Learning, Creating, and Using Knowledge

Concept Maps as Facilitative Tools in Schools and Corporations

Second Edition

Joseph D. Novak

Routledge
Taylor & Francis Group
NEW YORK AND LONDON

Contents

Act (passed in 1865) and the Extension system that has been so successful for our advances in agriculture could yield enormous advances in education. What has been needed is a vision or, more specifically, a comprehensive *theory of education* to guide the changes needed. The foundations for theory/research-based improvement of education are being laid. We need to seek better institutional structures to advance and build upon these foundations. There are no easy solutions to the political problems that will need to be solved to effect this advance. With the growing importance of education in every phase of our lives, including our economic well-being, I am confident that solutions will be found

With the accelerating "globalization" of business and the growing importance of creating and using knowledge to remain competitive, we have seen in the past decade significant growth in corporate interest in educating—that is educating that empowers people to be more creative as well as more content. I see a future where new partnerships will be formed between businesses and educational institutions, where a new kind of sharing and seeking solutions will take place. The first few decades of the twenty-first century are likely to be revolutionary in many respects, and most importantly in how we learn better to educate people for whatever the needs may be.

Chapter 3

Meaningful Learning for Empowerment

Meaningful learning results when the *learner chooses* to relate new information to ideas the learner already knows. Its quality is also dependent upon the conceptual richness of the new material to be learned and the quantity and quality of the organization of the relevant knowledge held by the learner. Rote learning occurs when the *learner memorizes* new information without relating it to prior knowledge or when learning material that has no relationship to prior knowledge. As will be discussed in the next chapter, creativity is seen as resulting from very high levels of meaningful learning. There is a continuum in learning from "pure" rote to highly meaningful, and Figure 3.1 represents this continuum. Meaningful learning has three requirements:

1. Relevant prior knowledge: That is, the learner must know some information that relates to the new information to be learned in some non-trivial way;
2. Meaningful material: That is, the knowledge to be learned must be relevant to other knowledge and must contain significant concepts and propositions;
3. The *learner must choose* to learn meaningfully: That is, the learner must consciously and deliberately choose to relate new knowledge to relevant knowledge the learner already knows in some non-trivial way.

This raises the question: What are non-trivial relationships? For example, if a learner knows that Ohio, California, and New York are states, it is comparatively trivial to learn that Michigan is also a state, unless one goes further and recognizes that states are relatively large geographic units and there are only 50 in the United States, including Alaska and Hawaii. The learner needs to seek to build an *organized* knowledge structure that moves toward recognition of the differences between towns, cities, states, and countries.

When knowledge structures are well organized, "higher order" concepts that are more inclusive and more general *subsume* "lower order" concepts that are more specific and less general. Figure 3.2 illustrates these relationships for the study of history, where the superordinate concept is HISTORY, and two

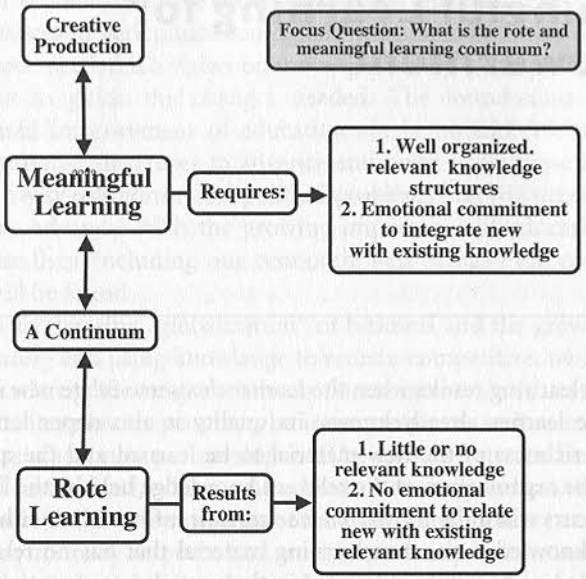

Figure 3.1 The rote–meaningful learning continuum. High levels of meaningful learning require: (1) well-organized, relevant concepts and propositions held by the learner; (2) materials that are rich in concepts and meanings; (3) learner's desire to integrate new knowledge with prior knowledge. Creativity is viewed as very high levels of meaningful learning.

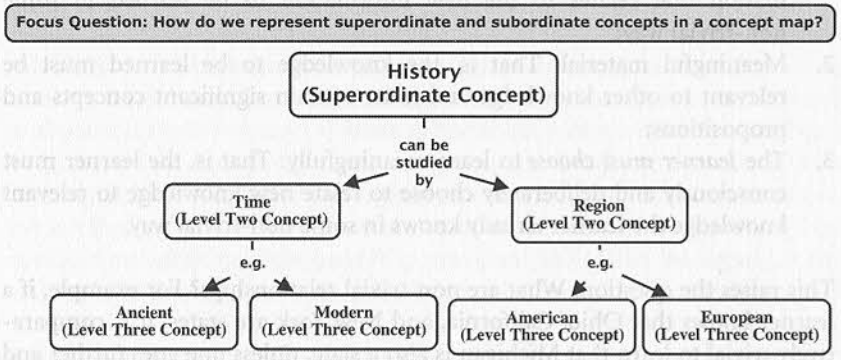

Figure 3.2 A concept map dealing with the superordinate concept HISTORY and showing second- and third-level subordinate concepts.

levels of subordinate concepts are shown. The hierarchical organization is, of course, dependent upon the context we are dealing with, and a remarkable characteristic of our minds is that we may use the same concepts in many different contexts and many different hierarchies. For example, for the study of geography, the concept *European* might hold a more subordinate position on a concept map dealing with geography of the world, and it would also have a somewhat different meaning in this context.

Facts, Concepts, Propositions, and Principles: Components of Knowledge

The universe consists of *objects* and *events*. Objects are composed of atoms and molecules whereas events involve objects and exchanges of energy. For example, this page and the words on it are objects composed of carbon, cellulose, and other substances. Energy was required to produce this page.

