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AUTHOR	Shambaugh, R. Neal
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ABSTRACT

Noting that students fail to fully realize the advantages of notetaking as a process to develop a personalized learning system, this paper proposes the use of visual constructions to help students re-establish for themselves the unity of knowledge and to create personalized meanings to this knowledge. The paper summarizes the benefits of notetaking and reviews research on the subject. The paper also proposes a broad definition of visual notetaking, and provides a survey and summary of visual notetaking and direct instructional visual notetaking methods. The paper examines cognitive features of visual notetaking that serve as a basis for establishing the cognitive potentials of visual constructions. Seventeen figures illustrating aspects of visual notetaking, a table presenting the features, benefits, and drawbacks of visual notetaking methods, and a table presenting cognitive strategies and processes are included. (Contains 55 references.) (RS)

Personalized Meanings:
The Cognitive Potentials of Visual Notetaking

R. Neal Shambaugh
College of Education, Virginia Tech
201 Media Building Blacksburg, VA 24061-0133
703-231-8593 jake@vtvm1.cc.vt.edu

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Abstract

Students spend a lot of time taking notes; however, students fail to fully realize the advantages of notetaking as a process to develop a personalized learning system that could serve them effectively over a lifetime. This failure is due, in part, to the linear and compartmentalized manner in which school knowledge is presented. Although this method is efficient for the delivery of declarative knowledge, it destroys the connections between academic knowledge. In this paper I propose the use of visual constructions to help students to re-establish for themselves the unity of knowledge from bits of knowledge and to create personalized meanings to this knowledge. The benefits of notetaking and review from research are summarized. A broad definition of visual notetaking will be discussed, and a survey and summary of visual notetaking and direct instructional visual notetaking methods are provided. Cognitive features of visual notetaking will be examined as a basis for establishing the cognitive potentials of visual constructions.

Notetaking As a Learning Opportunity

Information delivered from instruction is necessary; however, the information from lessons, lectures, or textbooks frequently consists of sequential "bits" of knowledge. Although efficient for the delivery of school knowledge, this linear, compartmentalized organization and presentation of knowledge destroy the connections that research and collaboration have built up over time (Eisenburg & Dreyfus, 1991). These lost links and interconnections between academic and instructional knowledge contain much of the richness of our documented world -- the interrelationships of facts, the understandings from multiple contexts, the potential of 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? What range of interpretations of this knowledge are possible with generic facts, truncated concepts, and missing contexts? As a result, students are faced with inadequate knowledge in which to organize into information that is meaningful to them.

According to Brown, Collins, and Duguid (1988), one of the problems of school is that *knowing* and *doing* are separated in practice; however, both are linked in reality and that true knowing is situated in the complexity of the world. The use of visual constructions and visual notetaking discussed in this paper sit comfortably within these notions of situated constructions -- that true knowing and understanding can be developed *in* the learner and *by* the learner through the transformation of fragmented, compartmentalized bits of knowledge into knowledge of *personalized meanings*.

In this paper I propose the use of visual notetaking as one method to help learners construct frameworks of thinking which facilitate the evolution of personalized meanings. This learning strategy uses visual constructions to encode and store integrative information; thus, helping to preserve the relations of information, to contribute to a deeper understanding of the significance of information, and to establish personalized meanings for learning to build upon.

Does Notetaking Work? - What Research Tells Us

A great deal of research has been conducted into the value of notetaking in education. Carrier (1983) provides five general conclusions that serve to summarize what notetaking research has discovered. These conclusions are listed below:

- Taking notes promotes learning better than listening alone.
- Taking and reviewing notes promotes learning.
- Review of notes promotes learning.
- Highlighting and organizing information aids notetaking.
- Students require different notetaking strategies.

The first conclusion is that "*students who take notes during a lecture will learn more than those who simply listen.*" Notetaking facilitates information processing by actively engaging the learner (Ladas, 1980).

Conclusion number two states that "*in general, students will learn more from a lecture if they both record and review their own notes.*" A personalized recording and review of notes provide for unique coding and rehearsal of information and generate cues that serve to activate retrieval strategies (Thomas, 1978).

The third conclusion elaborates on the second stating that "*review of notes will lead to improved performance.*" Review immediately following a lecture helps the student to fill in gaps from existing notes and to generate questions that will help to clarify uncertainties. This immediate review, which stems from an individual's motivation to *understand*, enables the student to re-code personalized notes for meaning. Delayed review, meanwhile, is motivated by the *need to perform* and is useful prior to testing (Carter & Van Matre, 1975).

Conclusion number four claims that "*lectures can facilitate student notetaking by highlighting important information and providing a clear organizational framework.*" It appears that humans have a natural ability to generate organizational frameworks (Howe, 1970). These highlighting and organizational frameworks can be enhanced by specific teacher behaviors, such as pacing and organization of material, calling attention to important points, and strategic use of the blackboard and overhead transparencies (Ladas, 1980). Notetaking helps the student to recognize connections between ideas and to strengthen associations between important points. This deeper level of processing by the student can be explained by the encoding variability hypothesis (Craig & Tulving, 1975), which claims that multiple encoding strategies for the same information results in greater remembering. As students progress from recording exact replicas of teacher-generated notes to reconstructed personal meanings through a range of elaborations, the greater the benefits students will receive from notetaking (Barnett, Divesta & Rogozinski, 1981).

The final conclusion of notetaking research as summarized by Carrier (1983) is that "*students with different abilities and levels of prior knowledge may require different notetaking strategies.*" Students with different memory and listening abilities, prior knowledge, and cognitive styles create different notetaking systems (Ganski, 1981). No one style or approach appears to be superior to another and it would appear impossible to judge a set of notes for quality since individuals process information quite differently.

How can these positive attributes of notetaking be enhanced for use by teachers and students? Figure 1 transforms this list of attributes into a visual qualitative equation which portrays the *acts* of notetaking and review as *processes*, denoted by circles. The summed effect of both processes may create unique frameworks of meaning for each learner and help to enrich notetaking and review. Can *visuals* be used to improve an individual's notetaking and review system?

Insert Figure 1

What is Meant by Visual Notetaking?

Visual notetaking in this paper is defined broadly as "any visual that promotes a reconstruction of meaning for the learner." Any notetaking, including exact replication of a lecture, can be viewed as visual notetaking if it promotes meaning for the student. Attempts to edit, filter, and paraphrase what is heard or seen can be labeled as visual notes, as well as any attempts to organize lectures and readings. Figure 2 lists several common methods of encoding study material.

Insert Figure 2

Teachers make frequent use of visuals to communicate information in the classroom (Figure 3). Textbooks and handouts include pictures, graphs, diagrams, sketches, organizers, and many other variations. Students may choose to transcribe everything and make judgments later, while others will make ongcing decisions as to the value of the presented information and how it should be recorded in their notes. Unless the blackboard or overhead transparency contains a picture or other

Insert Figure 3

visual, the notetaking will usually consists of verbal information in the form of words and sentences. Is it possible for students to transform verbal information (spoken and written) into visual information? Do teachers need to improve encoding of their lessons and to cue students to create mental images or visual representations of information? Do such transformations enhance retention and recall? And do such transforms further develop a student's metalearning capabilities -- an ability to regulate, monitor, and reflect on one's own learning? The next section of this paper examines several visual notetaking methods to determine if their features promote these benefits.

Examples of Visual Notetaking

Numerous notetaking methods have been proposed, but the ones discussed here feature a prominent use of visuals and have been divided into four categories: page organization methods, visualization or mental imagery approaches, concept diagrams, and notetaking teaching processes that include a strong visual orientation.

Page Organization

This first category organizes a page visually and provides a structural framework to help students organize their notes.

The first page organization method is the **outline** (Figure 4), a traditional form of notetaking, which assigns key concepts and supporting ideas into a standardized numbering sequence (I, A, 1, a, etc.). This method enjoys one benefit that the others in this survey do not -- that many students have received outlining instruction during their formal schooling. Outlining is also easy to create as it usually parallels the topic subdivisions in most textbooks.

Insert Figure 4

The second page organization method features a **split-page** where the notebook page is divided into sections for notetaking. The most basic of split page methods features a line drawn down the first third of the page (Figure 5A). Major points are recorded on the left side and supporting details are recorded on the right two-thirds of the page. Variations of the split-page include Pauk's (1962) three column approach (Figure 5B), which incorporates a left column (2") for lecture summary, a middle column (5") for lecture content, and a right column (1") for notation of personal ideas and synthesis of concepts. In addition to this 2-5-1 structure, a 2-6-2 (Figure 5C) format features a two inch section running along the bottom of the page to provide more space for student notes. Yet another variation, the 2-3-3-2 (Figure 5D), includes a three inch column to record notes from a textbook which parallels class lectures and helps students to avoid duplicating notetaking from both textbook and lecture.

Insert Figure 5A - D

The split-page structure requires students to make decisions about what they hear and read; thus, accessing a deeper level of processing. The summary column helps to clarify meaning and relationships among material and can be useful in review. The reflecting column in Pauk's method enhances the basic split-page method by helping students to apply ideas in new areas and to record and monitor one's thinking.

A third page organization method, the **T-line** (Figure 6), divides the paper in half with a line drawn along the top to form a T. Stein (1987) recommends this page layout to describe *narrative* thought where a chronological pattern of teaching and learning is used. The vertical line of the T records "Dates" while "Persons" under the left side can be matched to "Events" on the right side, a format that allows the student to visualize and to encode this chronological pattern for understanding and recall.

Insert Figure 6

Stein (1987) proposes his own format to organize a page for visual note making (Figure 7). In this **note-page** method, the left-most column, Section A, is reserved for vocabulary while the right-most column, Section C is used to record teacher-asked questions. A student uses the middle six inches of the page for notetaking, using both text and pictures. The bottom two inches Stein refers to "Instant Replay," which records "things to remember" and important dates. According to Stein, this page organization method mixes verbal and visual thoughts and takes advantage of left and right brain qualities.

Insert Figure 7

Visualization

Several visual notetaking processes can be found in the literature of reading comprehension (Fredericks, 1986). The first example of visualization, or mental imagery, is a **mind picture**, which is created in a student's mind prior to, during, or after reading.

Mind pictures help to develop thinking skills, such as elaboration and inferencing, create personal structures, stimulate active involvement, improve comprehension, and increase readers' control of their own strategic behaviors.

A second example of visualization are **word pictures** (Figure 8A), which are graphic representations of ideas, concepts, data, and numbers that use simple line art, geometric shapes, clip art, symbols, arrows, underlining, textual clues (bold type, italics), and color to show relationships among concepts or variables (Cyrs & Smith, 1991). Word pictures are labeled as *text* *structures* by Smith and Tompkins (1988) and can be used to organize information that is read or heard. These text structures (Figure 8B) include the description of a concept or an event, a listing of the steps in a process, elaboration on the cause and effect of an event, the depiction of a problem with its solution and results, a comparison or contrasting of alternatives, and definitions of a concept or idea with examples.

Insert Figure 8A-B

Stein (1987) claims that word pictures are suitable for four different types of thought: narrative, description, explanation, and persuasion (Figures 9A - 9D). The T-line, mentioned earlier as a page organization method, is also a visual symbol which can be used to depict *narrative* or chronological thought. A star or a stick person (Figures 9A, 9B) can be used to *describe* a person or a group. A student can label the qualities of a person by attaching notes to one of several areas on a stick person. Expository or *explaining* thought includes defining, providing examples, comparing and contrasting, how, why, categories and functions, and main idea and details. For example, a triangle (Figure 9C) can be used to depict cause and effect. *Persuasive* thought, which can take the form of approval, disapproval, or uncertainty, can use a thumbs up/thumbs down visual to register any of these reactions, or a scale (Figure 9D) to symbolize the weighing of the evidence.

Insert Figure 9A-9D

Word pictures help students to remember more, to prepare for tests, to reason during class discussions, to become a more active participant in class through writing, and to develop visual imagery (Cyrs and Smith, 1991).

Cyrs and Smith (1991) have used word pictures to develop **interactive study guides** for distance learning. An interactive study guide (Figure 10) consists of a highly organized set of student notes, graphics, pictures, charts, and activities. In addition to using word pictures, these study guides can also include key notes, phrases, and other visual elements; however, not all information is provided nor are all activities included. Extra space is provided for student notes and visuals are printed in logical, numbered segments called displays. Cyrs and Smith (1991) claim that interactive study guides promote interactivity and focus the attention of students on key concepts by requiring them to fill in the blanks.

Insert Figure 10

Concept Diagrams

Three types of diagrams that visualize concepts are described here: concept circles, concept maps, and knowledge vee diagrams.

Concept circles (Wandersee, 1987) represent isomorphically the conceptual *structure* of a piece of knowledge (Figure 11). Quantitative and categorical (concept) information are encoded by labeling, geometry, and color. The circle represents bounded units of knowledge and the circle area is used to represent qualitative or quantitative differences.

Insert Figure 11

Concept circles are based on constructivism -- that knowledge is constructed -- and Ausubelian learning theory, which is characterized by the following: relating new knowledge to old, determining what a student knows and adapting to subsequent teaching, and the idea that knowledge about *how* one learns enhances learning. Another theoretical basis to concept circles is visual perception, particularly the use of color, geometry, and labeling. The circles, which are descendants of Venn diagrams and Euler circles, are limited to five; thus, restricting excessive detail that reduces the effectiveness of communication.

The benefits of concept circles stem from the use of color, geometry, and labels to aid understanding and recall, two requirements of a metacognitive tool. The circles are easy to draw, much simpler than the more sophisticated techniques, such as concept maps and knowledge vee diagrams described below. Concept circles can also be used to differentiate concepts and are useful diagnostic tools for teachers and researchers to analyze students' views on concepts and ideas.

