994) surveyed visual note taking methods and outlined three categories of cognitive potentials. (See Table 1 for a summary). Visuals have the potential, first of all, to act as *personal organizers* of personalized meanings to information by providing alternate representations of knowledge and by structuring information and conceptual relationships of knowledge in highly unique and personal ways. The representation form is a unique, personalized knowledge structure which may be faulty at first but can evolve to become, over time, more compact and efficient with an overall higher degree of personal meaning than before. By their compact nature visuals are rich sources of information and possess features, such as symbolic attributes, that enrich the visual or make it more accurate. Visuals that are incorporated into a personalized notetaking system help to organize conceptual relationships based on their connecting and organizing features, and also help to provide closure to ideas and concepts, which would be difficult to achieve with verbal information alone (Barwise & Etchemendy, 1991). Visuals used for notetaking may also improve concept learning in both concept assimilation, and with evolved visual notetaking systems, may assist in concept

formation (Ausubel, 1966). Classrooms generally impart "ready-made" concepts to students, but visuals used in note taking may improve understanding of these ready-made concepts by allowing learners to construct unique representations of their understanding.

A second category of cognitive potentials treats visual constructions as *efficient processors* of information. Larkin and Simon (1987) cite the major value of visuals, is not that they create new representations, but that they consume less computational energy. Visuals, or diagrammatic representations as Larkin and Simon refer to them, preserve explicitly the relationships of the visual information. The information in diagrams is "indexed by location in a plane," while written information in the form of sentence representation, is "information indexed by position in a list." These sequential representations require greater amounts of cognitive processing power than for the processing of diagrams. Visuals also possess the capacity to reduce the problem solving time by limiting the choices a student has to make.

Visuals also improve overall cognitive processing by serving as primers of information, which is based on the fundamental connotations that some visuals have. For example, any symbol that represents a category can stimulate recall to members of the category (Miller & Burton, 1994). Priming is useful in the short-term to a student desiring recall of information for quizzes or tests. In the long run, visual primers lay the basis for efficient and powerful recall of concepts, knowledge, and insights over a life span.

Visual constructions also provide deeper processing through active learning, attention, and multiple modes of communication. If incorporated into instructional strategies and learning activities, visuals can enhance the processes of active learning by improving the engagement of learners to tasks. Another learning issue is attention. Although not sufficient for learning by itself, attention may be improved through the use of any method that promotes activation of encoded knowledge structures, which are enhanced by the symbolic attributes of visual constructions. Finally, since multiple channels are

Table 1: Cognitive Potentials of Visual Constructions

Personal Organizers	Efficient Processors	Personalized Understandings
• Alternate representation of knowledge • Structure information • Conceptual relationships	• Efficient use of computational energy • Active learning • Attention • Multiple communication modes	• Self-construction of knowledge representation • Improve teacher-student relationships • Satisfy cognitive needs

promoted through the use of visual constructions to supplement visual and verbal presentations of instruction, a deeper level of processing is activated by the learner.

A third category of cognitive potentials of visual constructions is that they provide *personalized sources of understanding*, particularly when they are used by learners to generate their own representations of knowledge. Self-constructed frameworks are more meaningful than external representations, although not necessarily more accurate in the early development of understanding. The use of visuals in the classroom may also result in improved understandings between learner and teacher by providing both with visual evaluation tools, such as when student-drawn concept maps illustrate difficulties with certain concepts. Visuals can also be used by teachers to gain insight into a learner's learning style, higher level thinking, and self-image. Visual constructions, as a tool or strategy, also help to satisfy a learner's cognitive needs or motivations to observe and know the environment. The use of visuals could ultimately become part of a personalized learning process, a metalearning strategy that helps learners to monitor their own learning and to reflect and make changes in how they learn.

Visual Construction Types

Table 2 summarizes the essential features, benefits, and drawbacks to visual constructions used in notetaking strategies. These techniques or systems have been matched to appropriate grade levels in Table 3.

These constructions were grouped into four categories or families. *Page organization* types of visual notetaking organize a page visually and provide a structural framework to help students organize their notes. The second category identified are *visualization* methods, ranging from mental images to word pictures, and interactive study guides. *Concept diagrams* form a third family, consisting of concept circles, concept maps, and knowledge vee diagrams. Concept diagrams share a common feature in that they represent conceptual structures and relationships between concepts. Knowledge vee diagrams are visual tools that also help students to discover what knowledge is and how it is constructed. Finally, a fourth grouping of visuals include *notetaking teaching processes*, the most simple being graphic organizers.