Concepts. Your reading of this page is an event that requires mental activity, and this requires energy in the form of biochemical changes in your brain cells. Human beings are unique among animals in their ability to *perceive regularities in objects and events* and to code these regularities symbolically using language (Gazzaniga, 2008). While other animals code experience in sets of neurons that Tsien (2007) calls "neural cliques," only humans use what we call language to represent experiences we have stored. These symbols for regularities in events or objects are usually words (about one million in the English language), but may also be signs such as +, –, Σ, Δ, etc. The symbols represent *concepts*, which I will define as *perceived regularities or patterns in events or objects, or records of events or objects, designated by a symbol* (Figure 3.3). For example, there are various shapes and kinds of things we call a chair, but once a child acquires the *concept chair*, that child will label correctly almost anything with a seat, back, and legs as a chair (see Macnamara, 1982; Bloom, 2000).[1]

Facts and Artifacts: No one has ever seen an atom disintegrating, but we can observe regularities in *records of events* (such as counts of a geiger counter) that *we interpret* to mean atomic decay or disintegration. Similarly, no one has ever seen a dinosaur, but we have bones, footprints, and other records whose regularities allow us to construct the concept of a dinosaur. Much of what humans know is constructed from records of events or objects rather than direct observations. We shall use the term *fact* to indicate a *valid record*. It is a fact that water boils at 212° Fahrenheit, but if our thermometer reads only 200°F in boiling water, we may be some thousands of feet above sea level, or we

Concept
A perceived regularity or pattern in events or objects, or records of events or objects, designated by a label.
J. Novak

Figure 3.3 My definition for *Concept*.

1 For a more sophisticated, esoteric discussion on acquisition of language see Pinker (2007).

may have a faulty thermometer. In the sciences, and especially in the social sciences, it is not always easy to see regularities in events or objects since often times our records are faulty or our measuring instruments are limited or faulty. This is a huge problem in the study of education. Facts are not always easily distinguished from *artifacts*. The pottery fragments studied by anthropologists are human constructions (not naturally occurring objects) and these records of human activity are artifacts. Their meanings must be interpreted, and interpretations may vary widely.

Propositions. When two or more concepts are related by the use of what we will call linking words, propositions are formed. These become the fundamental units of meaning stored in our cognitive structure. The richness of the meaning will depend on the precision and clarity of the component concepts, as well as the specificity of the linking words, and this will depend on the quality of learning that has taken place in forming the concepts, and in turn the meanings of the propositions. We often find confusion between propositions and prepositions, the latter being a grammatical term for words such as "to," "on," "beside," etc. Prepositions may make up linking words, but they are not fundamental units of knowledge, as are propositions. Statements such as: "all men are created equal" and "do unto others as you would have them do unto you" are familiar examples of propositions. Figure 3.4 shows key ideas regarding propositions.

Principles are relationships between concepts. Principles tell us *how* events or objects work or how they are structured. In physics, for example, we have the

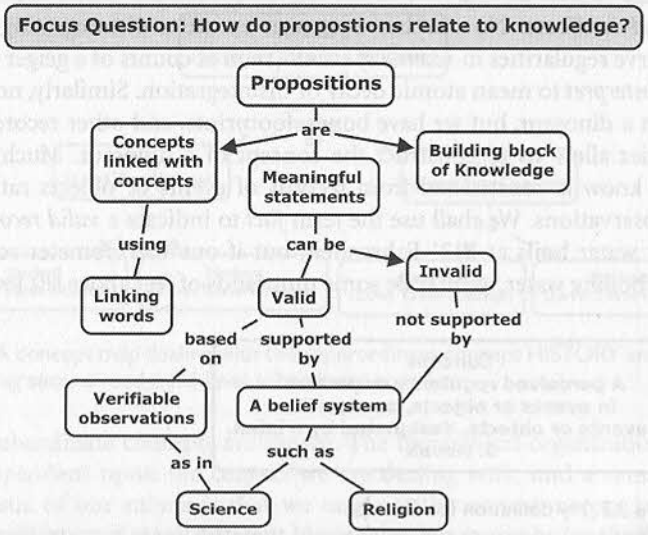

Figure 3.4 A concept map showing the meaning of proposition.

principle: force equals mass times acceleration (F = ma). This principle involves the concepts force, mass, and acceleration. In education we know that learning is in part a function of study time, but the relationship is complex and we cannot write a mathematical formula to express this principle. This book attempts to present a number of principles regarding education and management, principles that I believe are valid even though they derive largely from records that have limited accuracy and validity.

Human Memory Systems

The early pioneering studies of memory go back to the work of Ebbinghaus (1885) who studied his own capacity to remember. He invented "nonsense" syllables, short three-letter words that had no language meaning, to avoid interference from memory of prior knowledge. Nonsense syllables have been used widely in psychological studies, but we now recognize such studies as of little value in understanding human learning. Bartlett's (1932) pioneering work focused on studies with meaningful material and would have been more influential in psychology if behavioral psychology had not crowded out cognitive learning studies for some 75 years. The human brain is a complex organ. It contains at least 300 trillion cells, and each of the cells that functions in storage of information has some thousands of axons and dendrites that permit these cells to store and pass along information. Part of the brain, the lower or limbic region, records information about our feelings, positive or negative. Brain cells are also connected to the skin, heart, lungs and other organs of our body, as well as to the many muscles of our body that produce our movements or actions. In some wonderful way, the brain serves to integrate our thinking, feeling, and acting. The challenge of education and management is to help us most constructively to achieve this integration in a wide variety of contexts. Recent research indicates that "congruence between the recipient's bodily expression of emotion and the sender's emotional tone of language, for instance, facilitates comprehension of the communication, whereas incongruence can impair comprehension" (Niedenthal, 2007). Recent research also indicates that the way our brain codes memories involves a large population of neurons acting in concert to form a memory of an experience (Tsien, 2007). Research by Tsien and his colleagues indicates that memories are formed in the hippocampus region of the brain, and signals produced in the process can be categorized to produce a "codebook of the mind." Grove (2008) also reports that their research indicates that the hippocampus plays a role in organizing information in memory. The hippocampus also functions in the retrieval of memories and imagining new events (Miller, 2007). The amygdula region of the brain functions in organizing and storing feelings associated with experience. While many questions remain, we can expect great progress in the next decade in our understanding of memory processes in the brain.