A second type of concept diagram is a **concept map** which is a visual representation of the *relationships* between concepts. Concept maps are hierarchical with the most inclusive of concepts represented at the top while less inclusive concepts are depicted as one moves to the bottom of the diagram (Figure 12). Concept maps use labeled circles to represent concepts with the circles being linked by words, such as "The barn IS red," to denote concept relationships.

Insert Figure 12

An important, but subtle feature of concept maps is that they are not fixed representations. Concepts can be represented in more than one hierarchy, which demonstrates to students that concepts can have multiple views. In addition, a student's effort may not be an accurate one, so misconceptions can readily be spotted by the teacher. Concept maps require direct instruction for them to be successfully implemented in the classroom. Classroom activities introduce the students to the method and to help them practice the technique, while a scoring system tabulates successful features of their construction. (Novak & Gowin, 1984).

Concept maps help students and teachers focus on the major ideas of any learning task, to recognize new meanings and relationships, to highlight misconceptions, and to exchange views between teacher and student. Novak and Gowin (1984) claim that knowledge is constructed by individuals, but that the "meaning" of this knowledge can be shared in groups. Concept maps provide a schematic summary and a visual road map of interconnected meanings of concepts, which helps learners to explore what they already know and to chart a course with a beginning and an end. This technique can also be used to extract meaning from textbooks, labs, studios, field trips, reading articles in newspapers, magazines, and journals, and can be used to plan a paper or a presentation (Novak & Gowin, 1984).

Even more complex than concept maps are **knowledge vee diagrams**, which are visual tools to help students discover *what knowledge is* and *how it is constructed*. Vee-diagrams were first introduced in 1977 to help junior high students learn *how* to learn science. They have been used primarily in science and social science settings from seventh grade through college (Novak & Gowin, 1984).

Vee-diagrams are based on the idea that knowledge is constructed by first examining events or objects through concepts that students already know. These events or objects are noted at the bottom of a V-diagram (Figure 13). The V-shape directs attention on the critical beginnings of a student's conceptual understanding. A *question*, recorded within the V, focuses inquiry. The left side of the V represents concepts, the "thinking" and the theories that have built up over time, while the right side denotes the methodological, the "doing" of immediate inquiry.

Concept mapping, which is usually taught before the use of V-diagrams, helps students to understand the importance of *events/objects* and concepts. Students then identify on the left side of the V what concepts they already know that relate to these events or objects. The conceptual left side includes world views, philosophies, theories, principles, constructs, conceptual structures, statements, in addition to concepts. On the right side of the V students record what new constructions are worth making, which can include not only facts, but claims interpretations, explanations, generalizations, results, and transformations.

Insert Figure 13

From this information students can begin to generate *claims* on knowledge learned. Students then relate these knowledge claims to the left side of the V, which records principles and theories that may be operating in their inquiry. Once students become comfortable with knowledge claims, they can then evaluate value claims, such as "Is this a good or bad idea?" and "Should we choose this option?" Looking at both knowledge claims and value claims helps to show students that both are interconnected and not divorced from each other.

Processes that Teach Visual Notetaking

A fourth category of visual notetaking methods examines processes that teach a notetaking method. The first example is the **Directed Notetaking Activity (DNA)** method, which incorporates three features: a split-page format, a self-questioning strategy, and the use of an adaptive form of Pearson's model of instruction (Spires & Stone, 1989). See Figure 14.

The left side of the split-page is once again assigned to main topics, while the right side is for supporting topics. An important feature of the DNA approach involves a series of questions posed by students: *planning* (before notetaking), *monitoring* (during notetaking), and *evaluating* (after notetaking). Pearson's (1985) model of explicit instruction, which features a gradual release of responsibility from teacher to student, is used to implement the system.

Insert Figure 14

The split-page structure provides a learning framework for the student and develops a deeper level of information processing than by merely transcribing notes from the board or from a book. Direct instruction provides students a rationale and explanation of the strategy, models the process, guides student practices, and encourages student independence.

Spires and Stone (1989) report that a DNA group outperformed a control group and an explicit instruction group on notetaking and comprehension measures. Student questionnaires from DNA students reported increased confidence after they received instruction.

A second type of teaching process that uses visuals is the **graphic organizer** (Figure 15), which can be defined as a visual outline of a lecture presented before instruction. An outline of the major ideas and supporting details is written on the blackboard or displayed on an overhead transparency. Some instructors in large classrooms use two overhead machines; one with the organizer in constant view and the second for display of lecture content.

Insert Figure 15

With the graphic organizer students learn to take accurate lecture notes of major points without relying on writing everything down. The technique seems to help students to listen effectively by providing them with a mental picture of a lecture. The organizer can also be used to help students take more economical notes by progressively reducing the amount of information a teacher includes on successive uses of the organizer. Through review a teacher can assess what students know before formal instruction and can help both students and teacher to remain focused on main ideas (Sakta, 1992).

A third notetaking teaching method is the **NOTES** system: Notetaking Observation Training and Evaluation Scales of Stahl, King, and Henk (1991). NOTES helps students take notes through four stages and can be used to train students in any notetaking system.

The four stages include *modeling* in which an effective notetaking recording method is demonstrated. Structure, recall cues, and an end-of-the-lecture summary are also provided. In Stage 2, *practicing*, students use notes from their other classes. Stage 3, *evaluating*, uses several rating scales or sets of ordered objective criteria for evaluating and monitoring progress. The final stage is *reinforcing*, which is conducted at the same time as Stage 3, and provides feedback for both teachers and students.

The key to the NOTES system is based on explicit instruction using practice with real notes, providing students with time and attention, and an evaluation structure that guides feedback.

Summary of Benefits, Drawbacks, Features

What features of the surveyed techniques might be useful in education? Table 1 summarizes these features for each of the methods surveyed. Four organizing types were used: page organization, visualization, concept diagrams, and teaching processes. One method will be nominated from each type for discussion. The **split page** is a worthy candidate from the page organization type. It has enjoyed widespread acceptance since formally introduced by Pauk in

1962 and is a key component to the Cornell method of notetaking and study. The component of the split-page that endows it with power is the third column for *reflection*, a space that enables students, perhaps for the first time, to synthesize on the significance of their notes and to reflect on their own learning. The 3-column method also appears relatively easy to learn and master.

Insert Table 1 here

Word pictures are useful visualization techniques that enhance traditional verbal notetaking. Choosing an image which summarizes or denotes a specific concept, fact, or idea requires a student to connect new material with existing meanings and to produce a new representation. Word pictures can be fun to construct and challenging to use, and they can be very satisfying to a student as a personalized rendering of one's learning. Although this method appears to be more difficult to learn and implement, particularly for those who might resist from fear of "going visual," the prospects of a richer set of notes appears to outweigh the downside. A combination of the 3-column method (main idea, details, reflection) and word pictures would create an even more powerful encoding and storage tool for the student.

Concept diagrams represent the most complex of the four visual notetaking types surveyed. **Concept circles** seem to be a good first choice for students and teachers interested in understanding knowledge and concepts and their relationships. As a result, they are appropriate for science and social science courses. Concept circles are easy to draw, and through practice with labeling and color, they can be used very quickly to help students with concept formation. From concept circles teachers and students can migrate to concept maps and finally to knowledge vee diagrams.

The teaching methods surveyed require time and commitment from students and teachers. The **graphic organizer** is the simplest to implement and almost immediate benefits can be obtained from its correct use. An organizer can be constructed quickly on the blackboard or on an overhead transparency and by using them for review a teacher can determine what students know prior to instruction.

Cognitive Dimensions of Visual Notetaking

Learning is a complex, real-world task and we are faced with the dilemma of possessing a general awareness of what learning is, but lacking a detailed picture of how this occurs in humans. The cognitive framework for researchers and teachers is an attempt to gain greater understanding of the processes that enable humans to learn.

In this section I will establish the relevance of the term "cognitive" in the title of this paper and how cognitive processing sheds light on how visuals, and in particular, how visual constructions can be used as a strategy to improve learning.

Cognitive Processing

Cognition is a general concept that embraces all forms of knowing, such as perceiving, imagining, reasoning, and judging (Chaplin, 1975), or cognition can be viewed as the acquisition of learning (Reed, 1992). The cognitive framework as applied to learning theory adopts the view that learning is a continual process of knowledge construction, that new knowledge is constructed upon old knowledge, and that learning is related to a particular situation (Resnick, 1990). I prefer to broaden the use of the term "situation" and replace it with "meaningfulness," that which has purpose or function to the learner. Situation may be a function of meaningfulness, as could be intelligence, predisposition to learning, health and safety concerns, social setting, among others.

The cognitive viewpoint uses the human information processing model to suggest how humans acquire, process, and store information (Miller & Burton, 1994). This model is sufficient to describe *knowledge recording*, but can also be extended to elaborate on the acquisition, processing, and storage of meaningful information, concentrating also on *knowledge interpretation* (Brown, Collins & Duguid, 1988). These processes can be understood within the context of the information processing metaphor by briefly outlining the various stages in which these cognitive processes occur.

Within these stages three types of memory structures are specified. *Sensory stores* acquire and hold stimuli from the environment for brief periods of time. A second type of memory structure, *short-term memory* (STM), stores a new meaning for the stimulus after having matched a pattern stored in long term memory (LTM). In STM information can be rehearsed, elaborated, and retrieved for use by the learner; however, STM has been shown to have limited capacity (Miller, 1956). *Long-term memory*, a third type of memory structure, is used to store STM information and to provide the sensory stores with information for comparison and pattern matching. Further encoding can occur as STM is re-constructed with old information to consolidate new organization structures for retrieval (Miller & Burton, 1994).

Visual Processing

Are there unique aspects to the processing of visual information by humans? Referring again to the information processing model, visual information is accepted by the sensory stores for a short period of time. Posner (1969) states that visual information persists in STM after the stimulus is gone; however, this capability is limited. Visual information is also stored into long-term memory and available for retrieval into short-term memory.

One explanation of how visual information is stored is Paivio's dual coding theory (1986), which specifies that different coding mechanisms exist to process visual and verbal information, but both can be converted between each other (Klatzky, 1980). One of the advantages of using graphs, charts, and diagrams in education is that information can be stored in both visual and verbal modes (Miller & Burton, 1994). Dual coding also stipulates that pictures are remembered better than verbal information (Pressley & Miller, 1987) and are translated automatically to words. However, verbal information, such as words, are optionally translated into pictures

(Paivio, 1986). Another feature of dual coding is that mental images are also encoded by modality-sensitive elements, such as those provided by the senses (Paivio, 1986).

Visual Notetaking as a Cognitive Skill

Visual notetaking is any conscious attempt by a learner to use "visuals" to reconstruct personalized meanings from the bits of information presented in traditional learning environments, most commonly classroom and self-study. The ultimate goal of this approach is the evolution of a personalized learning system where visual notetaking is a component learning strategy.

Visuals, or visual constructions, are loosely defined as any visual attempt to establish these personal meanings. A wide range of techniques from underlining to knowledge vee diagrams can be used. These were discussed earlier in this paper.

Can notetaking or visual notetaking be considered a cognitive skill? Royer, Cisero and Carlo (1993) describe four major features of a cognitive skill:

- A cognitive skill is an integrated mixture of facts and procedures for using those facts.
- A cognitive skill can be acquired through training and/or experience.
- A cognitive skill is applicable to activities within a domain.
- A cognitive skill is acquired in stages.

Although notetaking for most students is a heuristic activity learned mostly out of habit, the activities that make up visual notetaking include both *declarative* and *procedural knowledge*. For example declarative knowledge includes facts about visual notetaking, such as an understanding that diagrams possess compact sources of information or that some diagrams maintain explicit relations of information or that certain symbolic visual constructions, such as a T-line, are useful to visualize narrative thought. Procedural knowledge includes understandings that might include: what are the requirements of the learning situation, identify major points in a presentation, steps to reorganize verbal information into personal notes, or select an appropriate mental image.

Our intellectual abilities may be generally resistant to change via learning, but notetaking is a process that can be *acquired and developed* through self-study or direct instruction and evolve over time as the learner's goals direct. Notetaking skills and strategies may change for learners during K12, college, and graduate school. Direct instruction needs to provide specific procedures for learners plus adequate practice and opportunities to relate these skills to meaningful and individualized learning goals.

Specific notetaking strategies may be only effective within a *particular subject domain*, such as knowledge vee diagrams in science and social science classrooms. As notetaking skills evolve into a personalized learning system, specific and unique strategies and notetaking frameworks may emerge.

Finally, notetaking is a skill that can be *learned in stages*. This staged learning helps to transform this process from a highly taxing activity to one that is virtually automated and one that is seen by the learner as reliant and useful. Anderson's Levels of Cognitive Skill Acquisition (Anderson, 1982) breaks down this process into three stages. The *declarative stage* is the level at which the skill is introduced via example or instruction. The next stage, *knowledge compilation*, acts as a level of transition where the skill becomes an automatic procedure that is called upon when needed. The final level of learning a cognitive skill is the *procedural stage* where speed is achieved, the skill is strengthened and the process becomes more meaningful to the individual.

Cognitive Engagement Characteristics of Visual Notetaking

Before examining cognitive processes of visual notetaking it is necessary to describe the cognitive potential of the learner. This potential is labeled by Linda Anderson (1989) as cognitive engagement characteristics, which learners bring to learning and contribute to their cognitive processing. Anderson groups these characteristics into two major categories: knowledge and self-regulation (See Figure 16).

Knowledge includes one's content knowledge and various categories of information that a learner can bring to bear on a learning task. How these categories are structured is a personalized concern. Knowledge structure rates as an important issue in visual notetaking as explicit and external storage of such structures encoded in visual constructions is itself a learning task that may need direct instruction for its development in light of the requirements of instructional activities. Visual constructions may reveal a set of representations for the learner to consider and the teacher to evaluate.

