

Concept Mapping – Implementation in an IT-enabled Classroom

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ABSTRACT

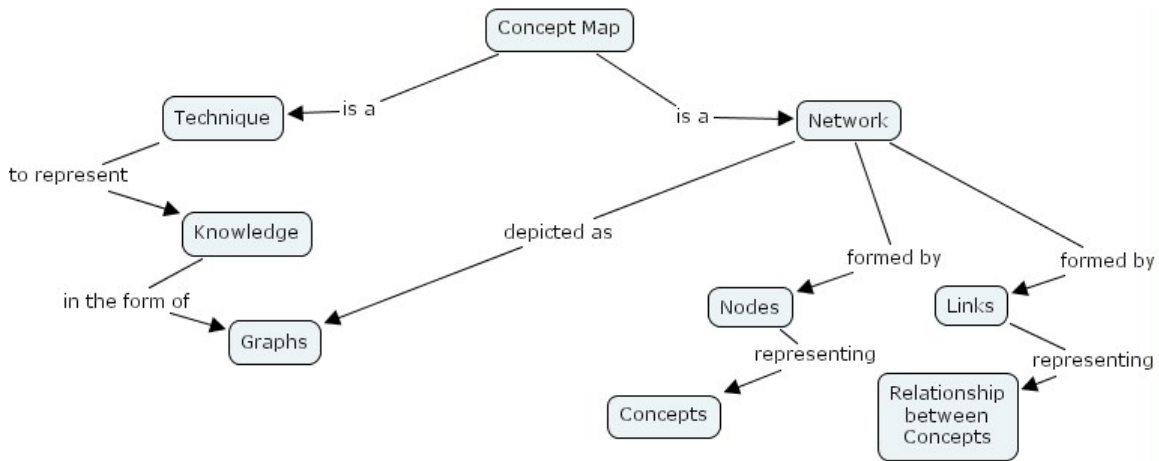
Concept mapping is a technique of knowledge representation introduced by Novak in the 1960s. It continues to gather proponents in many disciplines, including education. Based on meaningful learning theories put forward by Ausubel, concept maps have been shown to increase the capacity of learners to organize, systematize, and visualize relationships between concepts, which in turn enhance retention and understanding. Specifically, concept mapping can be used as a technique to generate ideas, design a complex structure, communicate complex ideas, aid learning by explicitly integrating new and old knowledge, encourage visual communication, improve affective conditions for learning, and assess understanding or diagnose misunderstanding.

Software have been developed to make concept mapping easier in an IT-enabled classroom. CMap is one such software that is available for free. In this session, applications of concept mapping (using CMap) are discussed.

What is a Concept Map?

Lanzing (1997) defines concept mapping as “a technique for representing knowledge in graphs.” He sees knowledge as a **network**. A network is formed by **nodes** and **links**. Each node is a concept or discrete idea; each link shows the relationship between the concepts.

Let’s try to do a concept map of the paragraph above:



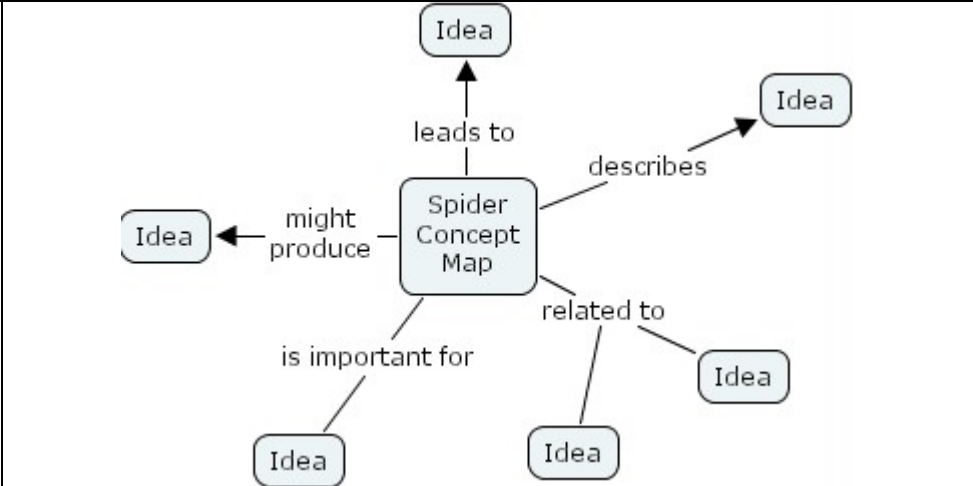
Note that links can be uni- bi- or non-directional. The linking words vary greatly, depending on the relationship between the concepts.