Our knowledge storage system consists of at least three parts: (1) sensory or

perceptual (PM) memory; (2) short-term or working memory (STM); and (3) long-term or "permanent" memory (LTM). Each of these memory systems depends upon the others, and what is stored in LTM strongly influences what will be perceived, how it will be processed in STM and finally how it will be stored in LTM. Our brain also stores memories of feelings, perhaps primarily in the amygdula region of the brain. And our brain and spinal chord stores memories of actions or physical movements. Study Figure 3.5 and notice that the arrows show interaction between all of our memory systems.

Many of our human limitations derive from our perceptual limitations. Most of us cannot hear sounds below 80 hertz or above 20,000 hertz, nor can we see light in the ultraviolet or infrared range. No amount of learning can overcome these inherited biological limits on our sensory organs. Nevertheless, there remains an enormous range of events we can respond to within our limitations, and instruments we have developed permit us to extend greatly the sights, sounds, and feelings we can record and respond to. While it is true that instruments yet to be developed may give us wonderful new powers to observe regularities in as yet unobserved events or objects, there is perhaps even greater promise in learning how to use the information we now can

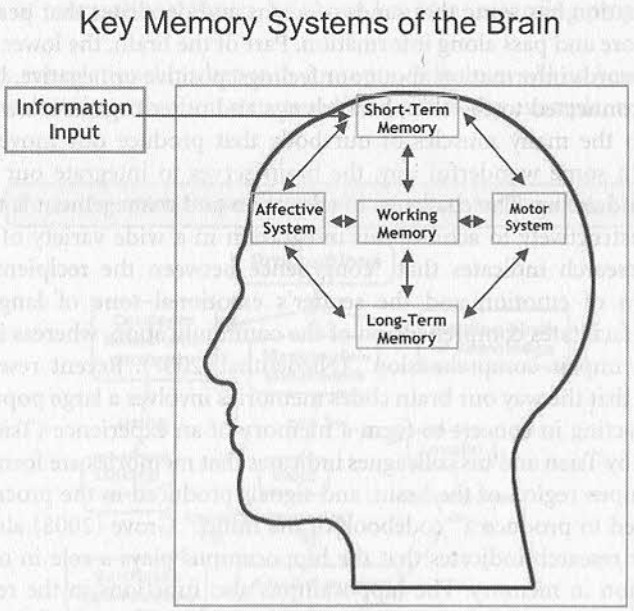

Figure 3.5 A representation of the memory systems involved in human learning. Note that each system interacts with the others, both limiting and facilitating the acquisition of information. Note that this diagram does not represent the actual structure of the brain. That can be seen at many Google sites using "structure of the brain".

gather by learning to improve our use of our working memory and the quality of the organization of knowledge stored in our long-term memory.

In 1956, George Miller published an article entitled "The magical number seven, plus or minus two." In this article Miller presented data to show that our short-term or working memory system can only operate on about seven "chunks" of information at a time. In a later article, Simon (1974) asked, "How big is a chunk?" Simon's answer was basically, the size of a "chunk" depends on the knowledge you have in long-term memory. This has been confirmed by numerous studies including our own work. For example, people who recognize numbers as symbols can remember six to eight numbers after a short (five to ten second) exposure to a list. The learning time must be long enough to perceive the material through sensory memory, but not long enough to "rehearse" or repeat the information, until it is set into long-term memory. The same is true for letters, but often letters can be "chunked" as words or word-like units, and hence nine or ten "chunks" might be recalled after a short exposure. In our work we find that the letters Q C V M E P Y T O are often chunked by people as Q, C, V, Me, Pyto, and all ten letters can be recalled. Familiar words may contain several letters but each word is a psychological "chunk," and five to nine words may be recalled after a short exposure. Very familiar strings of words can also be processed as single "chunks." For example each of the following statements could be a chunk: Jack and Jill went up the hill; to be or not to be, that is the question; pi is equal to the circumference divided by the diameter; profit is equal to the price minus the costs. If all of these statements are already well known by you, you could easily recall all four after a quick reading, since they would represent only four "chunks" in your short-term or working memory. Most people would not have stored in their long-term memory easily recallable meanings for all of these statements, and hence most would have difficulty recalling all four statements after a single quick reading. Certainly every reader has had the experience of listening to a lecture where all of the words used by the speaker were familiar, but when presented rapidly, especially when long sentences are used, the *meanings* of the sentences cannot be processed in working memory and the lecture is incomprehensible.

To return to the idea that meaningful learning requires *relevant* prior knowledge, we can see that for any learner, the quantity and quality of the relevant knowledge he or she has will vary from topic to topic. Therefore, even with intense willingness to learn meaningfully, any learner has limitations on the *degree* of meaningfulness that can occur in a given learning task. Refer again to Figure 3.1. Highly meaningful learning that includes novel problem solving and creativity is only possible in domains of knowledge where the learner has considerable, well-organized prior knowledge. Thoughtful practice or rehearsal also contribute. The dependence of meaningful learning on the adequacy of our prior relevant knowledge is both a blessing and a curse. The more we learn and organize knowledge in a given domain, the *easier* it is to

acquire and use new knowledge in that domain. The curse is that when we try to learn new knowledge in a domain where we know little, and/or what we know is poorly organized, meaningful learning is difficult, usually time-consuming and tiring. Too often we may escape the challenge by resorting to rote learning, even though we know that what we learn will soon be forgotten and it will not be of value in future learning. Such fraudulent learning may allow us to pass school exams, but contributes little or nothing to future learning or acting (Edmondson and Novak, 1993).