Insert Figure 16 here

The second type of cognitive engagement characteristic proposed by Anderson (1989) is *self-regulation*, the capacity of a student to control one's own learning through personal beliefs and perception of one's abilities, awareness of learning strategies, and the capability to reflect on one's learning efforts and to make conscious changes based on personal goals. This self-regulation is sometimes referred to as metacognition or the awareness of one's own cognitive processes (Schoenfeld, 1989).

An important aspect of self-regulation is motivation, which can be a function of a learner's beliefs and goals which relate to task performance (Anderson, 1989). Students who are goal-specific in particular ways achieve learning benefits. Ng in Leake and Ram (1993) distinguishes between goal-directed learning, such as a student going beyond the requirements of an assignment, and incidental learning that has nothing to do with an assigned activity, such as a student's motivation to fit in with the crowd. Ng reported that learners with explicit problem-solving or knowledge-building goals embraced the problem solving process with greater success, were able to constructively solve problems, raised more questions, and identified some problem aspects to be solved later.

However, without *both* goal and non-goal-driven activity, reality can be severely compromised. In a recent symposium report on goal-driven learning Leake & Ram (1993) reported that non-goal-driven learning occurs frequently in learning situations where a wide range of information is routinely processed by a learner, some of which may be useful in the future. One example is the routine storage of information during lectures, although this may be the result of some sort of goal-driven activity. The challenge to the learner is how to balance the energy given over to processing of what is required and what is most useful to the student.

Cognitive processes in visual notetaking:

Visual notetaking is a strategy which enhances a number of cognitive processes to establish personalized meanings for more effective storage and recall of information. Table 2 is a chart of cognitive strategies and cognitive processes for each, with cognitive engagement characteristics listed in the first column to remind us that certain learner features are brought to learning activities and that there exists a two-way relationship between features of these engagement characteristics (knowledge and beliefs) and cognitive processes.

Insert Table 2 here

Visual notetaking, like any traditional form of notetaking, is composed of two major strategies: notetaking and review, two processes which have been cited to improve learning (Carrier, 1993). Extracting meaning from visuals, or *decoding*, has been described as a two-stage process: differentiation and interpretation (Couch, Caropreso & Miller, 1994). Both stages are also involved in the *encoding* of meaning into notes; however, in the reverse order -- interpretation then differentiation.

First of , the *notetaking* strategy is a process that transforms bits of knowledge from lectures and textbooks to personalized meanings encoded in verbal/visual notes. In the first stage of the transformation, or encoding process, verbal/visual information from instruction is interpreted. The interpretation stage includes the following cognitive processes: first, registering images and sounds from seeing and listening; matching this sensory information with patterns retrieved from long-term memory and connecting this new information with prior knowledge to form initial meanings; and finally, making decisions and judgments about this new information. The second stage of encoding in the visual notetaking process is differentiation where the meaning of new information is encoded into unique, personalized structures using both verbal and visual constructions. Differentiation, specifically, identifies relevant information, which is classified into categories. These categories could, for example, fit into Stein's (1987) four types of thought: narrative, description, explanation, and persuasion, which might trigger the choice of an appropriate visual construction, such as a star or stick person for descriptive thought. Differentiation could also include decisions and judgments regarding the encoding activity at any level of the differentiation stage.

The decoding process used in review involves the reverse process: differentiation first and interpretation second. In a practical context the cognitive engagement characteristics of the learner are frequently at work in the review strategy. Decisions and judgments as to the value and usefulness of notetaking content and encoding structures will operate here. During review elaboration in the interpretative phase may occur as additional information is added to existing notes. Re-construction of notes with supplemental structures, including revised visual constructions, may also occur.

Another cognitive process that may take place in the review strategy is rehearsal, particularly maintenance rehearsal where information is repeated frequently enough to maintain it into short-term memory. It has been shown that rehearsal does not guarantee learning (Craik & Lockhart, 1972), but that the degree of importance that a learner attaches to the material and develops a lasting attachment via memory is key (Craik & Watkins, 1973).

Larkin & Simon (1987) state that "to be useful a diagram must be constructed to take advantage of [its] features." A learner needs to know *how* to construct an effective visual. Visual construction is a skill that can be learned, either self-taught with many of the methods surveyed in the previous section or with direct instruction that the more complex notetaking systems require. Mistakes can be made in the construction of visuals and they can be used improperly. It is also possible that students will make incorrect alternate visual representations of verbal information or appeal to the wrong features of a diagram in the solution of a problem. However, these dangers exist when students take notes at their desks, and they may individually attach different meanings and organization to classroom instruction.

A discussion of visual construction requirements are beyond the limits of this paper but they include two dimensions: organizational features and aspects of creativity.

One of the organizational features is the arrangement of visual detail. Meaningful organization of visual elements is required for effective retrieval and processing of a visual's rich set of meanings. Visual constructions that contain quantitative information can be evaluated starting in a generalized manner from some of the guidelines set down by Tufte (1983), such as his principles of graphical integrity which focus primarily on issues of clarity, precision, and efficiency.

Another organizational feature is its degree of isomorphism, or the degree of accuracy of the visual construction to the idea or concept being represented. A good visual is at least accurate along key dimensions or conceptual lines of thinking. (Barwise & Etchemendy, 1991).

A second dimension by which visual constructions can be evaluated by adopting Guilford's four categories of creative thinking: fluency, flexibility, originality, and elaboration (Couch et al, 1994). *Fluency* is the ease in which the learner uses information. When using visual constructions fluency can be affected by its organizational attributes mentioned above. *Flexibility* is the capability of a learner to reconstruct information in unique ways and to not be restricted by conventional representations. One of the attractive features of visual constructions is the visual manner in which these reconstructions appear. *Originality* and *elaboration* can be measured on the basis of comparison to norms that are somehow established. Originality when applied to visual notetaking provides learners and teachers with new ways of looking at conventional knowledge representations. Elaboration offers the potential of enhancing the meaning of information through new connections with different points of view or settings.

I have already mentioned that cognitive engagement characteristics are brought to each learning situation, including the strategies of notetaking and review. One of these characteristics is metacognitive beliefs and knowledge. With notetaking the student makes decisions based on learner goals. How much effort is needed to process this information? Should I be bothered by the information? Do I merely copy it down or do I edit, filter, or organize the material? A question that may or may be asked is, what transformations should I make to this material? As in the learning of any other skill the process of taking notes with visuals will evolve at different rates for each individual and may not be deemed useful by some students.

Some students may believe that visuals cannot be drawn quickly enough to include all of the material presented in class, and some may be reluctant to "draw" having had bad experiences or limited success in art classes. These perceptions can be dealt with in direct instruction on certain types of visual notetaking. Meaningful introductions as to the benefits of the process and adequate, guided practice are necessary for many of the processes.

Learners must come to understand that the construction of visuals is a skill that they can learn and that there are benefits to this effort. Teachers must realize that individuals will vary in their success and receptivity to the skill, and that integrating this process into traditional curriculums will be a challenge. Visuals can be difficult to insert into conventional instructional materials as they take time and thought to construct and the resources to do so may not be available. Of course, any instruction in visual notetaking takes away time from other instructional activities.

Hopefully, visual notetaking will help students to create and evolve their own personalized systems of notetaking, which combine verbal and visual modes of representation. Ideally, students need a mode of notetaking that is independent of the form of representation, which does not advocate or rely on one or the other (Barwise & Etchemendy, 1991). New variations of computer-based writing may provide students and teachers with interesting variations of traditional lecture notes and overhead transparencies.

Cognitive Potentials of Visual Notetaking

In this final section I will describe what I believe are the potentials of visual notetaking within a cognitive framework and the external world in which the cognitive characteristics of the individual interact.

Within the internal frame of reference are three cognitive potentials of visual constructions: as organizers, as efficient processors, and as agents of understanding.

Unique Organizers of Personalized Meanings

Visual constructions help to produce individualized organizers of personalized meanings by structuring information and conceptual relationships of knowledge, and by providing alternate representations of knowledge.

Visuals provide an *organizing* effect to visual information. By their compact nature visuals are rich sources of information and may come closer to representing the potential of the human perceptual system than any other sensory source. Visuals possess features, such as symbolic attributes that can be added to enrich the diagram or to make it more accurate. Larkin & Simon (1987) cite the benefit of diagrams to group information about a single visual entity, which avoids the need to match symbolic labels.

Visuals help to organize *conceptual relationships* based on their connecting and organizing features. Barwise and Etchemendy (1991) claim that such features enable visual forms of representation to act as important components of mathematical proofs and valid deductive reasoning. They claim that "visual information is part of the given information from which we reason," that visual information is "integral to the reasoning itself," and that "visual representations can play a role in the conclusion of a piece of reasoning." Visual notetaking establishes explicit connections between visual and verbal and analytic aspects of concepts and helps to maintain the balance between the various elements of school knowledge, such as verbal, logical, mathematical, and spatial and kinesthetic.

The symbolic potentials of visual constructions also contain powerful meanings that help to provide closure to ideas and concepts, which would be difficult to achieve with verbal information (Barwise & Etchemendy, 1991).

Visual notetaking may 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. This concept assimilation depends on three aspects of language development: (a) acquisition of higher-order abstractions of concept attributes, (b) acquisition of "transactional" terms, such as state, condition, property, quality, and relationship, and (c) acquisition of cognitive capacity to relate abstract ideas to. Visual notetaking improves understanding of these ready-made concepts by allowing students to construct a unique, personalized representation of meanings.

Concept formation is difficult to do in a classroom because it requires time to build up large amounts of content information and there isn't time to process this new information in classroom settings. However, visualization can be instrumental in attaching a symbolic meaning to a concept so that it can be processed (stored, classified, evaluated, communicated) more efficiently. Ausubel notes the necessity of symbolic representation before concept formation can take place (1966). Personalized notetaking systems possess attributes that help students to reflect, evaluate, and to change their learning program and thus may offer to the learner the potential to assist in concept formation.

Alternate knowledge representation is a key process that helps learners to construct personal meanings from bits of knowledge. The representation form, which may include visual constructions, is itself 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.

Efficient Processors

There are a number of cognitive processing issues that have an impact on learning. First, the visual notetaking process as a learning strategy represents active learning which promotes higher learning than passive learning. Second, although not sufficient for learning by itself, attention may be improved through the construction of any method that promotes personalized meanings. This is done through the activation of encoding. Third, since multiple channels of communication are 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.

Visuals in notetaking also improve overall cognitive processing by serving as primers of information and by their efficiency attributes.

Visual constructions can be used to activate memory. This *priming* effect 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, however, visual primers lay the basis for efficient and powerful recall of concepts, knowledge, and insights through a lifetime of learning. A primer can be viewed as a visual representative of a category which stimulates recall of a specific member of that category (Neely, 1977; Posner & Snyder, 1976).

Visuals also provide *efficient* use of cognitive processing. Larkin and Simon (1987) cite the major value of visuals not in 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." This sequential representation requires greater amount of processing power than the processing of diagrams. Visuals also have the capacity to reduce the problem solving time by limiting the choices a student has to make.

Personalized Sources of Understanding

In addition to acting as personalized organizers and efficient cognitive processing agents, visual constructions also provide learning and understanding. For example, mathematics has traditionally used visuals in the solving and representation of mathematical problems. However, many students perceive mathematics as merely notation and word problems, rather than as a richer world that with significant implications to society. Mathematics is the science of patterns, metaphorically speaking (Steen, 1988), but pattern is also a visual metaphor which can transform the richness of mathematics and other fields into understanding and appreciation by learners. Zimmermann and Cunningham (1991) state that the important goal in the mathematics classroom is not to visualize the diagram, but to visualize the concept or problem and that visuals are a means toward understanding.

An important finding in learning is that new information is remembered best when it is meaningfully connected to prior knowledge. Visuals that are constructed by the learner tap into this reservoir of trapped knowledge and allows an individual to link past experiences to new knowledge to create improved understanding. Also, self-constructed frameworks are more meaningful than external representations, although not necessarily more accurate in the early development of visual notetaking skills. Retention and potential for future use must be improved when new information is organized in this fashion.

Another way in which visual notetaking promotes true learning and understanding is that it may help to satisfy a learner's cognitive need -- a motive or desire to observe and to know the environment. A learner may transfer the skills of visual notetaking and review to other activities, such as constructing a lecture, preparing a paper or a proposal, analyzing a complex problem, and communicating an idea or concept. Visual notetaking could become a component of a personalized learning process, which promotes metalearning , a means for learners to monitor their own learning and to reflect and to make changes in how they learn. Eventually such a personalized system may help to reconstruct the unity of knowledge from school knowledge.

As I see it, visual notetaking offers to improve one's cognitive abilities as organizers of information and concepts, as efficient processors, and as a way to promote understanding.

The visual notetaking process also contributes to the external world which is engaged by cognitive processes. These external potentials of the teacher, the environment, and the learner are affected by a number of issues. First, how learners are assessed affects the way they approach learning. Visual notetaking can provide both students and teachers with ready-made evaluation tools, particularly with the use of visual notetaking methods that document concept learning. Visuals can also be used by teachers to gain insight into a learner's individual learning style, higher level thinking, and self-image. Visual notes can reveal misconceptions in a student's notetaking efforts and can help a teacher to develop a dialogue with a student in order to become better acquainted with a learner's goals.