Teacher & Student Strategies

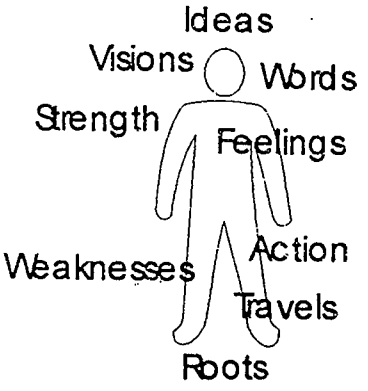
Certain types of visual constructions may be more useful to teachers and students in different settings and at different grade levels: K-5, middle school, and high school. These methods can be categorized as Teacher Strategies and Student Strategies. Table 3 lists teacher strategies that feature examples of visual construction strategies or notetaking systems. This rationale also allows the reader to investigate the details of the method and to adapt it to one's own needs or learner goals. Student strategies include suggestions that are linked to specific teacher strategies as they are contingent to a large degree on what the teacher does, but can lead to self-directed decisions outside of formal schooling. Next, are three examples of documented teacher strategies to demonstrate the application of some of the cognitive potentials described earlier.

K-5: Draw & Tell Stories

Richard Thompson's draw-and-tell stories involve the teacher drawing a picture as he or she is telling a story. Children participate by predicting and anticipating the action. Once teachers get used to the process they can come up with stories of their own. The process can be varied in several ways, but encouraging students to retell the story in partners, small groups, in class, to other classes, helps students to create their own story based on their knowledge of the structure and pattern of the story as well as from their memory of the story's details. Children acknowledge understanding of themselves as well as the ideas of others and the process stimulates visualization, active participation, and provides a "vehicle for explaining other language experiences" (Thompson, 1988, p.8). Thompson says that one objective in these stories is that stories are fun and magical and that children have ideas that are valued.

Middle School: Word Pictures as Thought Structures

Visuals can be used to represent four major types of thought structures: descriptive, narrative, expository, and persuasive (Stein, 1987). For example, a stick person can describe the attributes of people by labeling people qualities to body sections. This emphasizes the total person rather than just what a person did and enlarges person's life.



Word Picture

Table 3: Teacher and Student Strategies

K-5

Teacher Strategies	Student Strategies
Provide visual examples to demonstrate objects, people, places, ideas.	Search and share visual examples
Use mind pictures (Fredericks, 1986) in reading activities	Practice visualization exercises at home
Picture stories (Thompson, 1988)	Listening, speaking, reading, group participation, re-telling of story; I-Draw-You-Tell; make up story.
Outlining (later grades) instruction and appropriate topics and learning activities.	Later grades: Practice in recording key points for assigned papers.

Table 3: Teacher and Student Strategies (continued)

Middle School

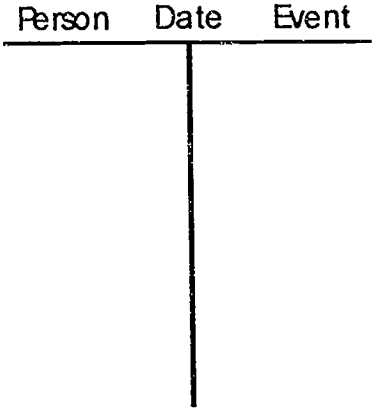
Teacher Strategies	Student Strategies
Encourage and model outlining as a study strategy; couple with other visual strategies when feasible	Use to make decisions on important ideas; construct personal outlining methods
Present page organization (Pauk, 1962); T-Line and Note-Page (Stein, 1987) and provide guided instruction with relevant examples; encourage the use of Reflection and Analysis or Synthesis sections within note taking page.	Experiment with page organization methods and personalize to fit one's needs; practice using Reflection and Analysis or Synthesis sections.
Word pictures as thought structures (Stein, 1987) to develop critical analysis of concepts and ideas	Keep portfolio of word pictures, either borrowed or self-constructed, and use with other coursework.
Introduce and experiment with the use of concept circles (Wandersee, 1987); use color when possible. Use groups and shared group activity to develop practice with techniques of concept mapping.	Personalize and experiment; share in groups.
Directed Note-taking Activity (Spires & Stone, 1989). Requires significant time to introduce and practice; include meaningful examples.	Personally consider value of system and modify for one's use, if necessary; teach to other students.
Incorporate graphic organizers (Sakta, 1992) before, during, and after lectures, activities, or presentations	Use in self-study, presentations.
Content visuals (wide range unique to subject content), such as weather maps, biogeochemical cycles, Feynman diagrams, physics diagrams, Periodic Table, atomic models, schematics, blueprints, etc.	Collect content visual types and become familiar with how they work and what they can tell you if used correctly.