This technique was developed by Joseph D. Novak in the 1960s based on the work of David Ausubel. As a learning theorist, Ausubel believed that we are able to retain more if we establish relationships between concepts. That is, new materials should be related to previous experience or existing memories. This is done through a process called subsumption in which “new information enters the consciousness and is directed or organized to fit within an already existing larger (broader, more general) category” (Thompson, 1999). This kind of meaningful learning is vastly superior to rote learning. The important thing here is that learners are encouraged to find relationships between ideas, as opposed to memorizing disparate, discrete concepts.

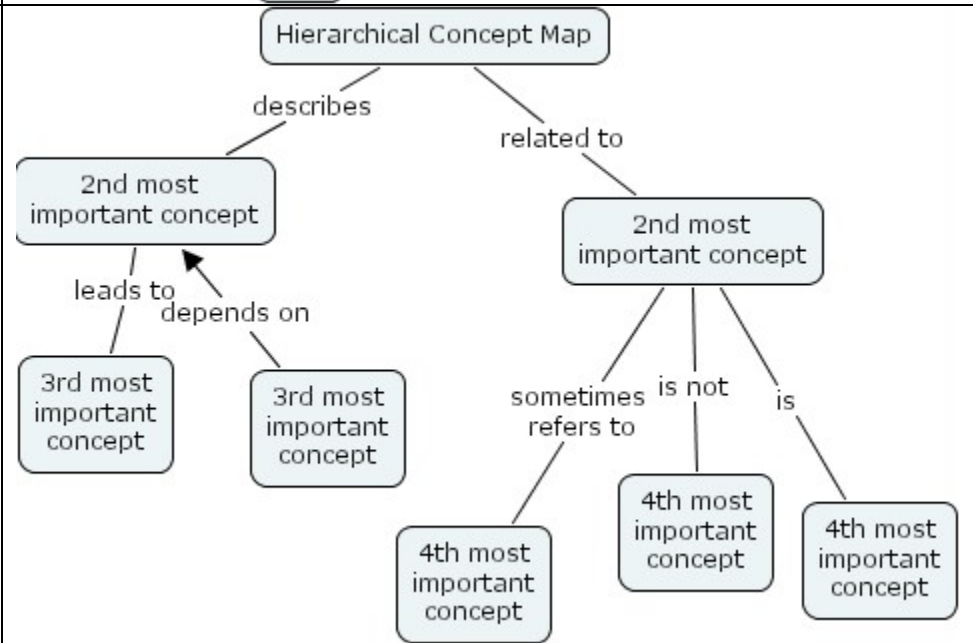
Concept maps are widely used in education, “to provide a visual representation of knowledge structures and argument forms. They provide a complementary alternative to natural language as a means of communicating knowledge (Gaines and Shaw, 1995).” In the sciences, for instance, concept maps are used as formal knowledge representation systems. Recall how chemical reactions are represented. In biology, picture in your mind the water cycle. Consider a diagram of an administrative structure, or a decision making matrix. Aren’t these examples of concept maps too?

There are different types of concept maps (ACES, undated).