Human beings are not only remarkable in their acquisition, storage, and use of knowledge; they also manifest complex patterns of feelings or emotions. Feelings, or what psychologists call *affect*, are always a concomitant of any learning experience and can enhance or impair learning. We know relatively little about the memory systems humans have for feelings, although we do know that the amygdula region of the brain is heavily involved, as are also the endocrine or hormone systems of the body. The involuntary or autonomic nervous system is also involved in some complex, but not well-understood manner. There is a complex interplay between our knowledge or thinking systems of the brain and those systems involved with emotion or feelings. Much remains to be learned about those systems of our body that produce and store emotional experiences, and this is currently a very active area of research. I believe we will see some breakthroughs in this in the next 10 years.

Human beings act. They consciously and deliberately move. I prefer the term act to behave, because the latter is so commonly used to describe animal movements, many of which are controlled genetically or by the environment, and not consciously by a thinking brain. Except for the patellar or knee-jerk reflex and a few other movements, most human movement is under control of our minds. Herrigel (1973) spoke well of this control in his book, *Zen in the Art of Archery*. We know that the lower brain regions and the spinal cord are involved in learning and storing information that controls our muscles, but as with feelings, our knowledge of the nature of this memory system is poor. Nevertheless, the complex interaction that takes place between stored information about knowledge, feelings and actions is very important in education. This interaction needs to be considered. Figure 3.6 illustrates these interacting systems. Recall also that learning is one element in education that interacts with the other four elements: teacher, knowledge, context and evaluation (see Figure 2.2).

An example of a learner seeking to integrate a new experience occurred when my granddaughter bought a new lock for her school locker. My six-year-old grandson also wanted one of these combination locks. We tried to suggest an easy-to-use keyed lock instead, but he insisted on getting one like his sister's. These locks have a combination such as: right 10, left 36, right 22. Joseph began trying to open his lock and continued try after try. Then he asked me to try, and I opened it quickly. Knowing that it was possible to open the lock, Joseph proceeded to try and try again. I noticed that he was not always

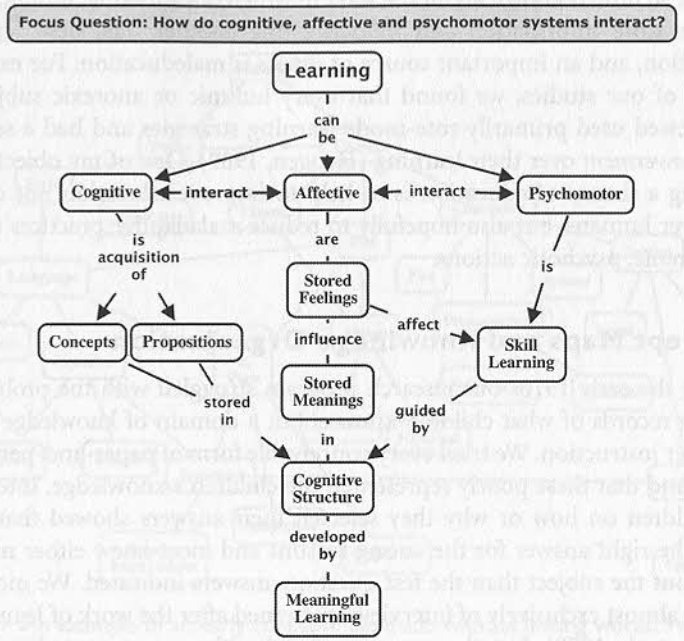

Figure 3.6 Humans have three distinct but interacting systems for learning, each of which has its own forms of information storage. Meaningful learning underlies development of cognitive structure that strongly influences our affective and psychomotor learning.

getting the number exactly on the mark before turning to the next number and pointed out this requirement for successful action (i.e., opening the lock). He persisted to try and try again, but still his lock would not open, and he came back to me for help. I asked him to show me and explain what he was doing, and I noticed he was not turning the lock one full rotation before turning to the second number. This was a key piece of knowledge that was missing from the lock code attached to the lock, but one I recalled from previous experience with this type of lock. Once he got this information—wow! the lock opened on the next try. Joseph was so excited, he kept on closing and opening the lock, showing his sister, parents, and grandmother how easily he could open the lock. In short, he had achieved successful integration (with a bit of help from his mentor—me) of thinking, feeling, and acting—and the result for Joseph was euphoria!

Any human experience that results in strongly negative feelings can contribute to a breakdown of the normal interplay between how we think, feel, and act. If such experience is repeated over and over, or is extraordinarily emotionally intense, we may observe actions that signal deviation from acceptable norms or in extreme cases, psychotic actions and what we label as "mental illness." Most mental illness is notoriously difficult to "cure," partly

because so little is known about the ways in which our thinking, feeling, acting systems store information and influence one another. The best "cure" is prevention, and an important source of illness is maleducation. For example, in one of our studies, we found that every bulimic or anorexic subject we interviewed used primarily rote-mode learning strategies and had a sense of *disempowerment* over their learning (Hangen, 1989). One of my objectives in building a theory of education is to help to improve education not only to empower humans, but also hopefully to reduce maladaptive practices and, in the extreme, psychotic actions.

Concept Maps and Knowledge Organization

During the early 1970s our research program struggled with the problem of making records of what children know about a domain of knowledge before and after instruction. We tried every conceivable form of paper-and-pencil test and found that these poorly represented the children's knowledge. Interviewing children on how or why they selected their answers showed that many chose the right answer for the wrong reasons and most knew either more or less about the subject than the test question answers indicated. We moved to the use almost exclusively of interviews patterned after the work of Jean Piaget (Pines, et al., 1978), but then we were faced with numerous audiotapes or typed transcripts of these tapes. It was exceedingly difficult to analyze these records and find patterns or regularities that could help us understand how and why children were learning or failing to learn the new subject matter. Working from Ausubel's (1963; 1968) theory of meaningful learning, we decided to examine interview transcripts for concept words and propositions given by the students, for these would indicate prior knowledge and post-instruction knowledge. After trying several ways to organize the concept words and propositions, our research group came up with the idea of *concept mapping*. At first we tried to strip away all text except for concept labels, and to show how these are related in a hierarchical structure, but without linking words. Figure 3.7 is an example from an early study by Moreira (1977). While the relationships may be obvious to one who understands these concepts, there is an obvious lack of clarity for most people. We soon insisted on inclusion of linking words to express the propositional meanings in the clearest possible manner. However, Moreira did find that her concept maps significantly improved a student's ability to critique novels.