Another issue is the realization that mastering any skill requires a great deal of time and patience. Visual notetaking as a strategy and a set of sub-skills is no exception. Mastery of a specific visual notetaking technique may also require direct instruction, which consumes instructional time in both preparation and delivery. As any other recommendation or innovation, the teacher must balance the challenge of a new idea with a sober estimation of instructional support. Integration of a particular technique to one's personalized learning system may require many years to achieve. The advantage, however, is that visual constructions, visual notetaking, or a personalized learning system, is a metalearning construction made by the learner. This is its most powerful potential.

I think also that whenever any of these techniques are introduced into the classroom, their use over time suggests to students that a teacher has high expectations for them, which I believe is a valid learning promoter. And, as mentioned before, such expectations must also contribute to improve relationships and interactions between learner and teacher.

Developing skills in visual constructions may provide personalized motivations to media that did not exist before and help to re-orient the role of media in the classroom from merely an instructional activity to a self-motivated drive by the student to learn and adapt media to fulfill a learner's goals. Visual notetaking as an ongoing process should help learners drive their need and mastery of media to fit their unique learning needs and to help them discover and understand their own learning and intellectual styles (Papert, 1993). In the past we have adapted our mind to fit the media. In the future we will adapt media to our needs. A personalized learning system serves to motivate learners to increase their skill levels with media and to customize its various forms. This personalized motivation of media will allow students to develop skills that enable them to learn with appropriate tools.

Generally, these issues reinforce this belief -- that task, learning environment, teacher, and learner affect an individual's motivation to learn. I regard the construction of personalized meanings, with or without the use of diagrams or pictures, or stick figures, as a key contributor in the learner's motivation to instructional activities or self-directed learning.

A Final Comment

The purpose of this paper has been to identify a perceived problem with instruction: its fragmenting effect on the wholeness of information and its removal from context, which robs information of its significance and its ability to become a part of a learner's set of personalized meanings.

I have proposed that the process of visual notetaking may invigorate the mundane notetaking and review strategies with a prospect that over time personalized meanings to information can be assembled using visual constructions.

To validate many of these ideas will require a research program over much time. In a small way, visual notetaking is only a specific strategy that's being recommended in an effort to improve educational practice for those who teach and for those who learn. Elliot Eisner in his address to the AERA in 1993 asked, "What can we do that does justice to develop human intellectual capacities?" This should be the beginning to any educational research program.

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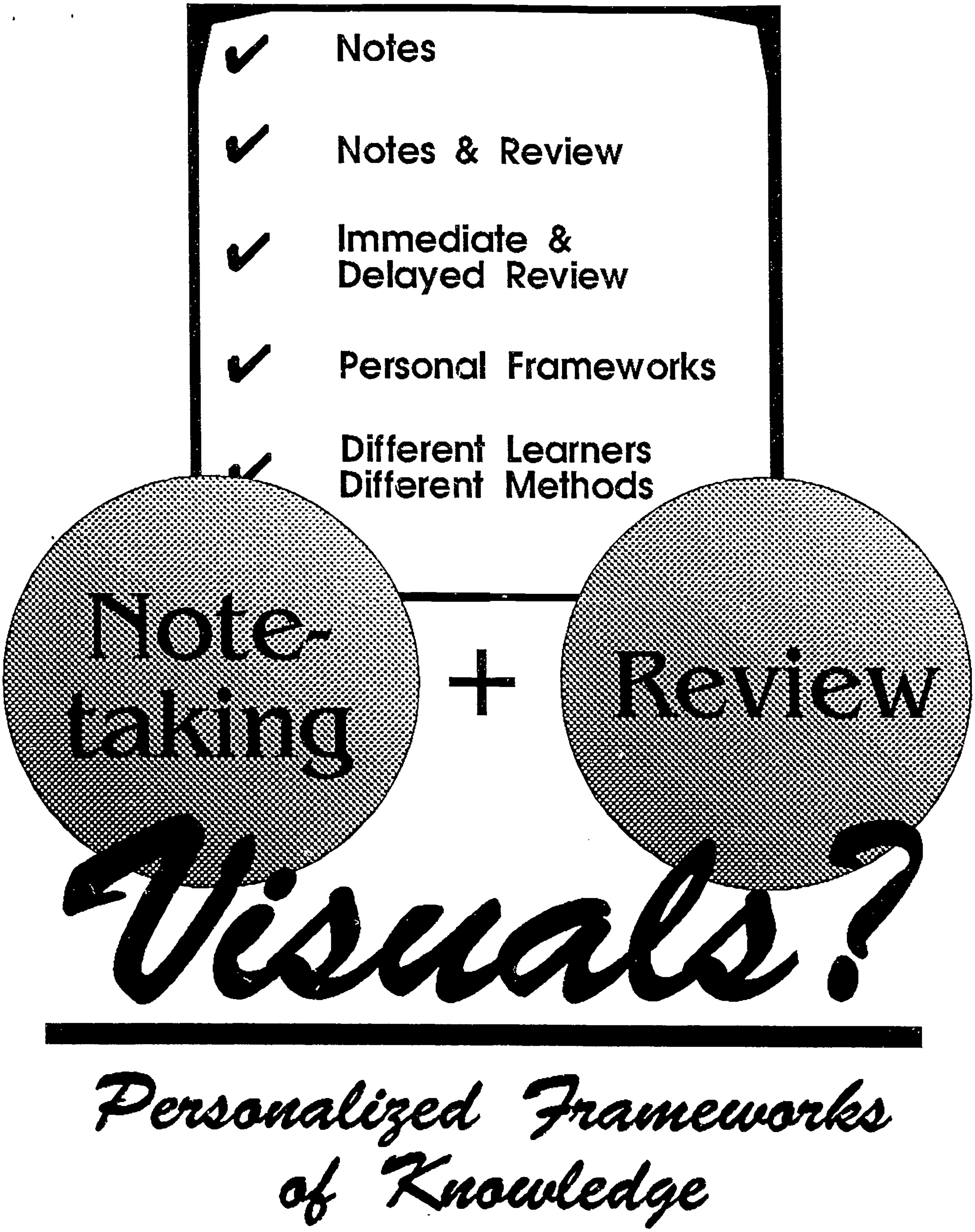

Notes
Notes & Review
Immediate & Delayed Review
Personal Frameworks
Different Learners Different Methods
Note-taking
+
Review
Visuals?
Personalized Frameworks of Knowledge

Figure 1

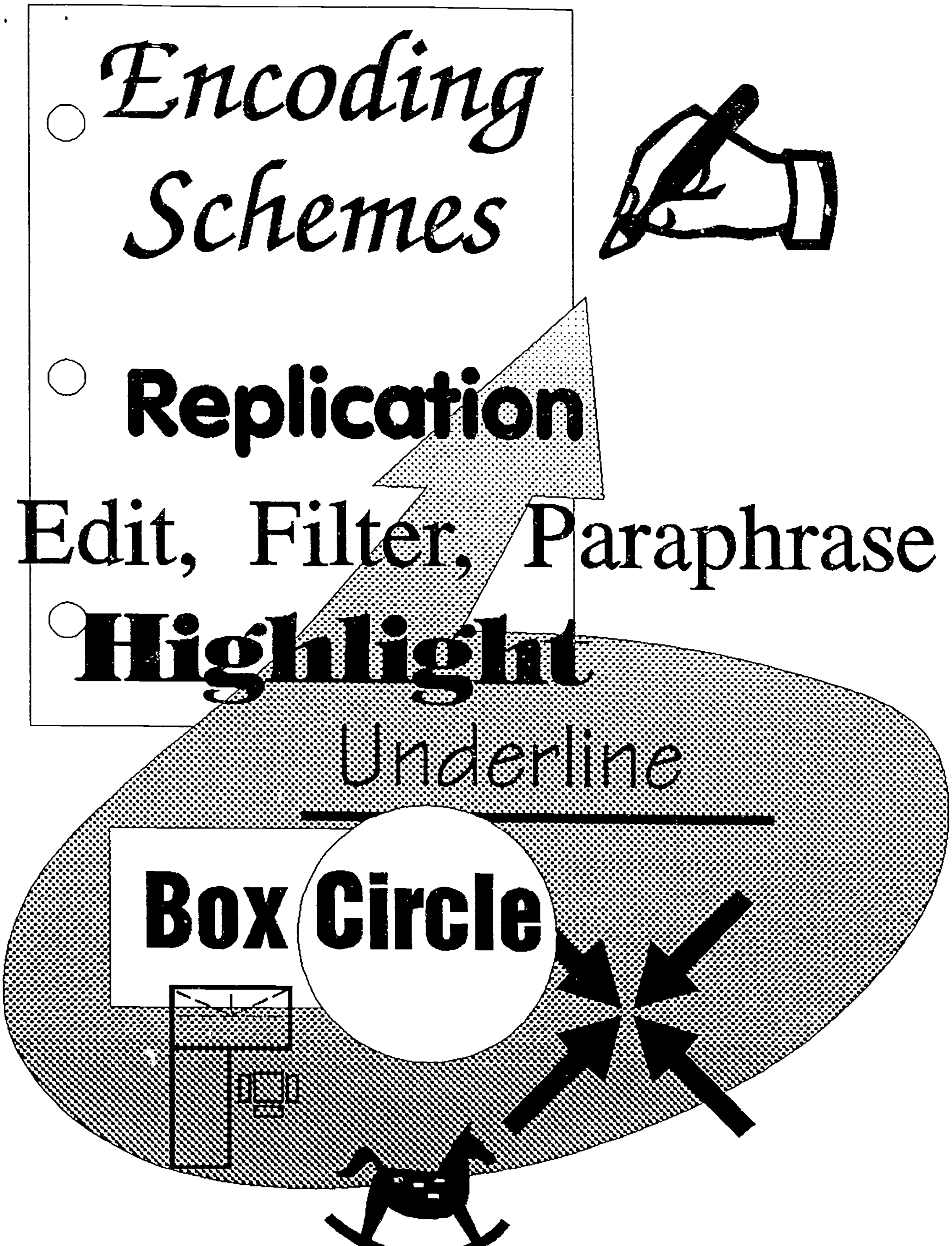
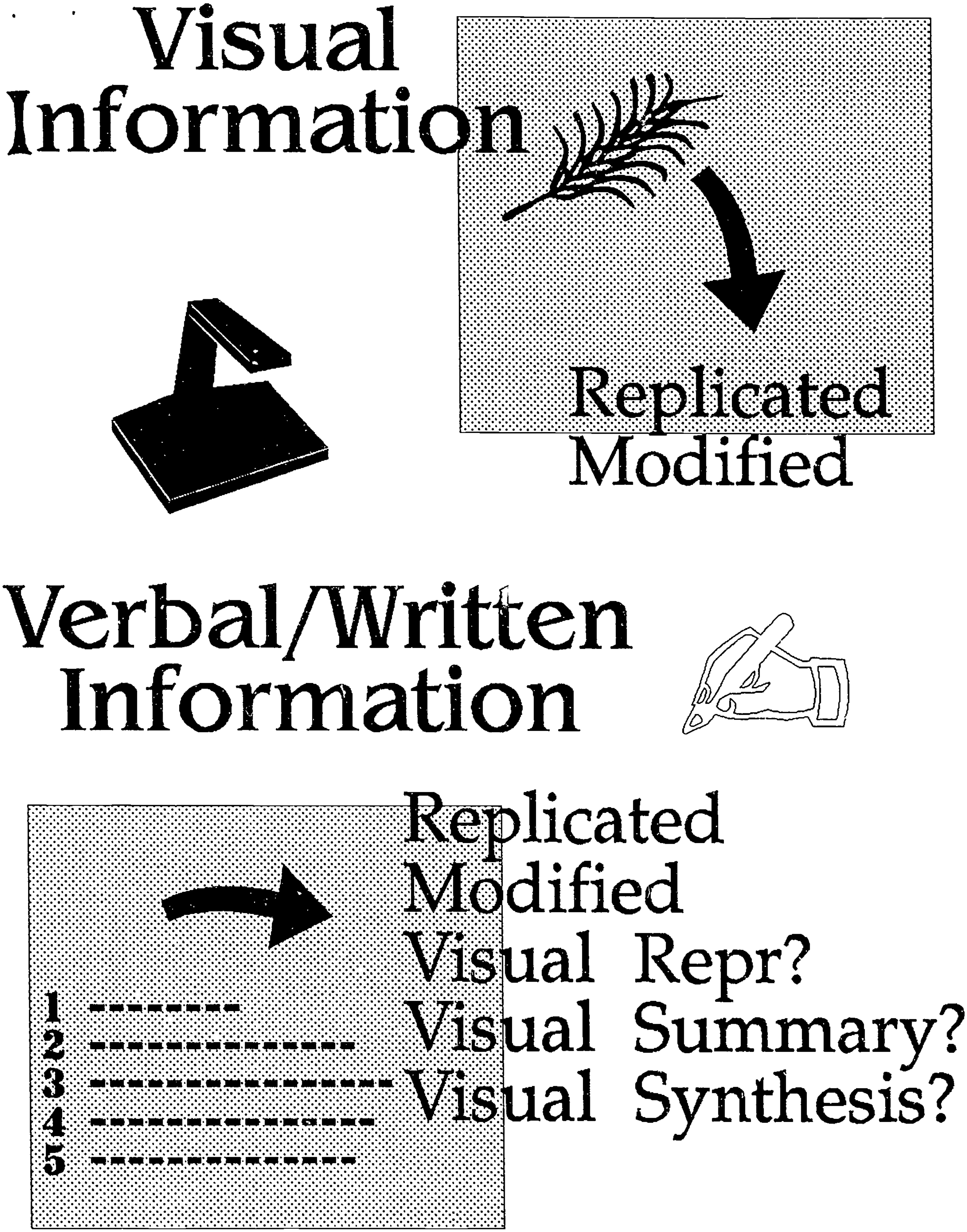