Table 3: Teacher and Student Strategies (continued)

High School

Teacher Strategies	Student Strategies
Encourage and review page organization (Pauk, 1962) methods; provide opportunities for use	Keep journals, working logs and use personalized methods.
Interactive study guides (Cyrs & Smith, 1991) to ensure coverage of discipline but also to provide resources to develop problem solving skills and satisfy cognitive needs. Provide relevant assessment which matches the approach of the guides.	Reflect in journals, logs, feedback to instructor, on how you are performing on class requirements and suggest re-direction.
Text Structures (Smith & Tompkins, 1988) to highlight the various ways to organize verbal and written information	Reflect on methods you use to establish meaning to what you hear in class and read from books, papers, and other sources.
Introduce concept maps (Novak & Gowin, 1984) into content-specific courses and spend adequate time with its introduction and practice; use to identify conceptual misunderstandings.	Practice
Use Knowledge Vee diagrams (Novak & Gowin, 1984) when additional concept mapping is required or desired.	Practice
Continue to use graphic organizers (Sakta, 1992) but continue to move students away from detail	Allow organizers to cue your note taking and understanding.
NOTES system (Stahl et al, 1991)	Practice
Guided imagery (Unumb, 1994) for problem solving and creative situations when writer's block is present; requires careful scripting.	Willingness to engage in this activity is necessary. Consider using out of class for similar problem solving and creative situations.

When narrative thought, or chronological verbal set of information is emphasized, a visual such as a T-line can be useful to visualize and connect a person (left side of T-bar) to an event (right side)with a corresponding date (vertical bar of T). Expository or explaining thought can be depicted through the use of a triangle where each side can be labeled with cause, effect, and conclusions with corresponding relationships listed off each face of the triangle. A fourth type of thought, persuasion, can be visually depicted through the use of a scale which visually weighs the pros and cons of a particular view or position.



T-Line

These and many other visual constructions can be used to help learners retrieve and categorize information. Furthermore, the use of these thought structures help students with the writing process by generating questions and listing important ideas.

High School: Interactive Study Guides

Discipline-specific courses, which involve presentation of concepts, relationships of people to concepts, and the sequence of ideas and events can benefit from the use of structured interactive study guides, a format designed to emphasize note-taking rather than note-copying. The challenge is to balance the providing of information with encouraging involvement.

The interactive study guide features key notes, phrases, and visuals in numbered segments. This allows students to concentrate on what's being said or demonstrated, rather than on what's being written. However, not all of the critical information is provided, which requires students to attend to what is being said or presented. A space for notes is included. Another key feature is the use of word pictures, which consists of line drawings, shapes, clip art, symbols, arrows, to provide graphic representations of ideas, concepts, or data.

Interactive study guides can be used in telecourses and large classes where direct participation is difficult or impossible. For complex aspects of some courses the time needed to assemble the guides are outweighed by the learner benefits of accuracy, completeness, interactivity, and visual connections to the material (Cyrs & Smith, 1991).

Research Goals

In my initial conceptual organizing paper on the cognitive potential of visual constructions, I cited a comment from Elliot Eisner that philosophically serves to begin this research program: "What can we do that does justice to develop human intellectual capacities?" (Eisner, 1983, p. 5).

The following are three broad research goals to consider in order to establish some basis for the cognitive potentials of visual constructions as identified above.

- How do personalized meanings via visual constructions create understanding? (and what is meant by understanding?)
- What are the effects of possible cognitive-motivational variable links when visual constructions are used by teachers and students?
- Which teacher and student strategies using visual constructions contribute to development of self-directed learning characteristics?

Timeless Images:

Future

The purpose of visual constructions is to help learners construct their own representations, or what have been referred to in this paper as "personalized meanings" to information presented to them and discovered by them in school. These personalized images, not only set the stage for more meaningful learning in school, but they can become integral performers over a lifetime, so that as learners learn they essentially create their own *timeless images*.

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