We soon found that concept maps could help students who were doing poorly in reading and in school in general. When one sixth-grade boy we worked with who was in a remedial reading program began making concept maps he soon moved to leading his class in understanding their readings using his concept maps. His self-image soared and his teachers praised his achievement. Figure 3.8 shows the first concept map made by this student.

We found that concept maps were a good way to help a teacher organize

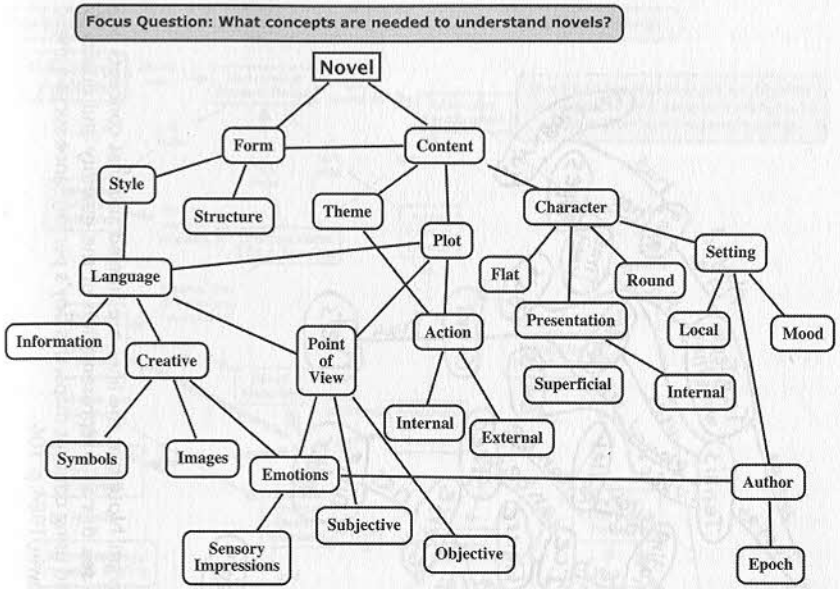

Figure 3.7 An example of an early concept map made without linking words. We soon insisted on the use of linking words to express concisely the relationship between the concepts and the propositional meanings expressed in the map. Reproduced with permission, Moreira, 1977, p. 100.

knowledge for instruction, and a good way for students to find the key concepts and principles in lectures, readings or other instructional material (cf. Novak, 1991). Moreover, as students gained skill and experience in constructing concept maps, they began to report that they were "learning how to learn." They were becoming better at *meaningful* learning and found they could reduce or eliminate the need for rote learning. Concept maps were helping to *empower* them as learners. They also help to empower the teacher, for they are useful as a tool for teachers to negotiate meanings about knowledge with students, and also to design better instruction.

More recently, we have begun to use concept maps in a variety of corporate settings. For example, Figure 3.9 shows a concept map of the structure of a New York company illustrating internal communication problems. With maps such as this, teams can identify problems and move toward more creative solutions. In essentially every company we have worked with, we find the same problems prevail as described by Crosby (1992): management of organizations don't understand the organization (pp. 5–6). Every organization I have worked with has found profit in trying to develop a concept map of the organization that is structured to show what the organization is all about. How can one engage in creative management when he or she doesn't comprehend the nature and purpose of the organization? I shall return to this issue in later chapters.

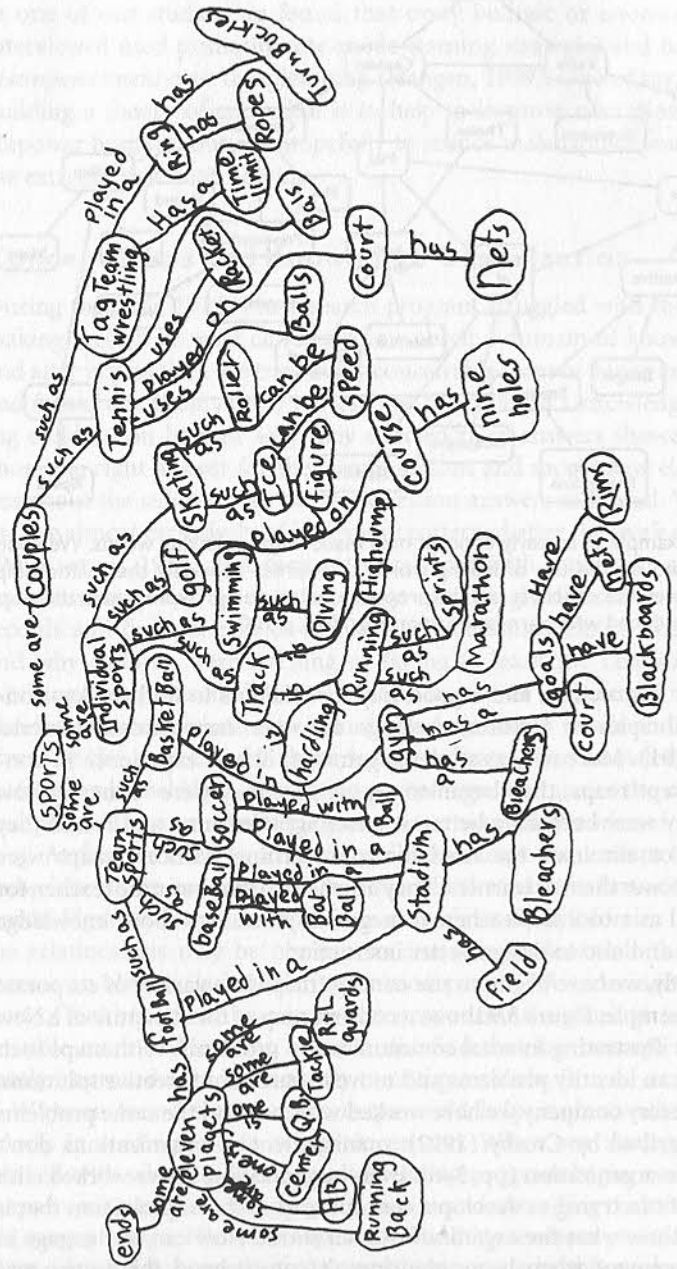

Figure 3.8 A concept map constructed by a sixth-grade boy in a remedial reading program. Note that the lines are labeled and that concepts plus labels form propositions or statements of principles this boy believes. We see this as a representation of the quantity and quality of knowledge this boy has regarding sports. After experience in constructing and using concept maps, this boy's performance surged ahead. Reproduced with permission from Cambridge University Press, Novak & Gowin, 1984, p. 106.