Encoding Schemes
Replication
Edit, Filter, Paraphrase
Highlight
Underline
Box Circle

Figure 2


Visual
Information
Replicated
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Verbal/Written
Information
Replicated
Modified
Visual Repr?
Visual Summary?
Visual Synthesis?
1
2
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5

Figure 3

Chapter 6 -- Visual Literacy: The Definition Problem (Seels)

I. Visual literacy as a concept

A. Evolution of the concept
  1. Solomon: transfer of literacy?
  2. Gardner: unique intelligence
  3. Text: broad meaning

B. Need for visual literacy
  1. Innative visual abilities
  2. Higher order thinking skills
  3. Difficult to achieve

II. Visual literacy as a construct

A. Visual/visible language
  1. Debes: visual literacy teaches visual language
  2. Differences between

B. Concept or construct
  1. Debes: hierarchies of visual skills
  2. Too many meanings to be operational

III. Visual literacy, thinking, learning, and communication

A. Visual literacy evolution
  1. Skills definition of 1970's
  2. Wileman (1980's) ability to read and understand images
  3. Heinrich (1982) learned ability to interpret images

B. Construct relationship with visual literacy
  1. Visual thinking, learning, communication subconstructs
  2. Visual literacy cube

C. Visual thinking
  1. Arnheim (1969) as metaphor
  2. Samuels (1975) many sources of imagery

(etc)

(Source: Seels, 1994, in Moore & Dwyer, 97-107)

Figure 4. Outline

Page Organization

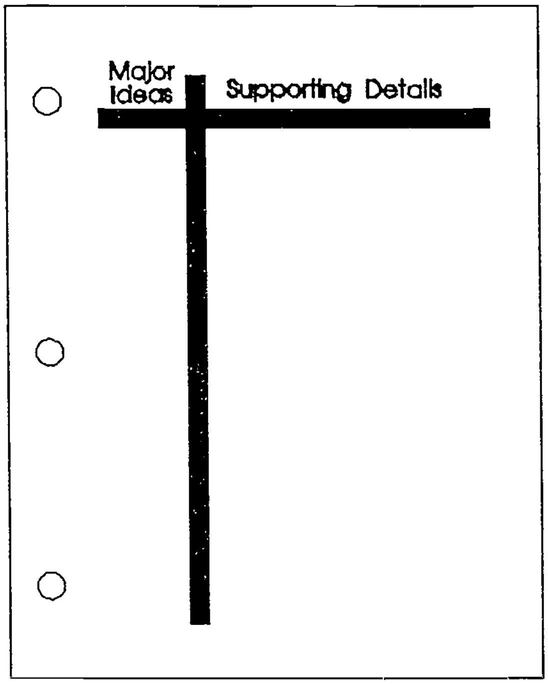

Figure 5a: Split Page

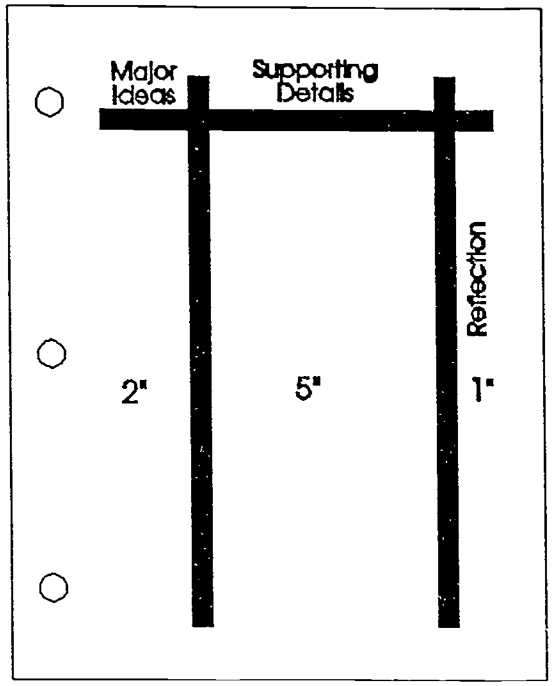

Figure 5b: 3-column

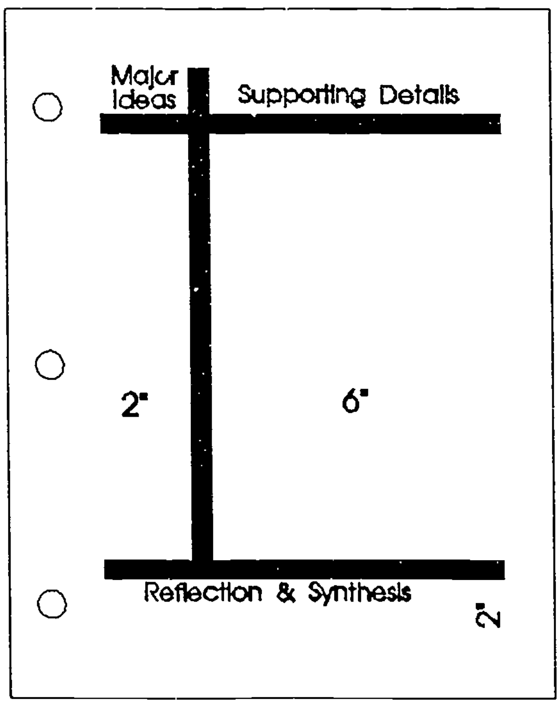

Figure 5c: 3-column (2-6-2)

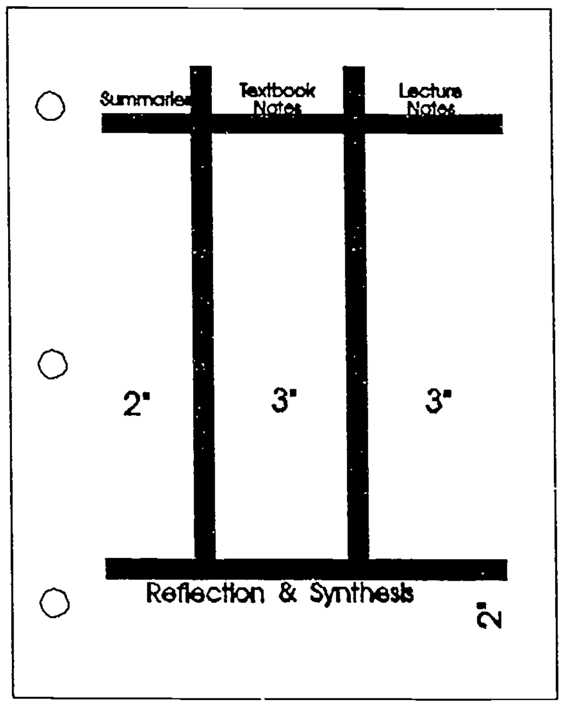

Figure 5d: 4-column (2-3-3-2)

Figure 5: Page Organization

Person	Date	Event
Columbus	1492	Discovers New World
John Cabot	1497	Explores North American coast for England
Magellan	1522	Sails the World

