For concept maps in generic programming, see Concept (generic programming).

A concept map is a diagram showing the relationships among concepts. It is a graphical tool for organizing and representing knowledge.

Concepts, usually represented as boxes or circles, are connected with labeled arrows in a downward-branching hierarchical structure. The relationship between concepts can be articulated in linking phrases such as "gives rise to", "results in", "is required by," or "contributes to". [1]

The technique for visualizing these relationships among different concepts is called "concept mapping".

An industry standard that implements formal rules for designing at least a subset of such diagrams is the Unified Modeling Language (UML).

**Overview**

A concept map is a way of representing relationships between ideas, images, or words, in the same way that a sentence diagram represents the grammar of a sentence, a road map represents the locations of highways and towns, and a circuit diagram represents the workings of an electrical appliance. In a concept map, each word or phrase is connected to another and linked back to the original idea, word or phrase. Concept maps are a way to develop logical thinking and study skills, by revealing connections and helping students see how individual ideas form a larger whole. [2]

Concept maps were developed to enhance meaningful learning in the sciences. A well-made concept map grows within a context frame defined by an explicit "focus question", while a mind map often has only branches radiating out from a central picture. There is research evidence that knowledge is stored in the brain in the form of productions (situation-response conditionals) that act on declarative memory content which is also referred to as chunks or propositions. [3] [4] Because concept maps are constructed to reflect organization of the declarative memory system, they facilitate sense-making and meaningful learning on the part of individuals who make concept maps and those who use them.

**Concept mapping versus topic maps and mind mapping**

Concept maps are rather similar to topic maps (in that both allow to connect concepts or topics via graphs), while both can be contrasted with the similar idea of mind mapping, which is often restricted to radial hierarchies and tree structures. Among the various schema and techniques for visualizing ideas, processes, organizations, concept mapping, as developed by Joseph Novak is unique in philosophical basis, which "makes concepts, and propositions composed of concepts, the central elements in the structure of knowledge and construction of meaning." [5] Another contrast between Concept mapping and Mind mapping is the speed and spontaneity when a Mind map is created. A Mind map reflects what you think about a single topic, which can focus group brainstorming. A Concept map can be
a map, a system view, of a real (abstract) system or set of concepts. Concept maps are more free form, as multiple hubs and clusters can be created, unlike mind maps which fix on a single conceptual center.

**History**

The technique of concept mapping was developed by Joseph D. Novak[6] and his research team at Cornell University in the 1970s as a means of representing the emerging science knowledge of students. It has subsequently been used as a tool to increase meaningful learning in the sciences and other subjects as well as to represent the expert knowledge of individuals and teams in education, government and business. Concept maps have their origin in the learning movement called constructivism. In particular, constructivists hold that learners actively construct knowledge.

Novak's work is based on the cognitive theories of David Ausubel (assimilation theory), who stressed the importance of prior knowledge in being able to learn new concepts: "The most important single factor influencing learning is what the learner already knows. Ascertain this and teach accordingly."[7] Novak taught students as young as six years old to make concept maps to represent their response to focus questions such as "What is water?" "What causes the seasons?" In his book *Learning How to Learn*, Novak states that "meaningful learning involves the assimilation of new concepts and propositions into existing cognitive structures."

Various attempts have been made to conceptualize the process of creating concept maps. Ray McAleese, in a series of articles, has suggested that mapping is a process of off-loading. In this 1998 paper, McAleese draws on the work of Sowa[8] and a paper by Sweller & Chandler[9]. In essence, McAleese suggests that the process of making knowledge explicit, using *nodes* and *relationships*, allows the individual to become aware of what they know and as a result to be able to modify what they know.[10] Maria Birbili applies that same idea to helping young children learn to think about what they know.[11] The concept of the Knowledge Arena is suggestive of a virtual space where learners may explore what they know and what they do not know.

**Use**

Concept maps are used to stimulate the generation of ideas, and are believed to aid creativity. For example, concept mapping is sometimes used for brain-storming. Although they are often personalized and idiosyncratic, concept maps can be used to communicate complex ideas.

Formalized concept maps are used in software design, where a common usage is Unified Modeling Language diagramming amongst similar conventions and development methodologies.

Concept mapping can also be seen as a first step in ontology-building, and can also be used flexibly to represent formal argument.

Concept maps are widely used in education and business[12]. Uses include:

- Note taking and summarizing gleaning key concepts, their relationships and hierarchy from documents and source materials
- New knowledge creation: e.g., transforming tacit knowledge into an organizational resource, mapping team knowledge
- Institutional knowledge preservation (retention), e.g., eliciting and mapping expert knowledge of employees prior to retirement
- Collaborative knowledge modeling and the transfer of expert knowledge
- Facilitating the creation of shared vision and shared understanding within a team or organization
- Instructional design: concept maps used as Ausubelian "advance organizers" which provide an initial conceptual frame for subsequent information and learning.
- Training: concept maps used as Ausubelian "advanced organizers" to represent the training context and its relationship to their jobs, to the organization's strategic objectives, to training goals.
- Increasing meaningful learning
- Communicating complex ideas and arguments
- Examining the symmetry of complex ideas and arguments and associated terminology
- Detailing the entire structure of an idea, train of thought, or line of argument (with the specific goal of exposing faults, errors, or gaps in one's own reasoning) for the scrutiny of others.
- Enhancing metacognition (learning to learn, and thinking about knowledge)
- Improving language ability
- Knowledge Elicitation
- Assessing learner understanding of learning objectives, concepts, and the relationship among those concepts
- Lexicon development

References


Further reading


External links

- A large catalog of papers on cognitive maps and learning (http://cmap.ihmc.us/Publications/) by Novak, Cañas, and others.