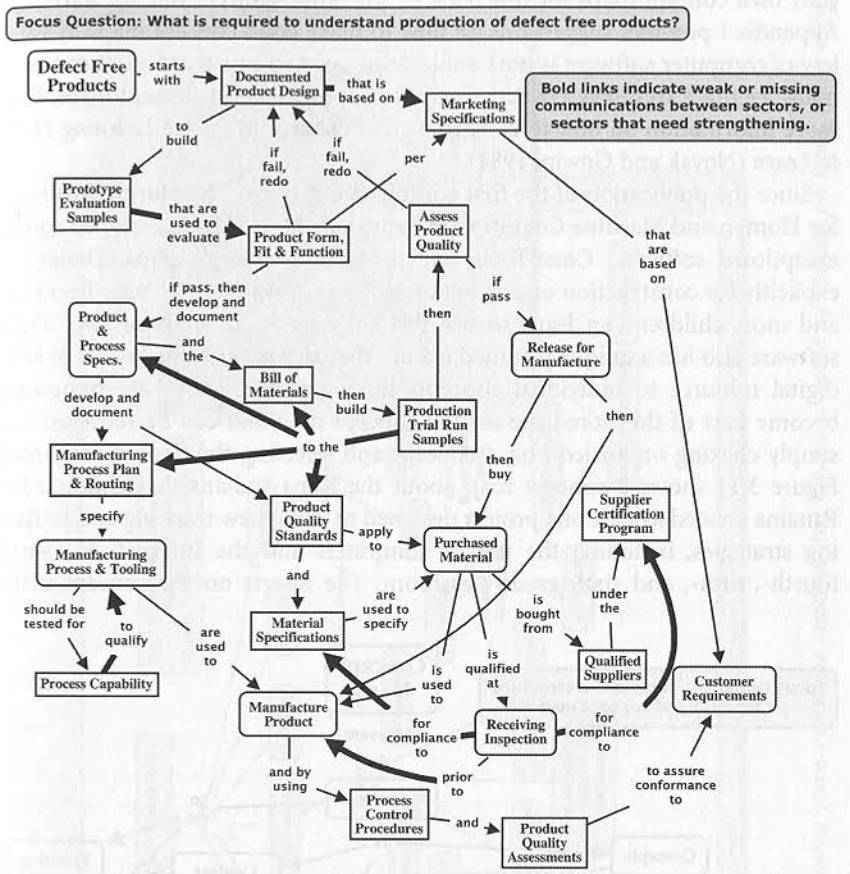

Figure 3.9 A concept map of the structure of a New York company illustrating internal communication problems dealing with product quality. Bold lines indicate where improvements are needed.

Our research, and more recent studies by many others in countries all over the world, has shown that young children learn quickly how to make good concept maps, whereas secondary school or university students often have difficulty, partly as a result of years of habit with rote learning (Novak & Wandersee, 1990). We have also found that to benefit from concept maps presented in text or lectures, learners needed to construct their own maps and learn this method of organizing their own knowledge. Our work and other studies led to the publication of *Learning How to Learn* (Novak & Gowin, 1984), now translated into Spanish, Italian, Chinese, Thai, and Japanese, Portuguese, Arabic, and Finnish. Concept maps will play a key role as a tool to represent knowledge held by a learner, and also the structure of knowledge in any subject matter domain. Begin to build your skill by starting now to make

your own concept maps for this book or for other subjects you are learning. Appendix I provides suggestions on how to make good concept maps. A variety of computer software is now available to assist in construction of concept maps. Figure 3.10 shows a concept map for key ideas about concept maps. For more information on how to construct good concept maps see *Learning How to Learn* (Novak and Gowin, 1984).

Since the publication of the first edition of this book, The Florida Institute for Human and Machine Cognition in Pensacola, Florida has developed some exceptional software, CmapTools, for producing concept maps. Designed explicitly for construction of concept maps, this software is very user-friendly, and most children can learn to use this software in an hour or two. This software also has a unique patented feature that allows easy attachment of any digital resource to individual concepts linking words, and these resources become part of the stored file for the concept map and can be retrieved by simply clicking on an icon on a concept and selecting the desired resource. Figure 3.11 shows a concept map about the Kuna Indians that children in Panama created as part of a project designed to bring new teaching and learning strategies, including the use of computers and the Internet, to every fourth-, fifth-, and sixth-grade classroom. The inserts on the concept map