Figure 6: T-Line

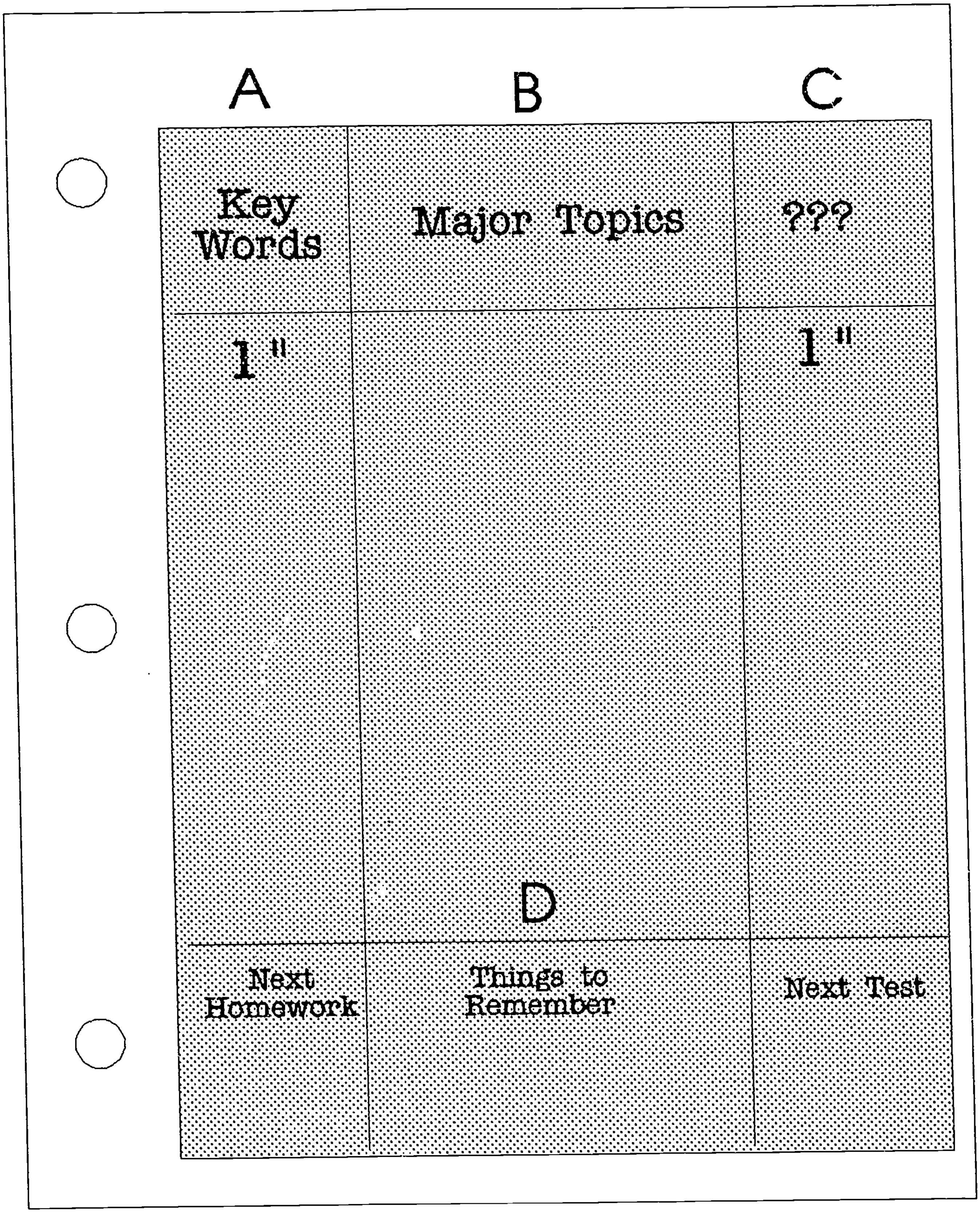

Figure 7: Stein's Note-Page

How Dinosaurs Became Extinct

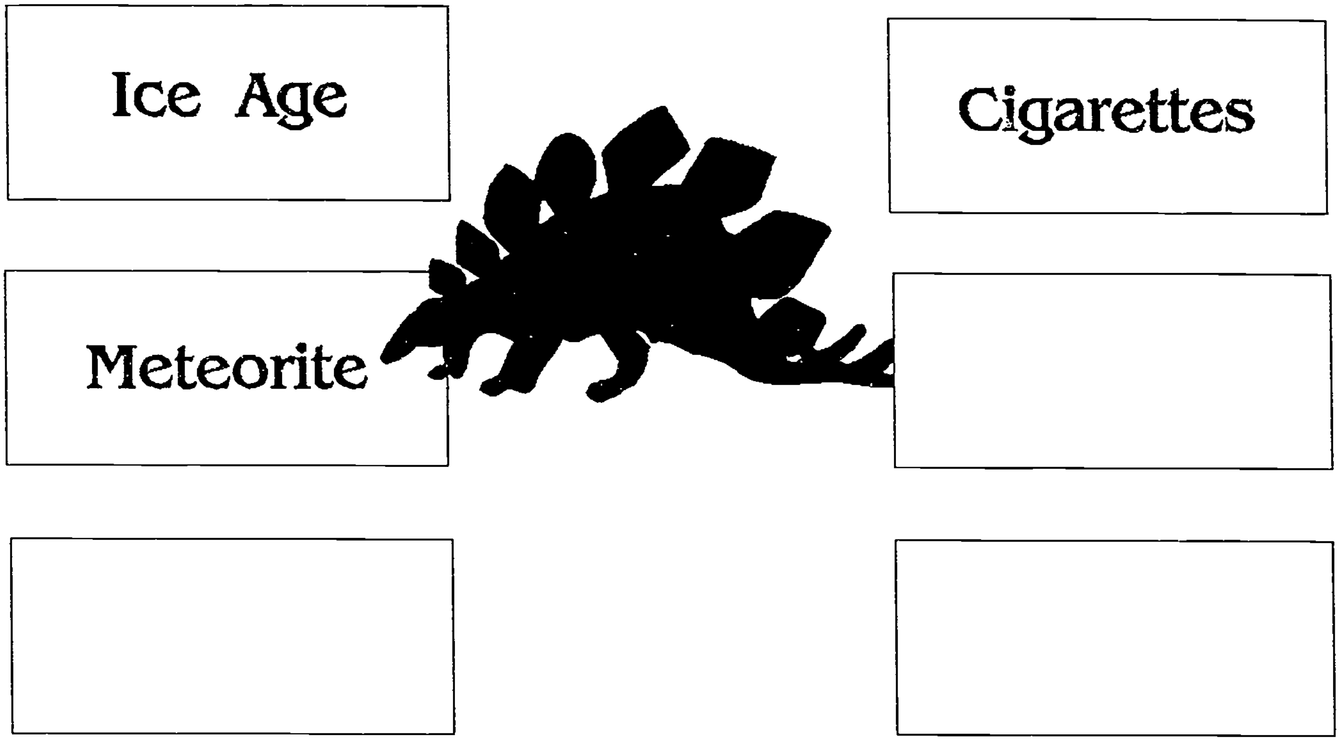

Figure 8a: Word Pictures

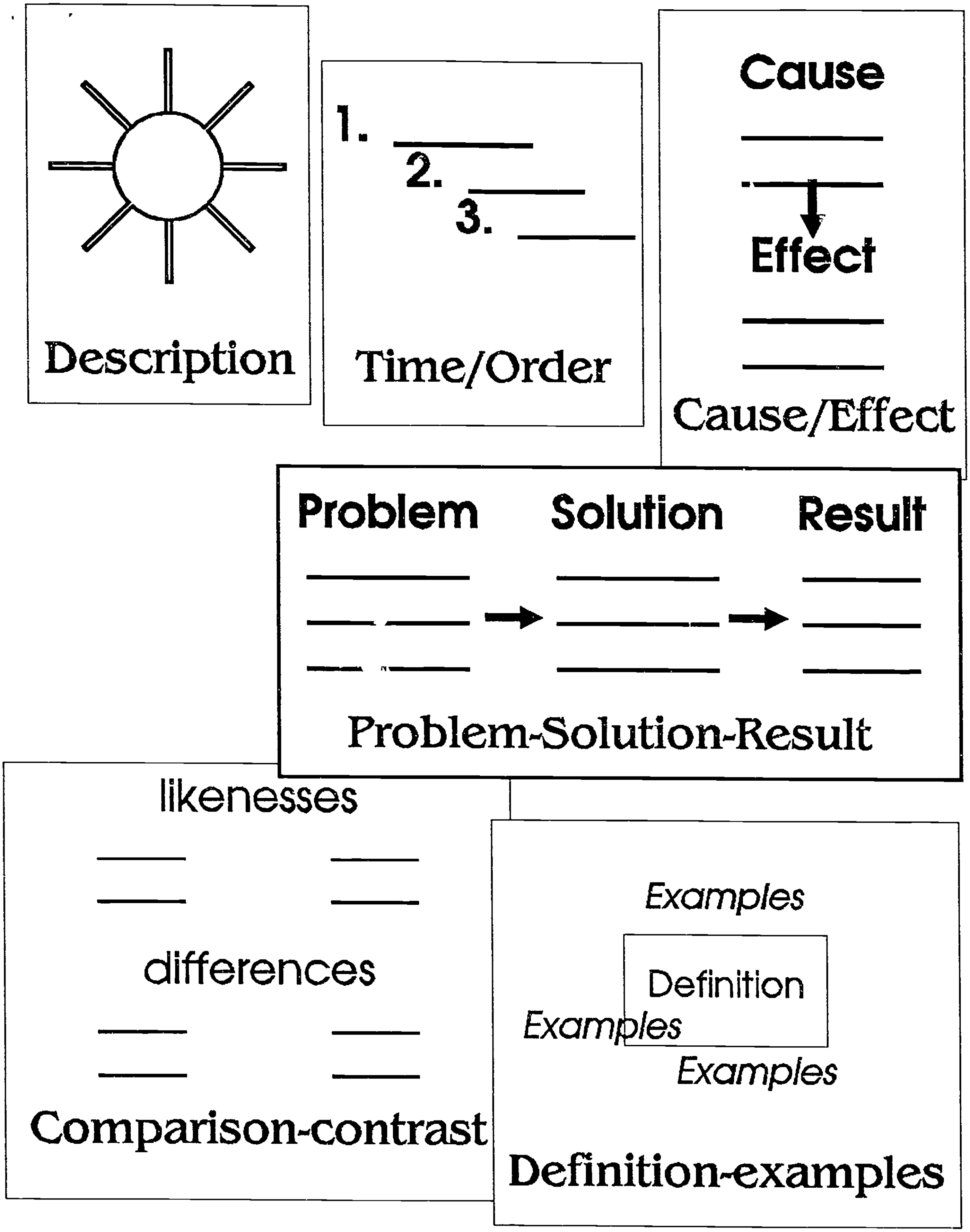

Figure 8B: Text Structures

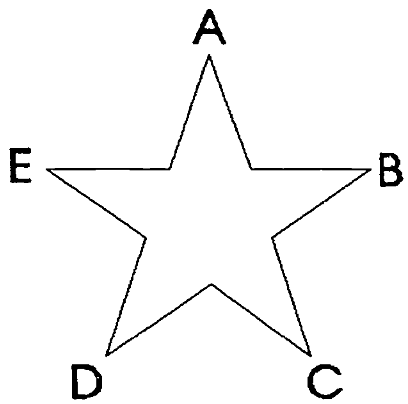

Figure 9a:
Star
"Descriptive"

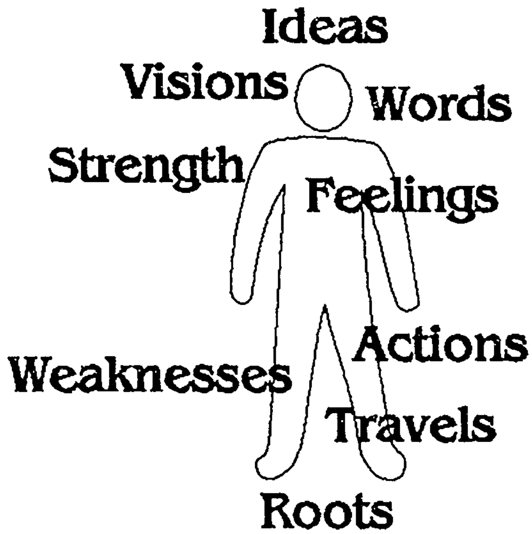

Figure 9b:
Stickperson
"Descriptive"

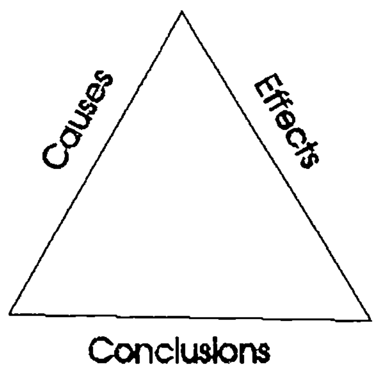

Figure 9a:
Star
"Explaining"

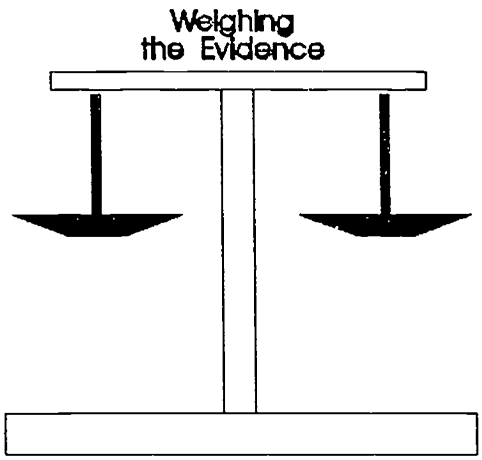

Figure 9b:
Stickperson
"Persuasive"

