Chapter 1
Representing Knowledge

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ABSTRACT

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- Examples of Graphic Representations
  - Semantic Trees and Conceptual Maps
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The invention of writing more than 6,000 years in Mesopotamia is a recent phenomenon in human history. In the few million years that preceded this event, knowledge was passed on from generation to generation by oral tradition.

Writing was a huge factor in accelerating civilization and transferring knowledge by enabling us to externalize our thoughts first on stone, parchment,

then paper, and finally by digitizing and recording them on optical disks and computer servers.

These media act as a kind of external memory that extends the storage capacity of our brain. This external memory can be accessed on demand, made permanent, changed in a multitude of ways, sent to others, used as a basis for mass communication orally or electronically, and distributed through print, analog, or digital media.

The purpose of this chapter is to broaden our understanding of knowledge representation through organized systems of symbols, to present these systems, and to describe how they are used to understand, communicate, and solve problems.

1.1 LANGUAGE AND THE REPRESENTATION OF KNOWLEDGE

In order to exchange, communicate, and process knowledge, we must represent it through a medium that is external to our brain and in a form that understandable. Before defining more precisely what language and representation systems are, let us first look at an example.

Mental Models and Representations

A user manual accompanying a television set has the following instructions: *If there is no image but only sound, check the brightness setting of the screen; if there is image but no sound, check the volume or mute controls. If there is no image or sound, make sure the unit is plugged in and the power switch is on.*

This text transmits a certain amount of *knowledge* required to solve a minor problem, in as much as the reader understands the meaning of the text. Figure 1 presents an alternative representation of the same knowledge. This second representation contains no English words and relies solely on an interpretation of the pictures.

This example (Paquette and Bergeron, 1989) illustrates that there are two levels involved in the process of representation: *knowledge* and the various *representations* of that knowledge. In general, a body of knowledge can be represented by many forms, such as the accompanying text or the pictograms in Figure 1, and used for many purposes.

Representation in the form of sentences or symbols is useful for transmitting knowledge from one human being to another, but since we sometimes need to process this knowledge in more structured ways, we resort to other representations. Simply reading the text or icons in Figure 1 is not sufficient for applying the knowledge they describe—such knowledge must be *understood*. Human beings understand texts or pictograms through mental representations, i.e. sets of ideas they have about a situation.

Many hypotheses have been suggested as to the actual form of these mental representations; however, we can confirm their existence through a simple exercise. Without referring to the text in the manual or to Figure 1, try to transmit the same information to another person. You will probably not use the same words or pictures, but the information will be conveyed.

Through your mental representation of the situation, you are able to consider questions such as *My TV has no sound or picture, even though it is plugged in. Where is the problem?* By using

Figure 1. Pictorial representation of knowledge