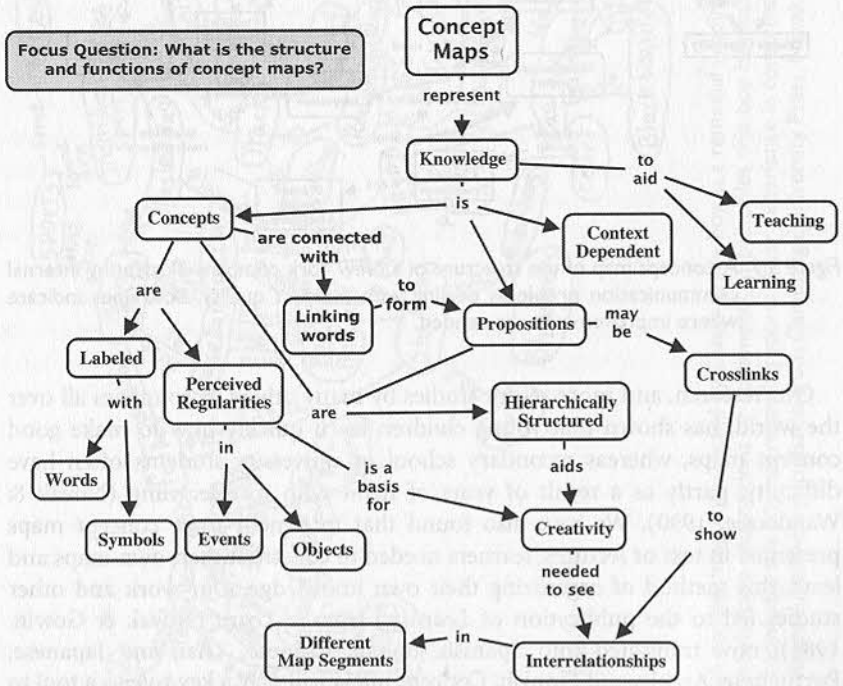

Figure 3.10 A concept map showing key ideas and principles exhibited in a good concept map.

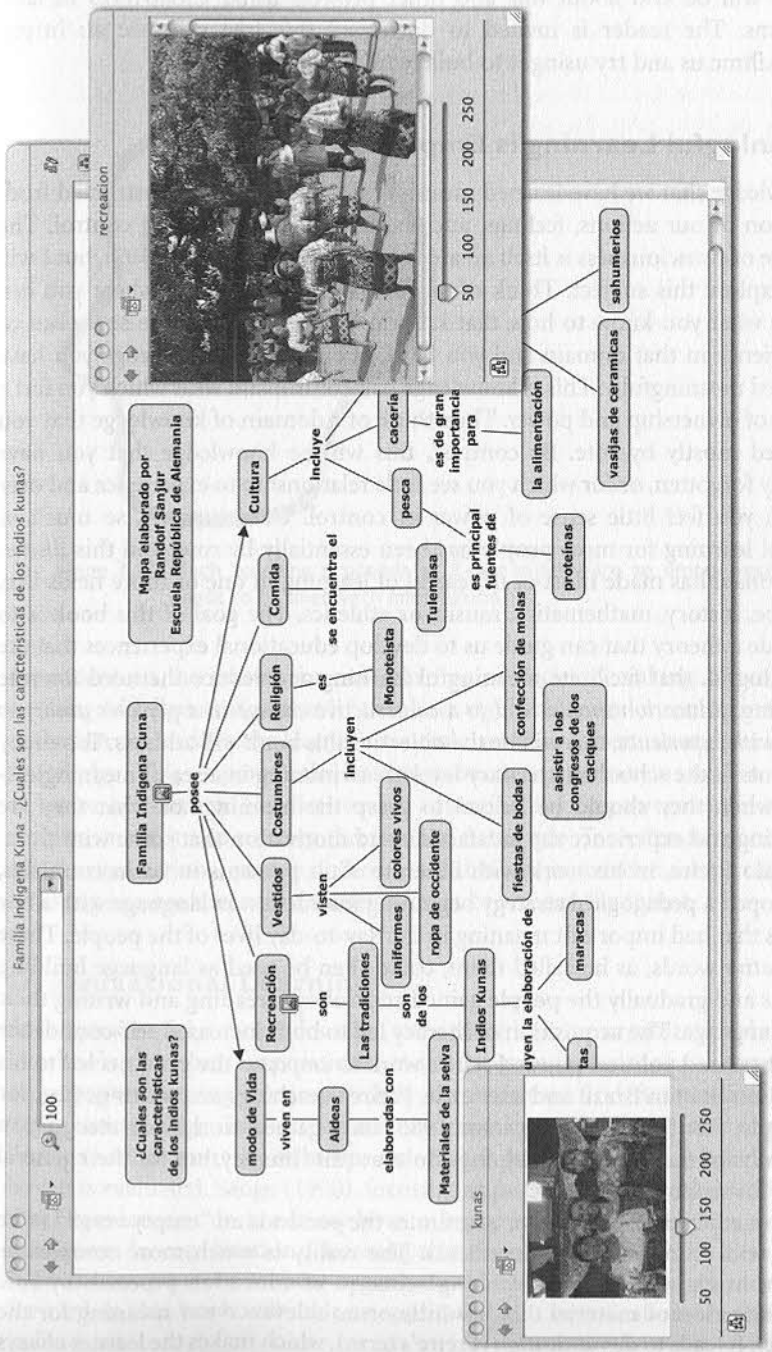

Figure 3.11 A concept map about the Kuna Indians showing some resources attached that can be accessed by clicking on icons. Made using CmapTools by fifth-grade children in Panama.

show some resources that can be accessed by clicking on icons on the map. More will be said about this and other projects using CmapTools in later sections. The reader is invited to download this free software at: http://cmap.ihmc.us and try using it to build concept maps.

Meaningful Learning is Empowering

Knowledge that we have learned meaningfully, that we have constructed from a union of our actions, feelings, and thought, is knowledge we control. The nature of consciousness is itself an area of inquiry (Hofstadter, 2007), but I will not explore this subject. Think of any domain of knowledge where you can relate what you know to how that knowledge operates to make sense out of experience in that domain and you have an example of knowledge you have learned meaningfully. This is knowledge you control and with which you feel a sense of ownership and power. Then think of a domain of knowledge that you learned mostly by rote. By contrast, this will be knowledge that you have largely forgotten, or for which you see little relationship to experience and over which you feel little sense of power or control. Unfortunately, so much of school learning for most people has been essentially by rote, and this *disempowerment* has made most of us fearful of learning in one or more fields like, science, history, mathematics, music, or athletics. The goal of this book is to provide a theory that can guide us to develop educational experiences that are meaningful, that facilitate meaningful learning and reduce the need for rote learning. *Education should lead to a constructive change in a person's ability to cope with experience*; this will be the objective this book will address. Too many students at the school and tertiary level are swimming in a sea of meaninglessness when they should be helped to grasp the meanings of what they are studying and experience the satisfaction and motivation that come with this.