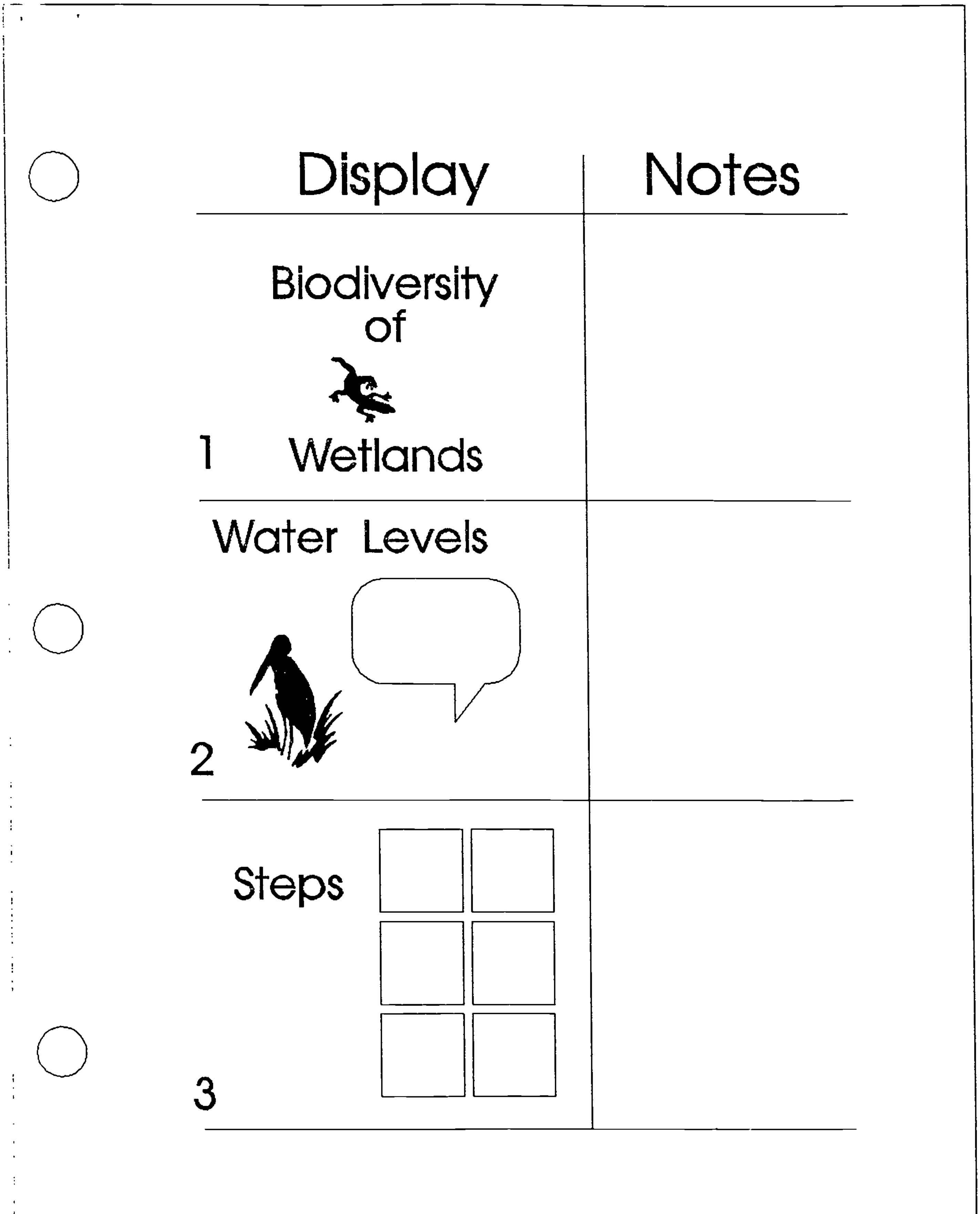

Figure 10: Interactive Study Guide

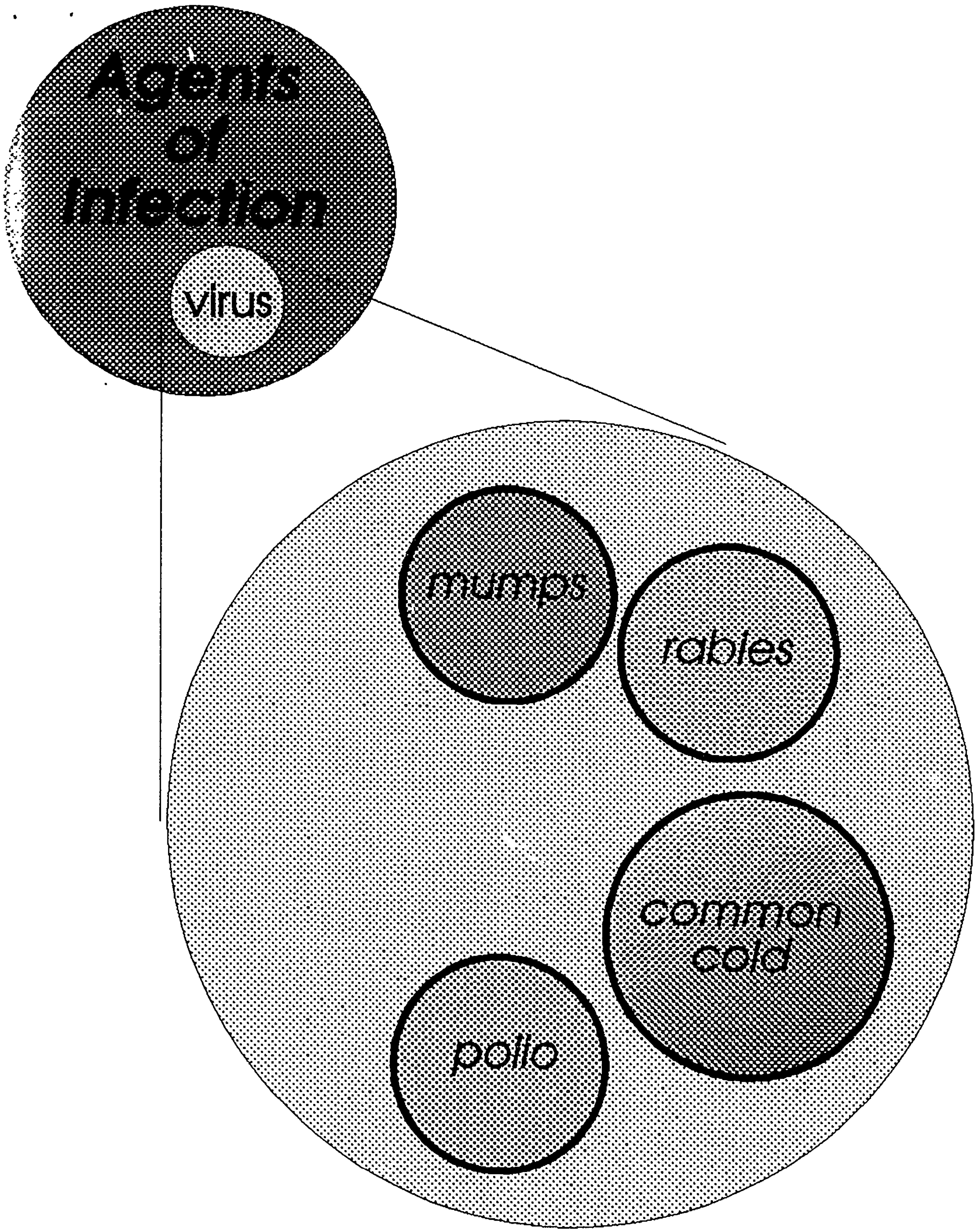

Figure 11: Concept Circles

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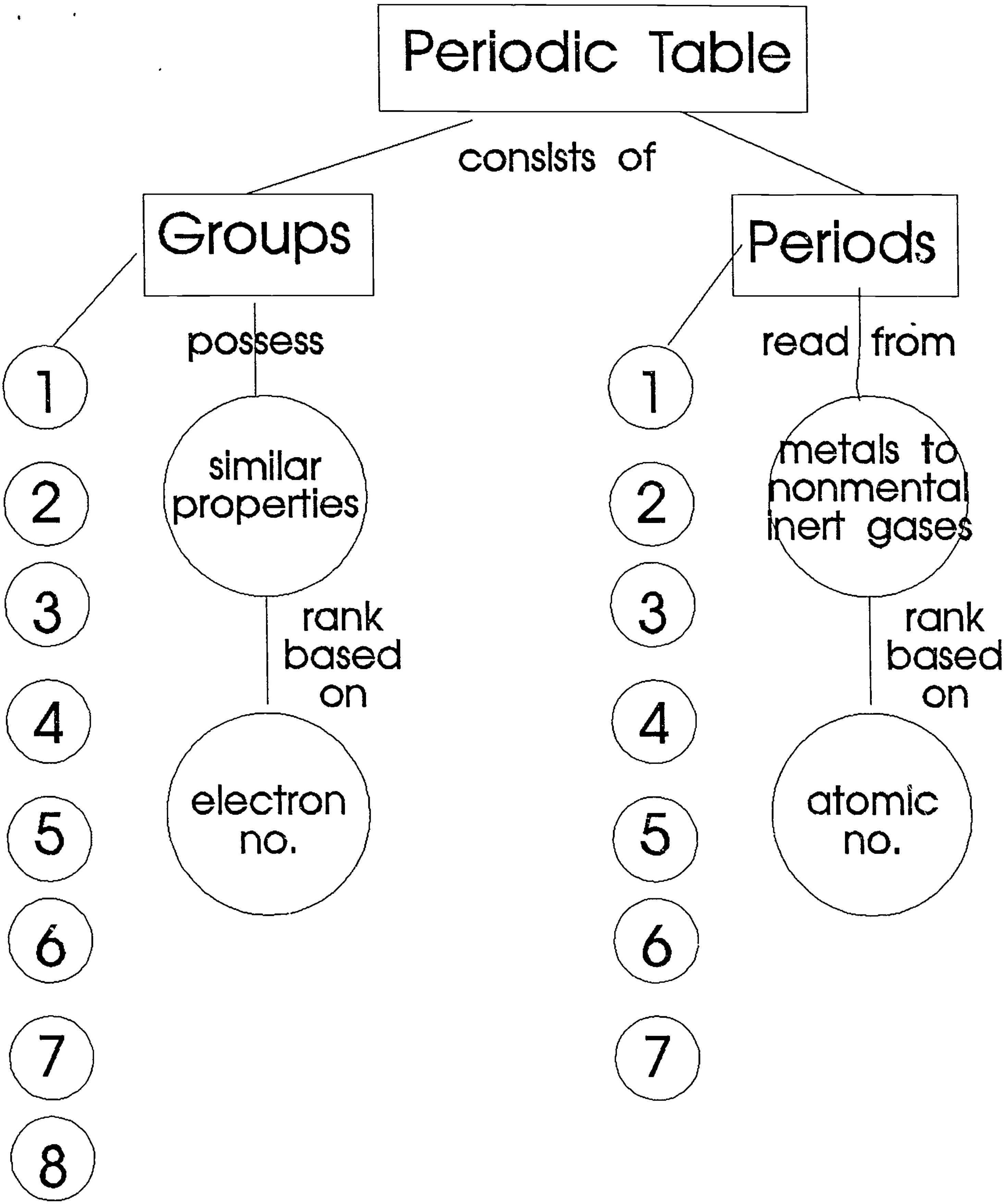

Figure 12: Concept Map

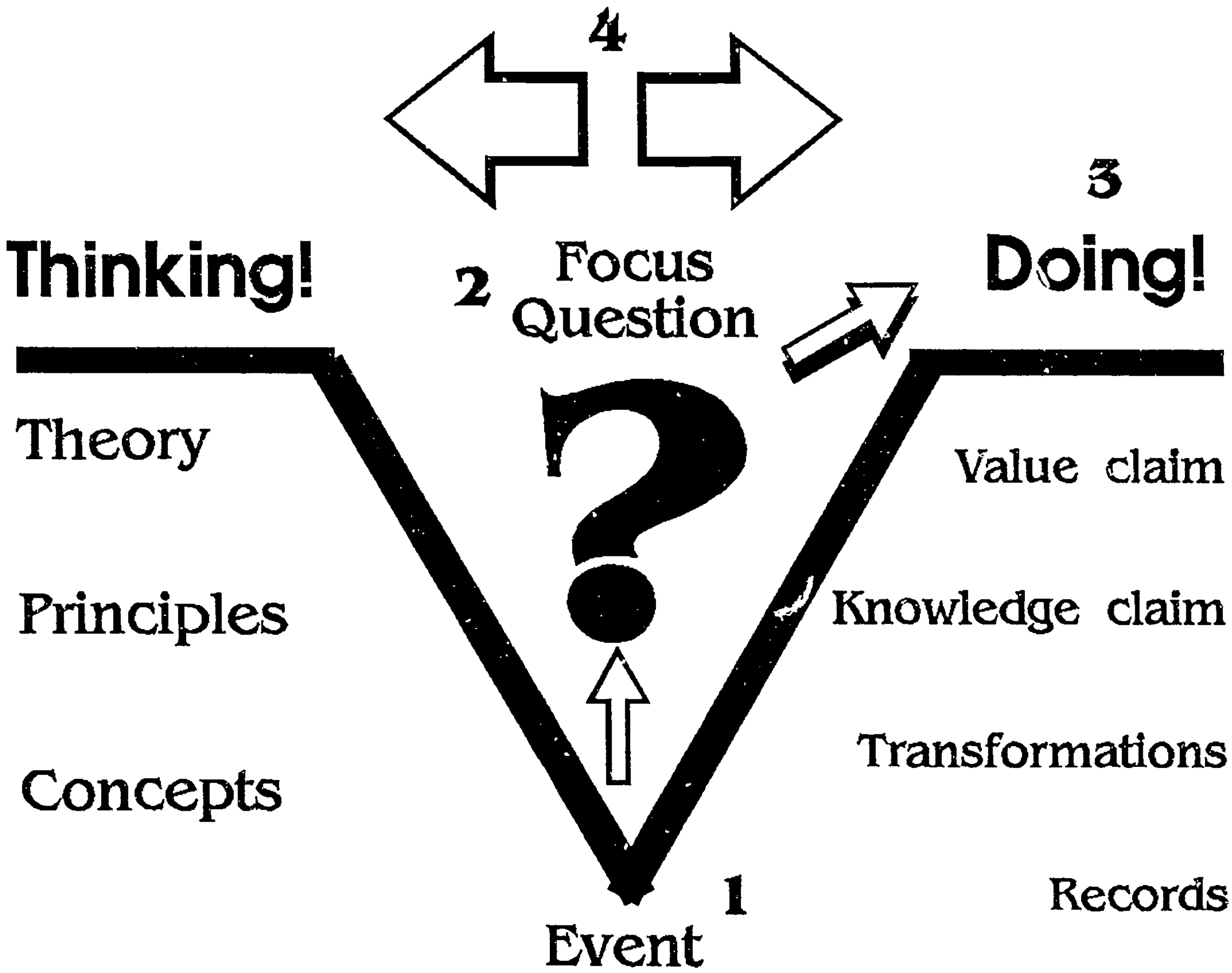

Figure 13: Knowledge Vee

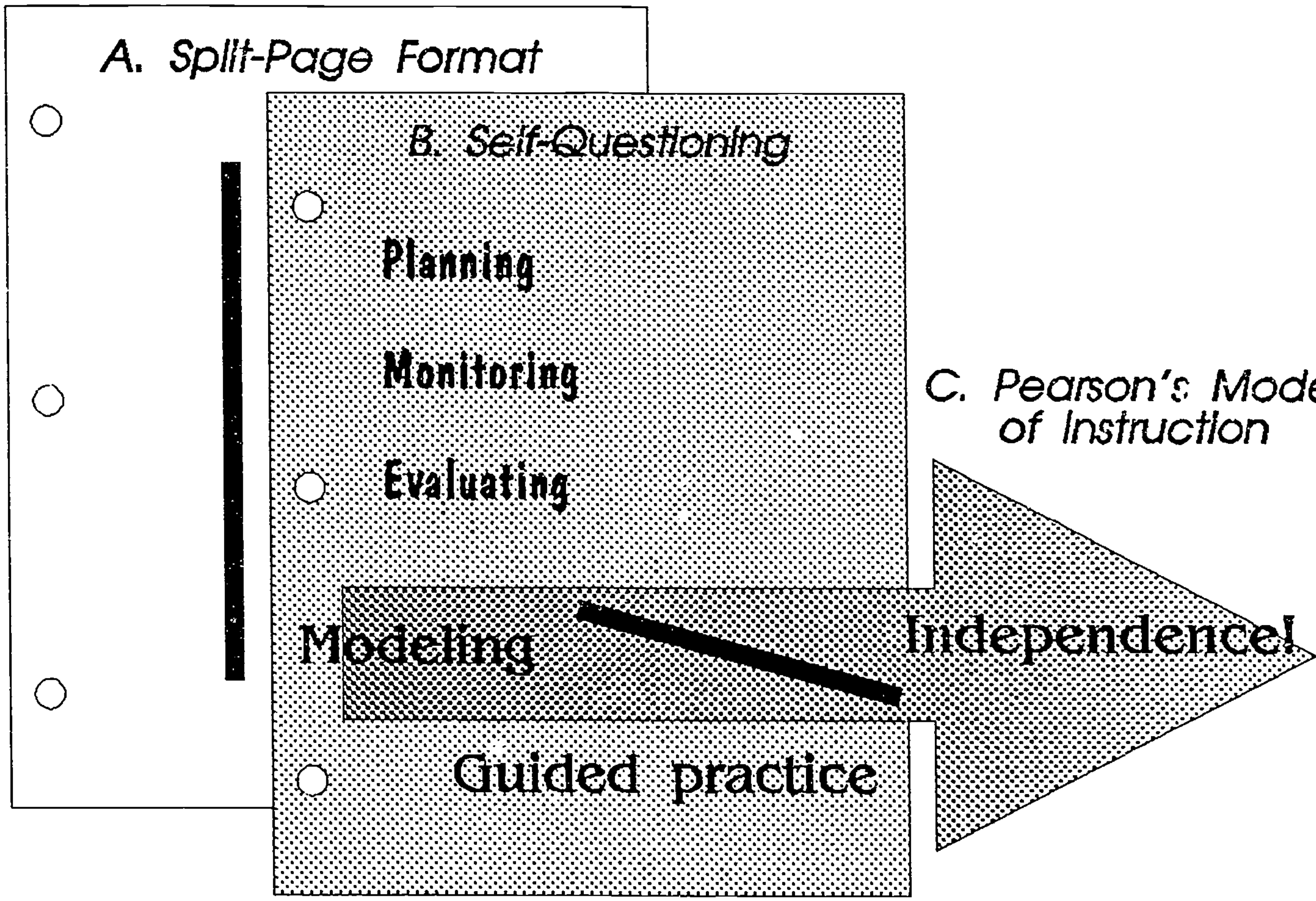

Figure 14: Directed Notetaking Activity (DNA)
(Spires & Stone, 1989)