Paulo Freire, in his work with illiterate adult peasants in Latin countries, developed a pedagogical strategy beginning instruction in language with a few words that had important meaning in the day-to-day lives of the people. These *generative* words, as he called them, could then be used as language building blocks and gradually the people gained control over reading and writing their own language. The acquisition of literacy led to both increased self-confidence and increased political power. Freire's work to *empower* the peasants led to his imprisonment in Brazil and later exile. Freire's teachings and writings (see, for example, *The Politics of Education*, 1985) have gained worldwide recognition not only for their power in helping adults acquire literacy, but for their general value for empowerment of people.

Most education, Freire asserts, assumes the person is an "empty vessel" to be filled with information (Figure 3.12). The reality is much more complex as shown in Figure 3.5. This "banking" concept of education proceeds by rote memorization of material that has little or no relevance nor meaning for the learner. It leads to *domestication* (Freire's term), which makes the learner always

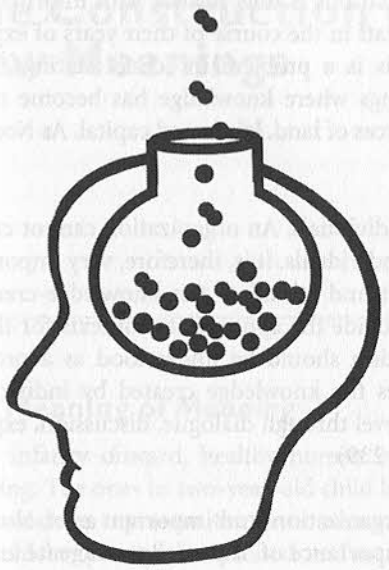

Figure 3.12 Much teaching proceeds as if our mind were an empty vessel that needs to be filled with information.

dependent on the master for new learning or decision making. By contrast, working with "generative words" that have significance and meaning in the life of the learner leads to the learner's control over the acquisition and use of new knowledge. This *empowers* the learner to become autonomous and in charge of his or her destiny. Needless to say, education for empowerment is often a risky business. It also tends to threaten the status quo. Too often in schools and other organizations, people and/or ideas that are innovative are threatening, resulting in a coalescence of forces to quiet or remove the threat.

Organizational Learning

At the present time, most education takes place in some organizational setting. In schools, churches, corporations, and other groups, many of the constraints on effective learning are imposed by the structure and functioning of the organization. Organizations are an important aspect of the *context* of education, as well as exerting influence on what is learned, how it is learned, and how it is evaluated. Senge (1990), focusing on business organizations, observes that organizations do not know how to learn, and others have shown similar limitations in organizational learning that, in turn, constrain the learning of individuals operating in these organizations. The theory, ideas, and tools put forward in this book will address applications to organizations as well as to individuals.

A major problem faced by organizations is how to deal with information, especially information acquired by staff in the course of their years of experience in the organization. While this is a problem in school settings, it is especially critical in corporate settings where knowledge has become more important than the traditional resources of land, labor, and capital. As Nonaka and Takeuchi (1995) observe:

> Knowledge is created only by individuals. An organization cannot create knowledge on its own without individuals. It is, therefore, very important for the organization to support and stimulate the knowledge-creating activities of individuals or to provide the appropriate contexts for them. Organizational knowledge creation should be understood as a process that "organizationally" amplifies the knowledge created by individuals and crystallizes it at the group level through dialogue, discussion, experience sharing, or observation. (p. 239)

While the knowledge created by an organization is an important asset, Nonaka and Toyama (2007) point out the importance of "knowledge to create knowledge, such as the organizational capability to innovate. Although current views on knowledge assets tend to focus on the former because they are easier to measure and deal with, it is the latter that need more attention because they are the source of new knowledge to be created, and therefore a source of future value of the firm" (p. 25). In Ichijo and Nonaka (2007, eds.) the importance of knowledge creation is stressed repeatedly. This book will deal extensively with understanding the nature of knowledge and knowledge creation.

In recent years some of my colleagues and I have put a good deal of time into working with corporations to help them become more effective at capturing, storing, sharing, and creating new knowledge. This work will be discussed throughout the book, showing how the ideas that empower learners are also the ideas that are need to empower organizations.

Chapter 4

The Construction of New Meanings

The Meaning of *Meaning*

From infancy onward, healthy human experience is a constant search for meaning. The one- or two-year-old child begins to recognize that older people use sounds to represent things or events and soon the powerful hereditary potential begins to be expressed as "mama," "dada," "doggie," and so on. Human beings have the innate capacity to do something no other animal species is capable of doing, albeit there is some debate on this (Gazzaniga, 2008). They can recognize and use language labels (or sign language) to represent regularities in events or objects. It is this incredible ability that distinguishes *Homo sapiens* from all other species of animals. The marvels of change in living things over the eons of time have somehow led in the last 50 millennia to an animal species that has this unique language capability. *Humanness* implies this capacity, and it also implies a capacity to discern these regularities with *feelings.* Humans think, feel, and act. Every experience they have involves thinking, feeling, and acting. This is as self-evident as the sun rising in the east and setting in the west. What is not obvious is why and how humans construct their *meanings* for events or objects.

The *meaning* of an event or object we observe depends upon what we already know about that kind of event or object. School, work, joy, and fear are labels for regularities in experience, but their meanings may be radically different depending on a person's experience. Meaning to a person is always a function of how he or she has experienced the combination of thinking, feeling, and acting throughout a lifetime of experiences. How humans *choose* to act depends on how they think *and* feel about an object or event to which they relate. School, work, joy, and fear involve experiences that can lead to radically different meanings for children growing up in radically different environments. It is evident that the *context* of experience has an important impact on the *meaning* of an experience. Here we see the important interaction of the learner and the context of the learning.

From birth onward, each human being creates his or her own meanings. Each of us has had a unique sequence of experiences, hence each of us has