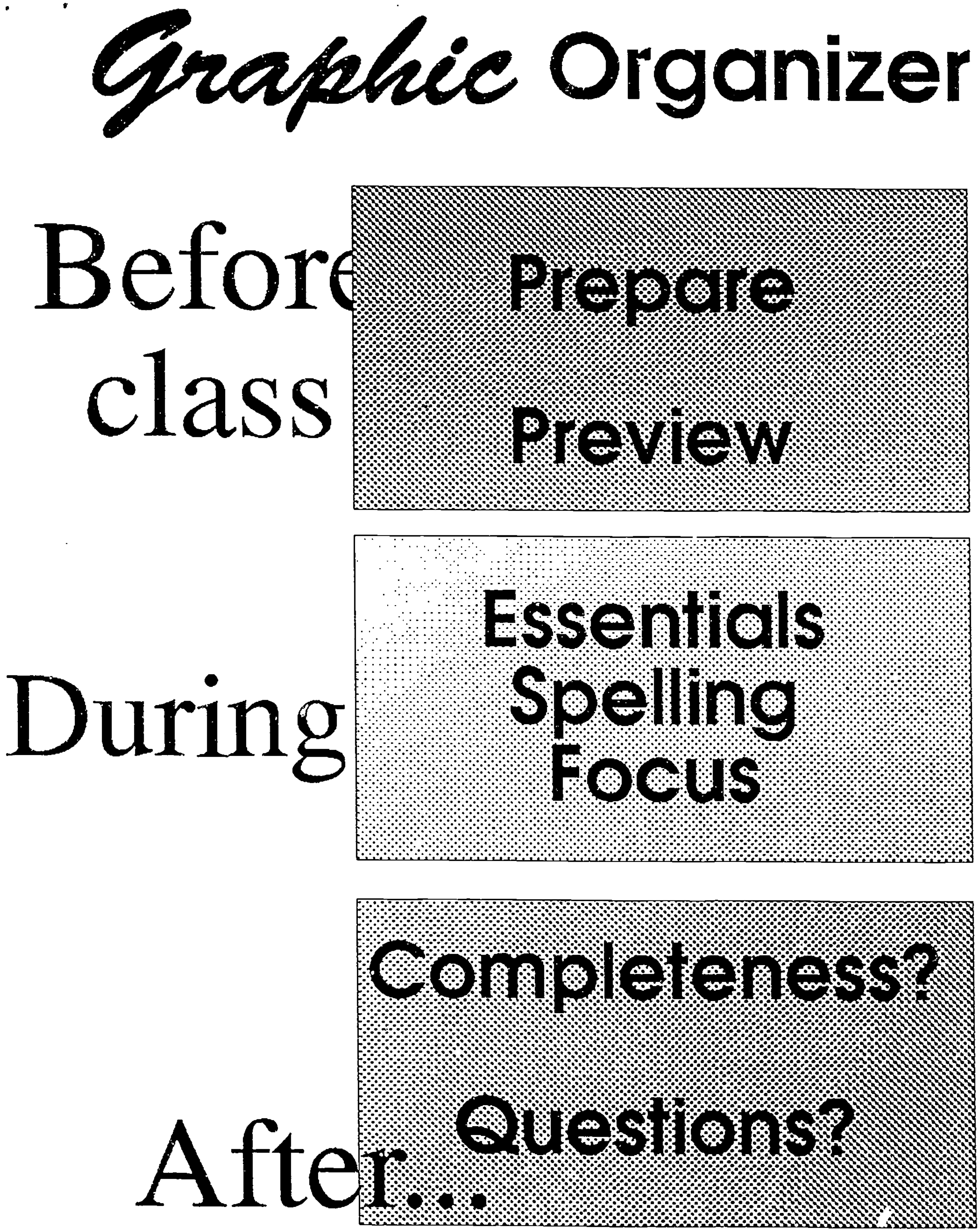

Figure 15: Graphic Organizer

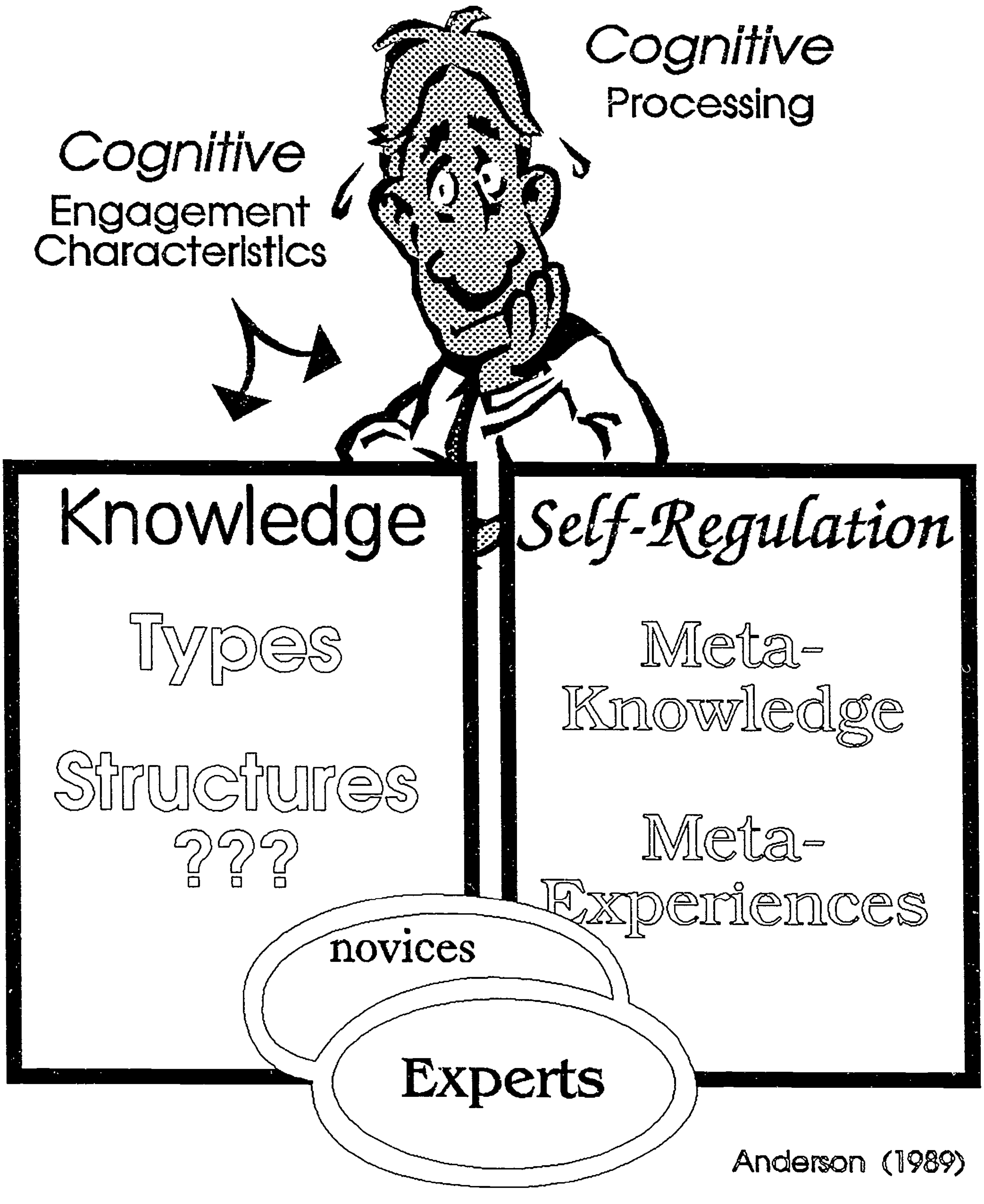

Figure 16: Cognitive Engagement Characteristics

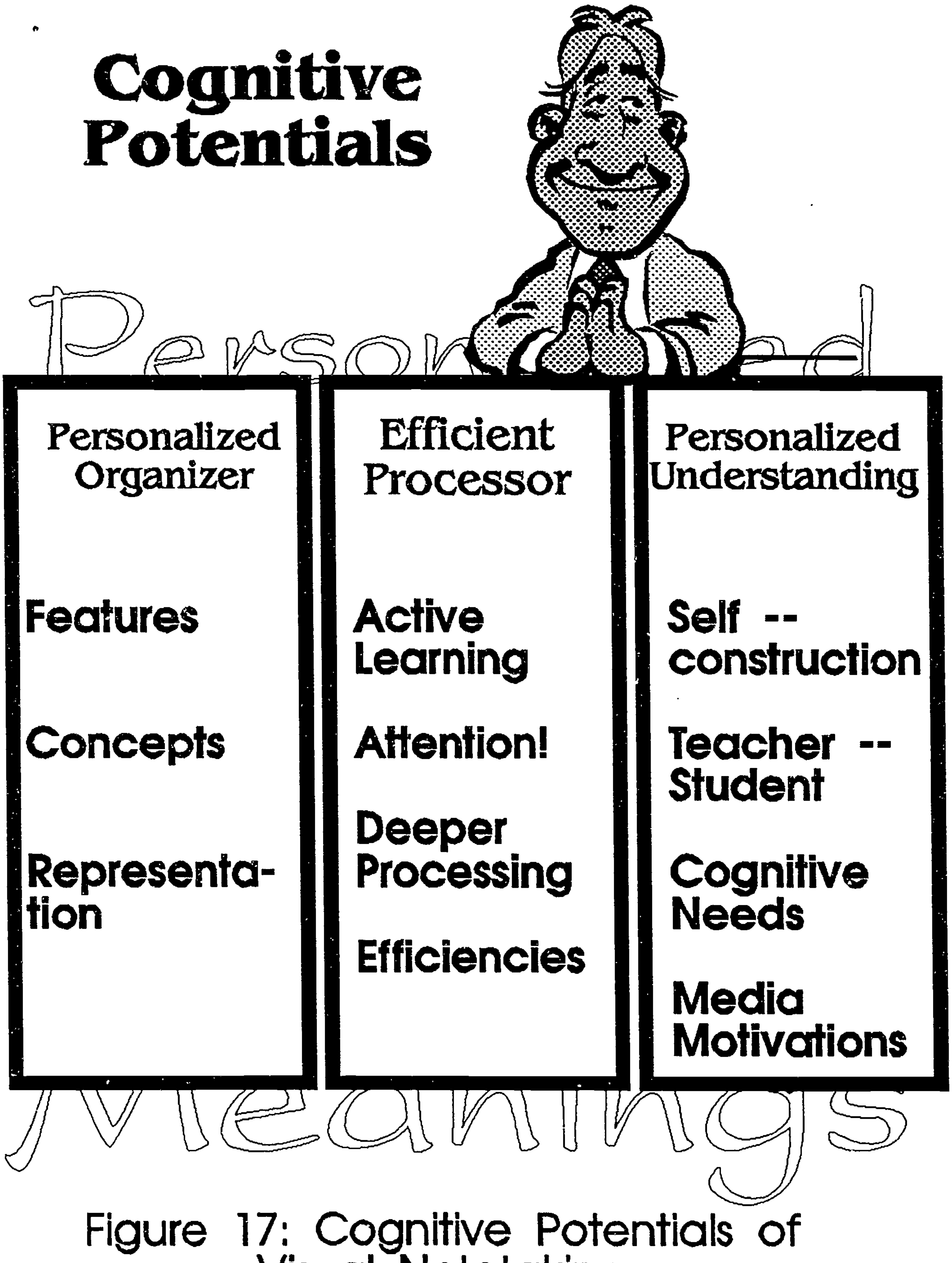

Figure 17: Cognitive Potentials of Visual Notetaking

Table 1 - Features, Benefits, Drawbacks of Visual Notetaking Methods

	Features	Benefits	Drawbacks
Page Organization			
Outline	Numbering sequence to record major ideas	Widespread, easily taught, parallels textbooks	Creates verbal notes; formal method
Split-Page	Left column: major ideas Right column: supporting Column 3 for Reflection Option column for textbook	Reflection column develops metalearning; help students to make decisions; clarify important points	Creates verbal notes and does not prevent verbatim notetaking
T-Line	Top: Person-Event columns Vertical line: Date	Recording chronological narrative; helps to visualize and encode	Limited to chronological thought
Note-Page	Sections for key words, teacher questions, notes, key dates	Mix verbal/visual	Practice needed; requires teacher support
Visualization			
Mind Pictures	Mental imagery	Develops elaboration and inferencing, personal structures, active learning, comprehension, control	Instruction required with learning activities
Word Pictures	Pictures of ideas, concepts, data; visual and verbal representations	Adapt endless variety to match situations; develops imagery	No one visual; variety needed to match topic requirements; modeling required
Interactive Study Guides	Organized story board of word pictures, some details left out	Promote interactivity; students focus on key topics; develop visual potential of topics	Requires teacher prep.
Concept Diagrams			
Concept Circles	Labeling, geometry, color applied to circles to represent concepts and structures	Aids understanding, recall; easy to draw; introduces students to metalearning.	Requires student or teacher to buy into constructivism and Ausubelian theory; instruction required
Concept Maps	Hierarchical relationships of concepts	Reveals student misconceptions; helps students to understand new meanings of knowledge; develops group learning	Requires instruction

Knowledge Vee	Pictures relationships of knowledge by relating thinking to investigating through a V diagram	Promotes relationships of knowledge; how knowledge is constructed and how it relates to our real world	Complex; instruction needed; uses concept maps
Teaching Processes			
DNA	Split-page, self-questioning	Promotes upper level processing; develops learning framework	Takes time to implement; requires instruciton
Graphic Organizer	Visual outline of lecture or chapter	Organizes student thoughts; student knows where lecture or chapter is heading	Teacher involved
NOTES	Modeling, practicing, evaluating, reinforcing system of notetaking instruction	Instructional system; wide application; evaluation component	Takes time and commitment by teacher and student

<table>
<tr><th>Cognitive Engagement Characteristic</th><th>Strategy</th><th>Cognitive Process</th></tr>
<tr><td rowspan="2">Knowledge
Self-Beliefs</td><td rowspan="2">Notetaking</td><td>ENCODING
Interpretation
Comprehension: listening, seeing
Pattern matching and connecting new to old
Decisions & Judgments</td></tr>
<tr><td>Differentiation
Identify relevant information
Classify information into categories
Choose visual construction
Decisions & Judgments</td></tr>
<tr><td rowspan="2">Knowledge
Self-Beliefs</td><td rowspan="2">Review</td><td>DECODING
Differentiation
Identify relevant information
Classify information into categories
Decisions & Judgments</td></tr>
<tr><td>Interpretation
Synthesize
Make connections from new to old
Decisions & Judgments
Elaboration
Rehearsal
Storage: reconstruction of notes</td></tr>
</table>

Table 2: Cognitive Strategies & Processes