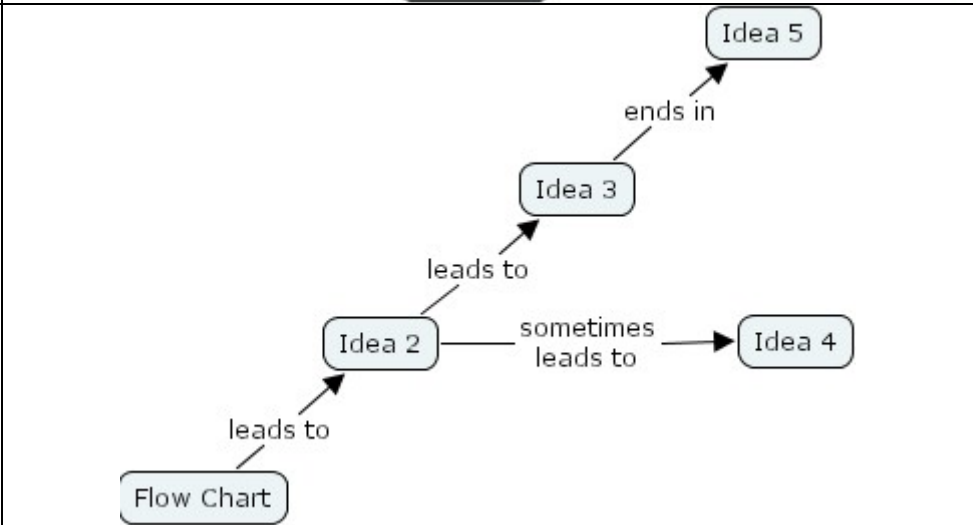
Spider – there is a central idea or unifying factor, and there are sub-themes arrayed around the center.



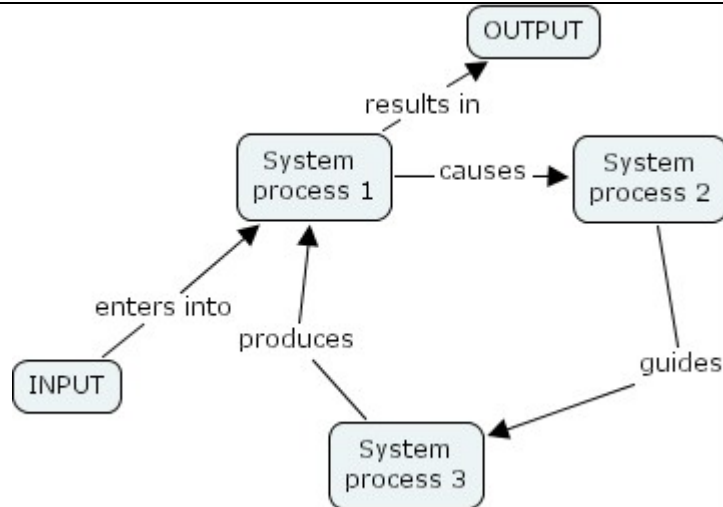
Hierarchy – concepts are arranged according to an order of importance; the most important idea is found at the top.



Flowchart – concepts are arranged in mainly a linear format.



System – this is similar to the flowchart, except that there is a provision for inputs and outputs.



Many concept maps are combinations of the four listed above. Some maps take on compelling shapes such as pyramids, mandalas, or concentric circles.

How can it help me teach and how can it help my students learn?

Various authors have listed the useful applications of concept mapping in education (ACES, undated; Canas, et al., 2003; Gaines and Shaw, 1995; Lanzing, 1997). Concept maps can be used:

- to generate ideas
 - through group brainstorming – knowledge elicitation
 - by promoting creative thinking or “free association”
 - by promoting critical thinking (such as listing pros and cons of a debatable issue)
- to design a complex structure
 - such as an outline for a term paper
 - such as a design a website
- to communicate complex ideas
 - such as a visual aid during a lecture
 - such as an illustration of a decision making process
 - to encourage consensus building - a visual representation of an idea that everyone can agree on
- to aid learning by explicitly integrating new and old knowledge
 - by using the concept mapping technique to take meaningful notes during a lecture
 - or in summarizing the information gathered from an interview
- to encourage visual communication
 - as an alternative to traditional writing assignments
 - as a way to explore multiple intelligences
- to improve affective conditions for learning
 - by serving as an avenue for collaboration

- by introducing a fun approach to learning
- to assess understanding or diagnose misunderstanding
 - when used as an examination tool
 - when used during discussions consolidating an educational experience such as a field trip
 - a before-and-after approach might show conceptual change as students correct misconceptions, or build upon “stock knowledge”

How do I start?

Making a concept map is not a “high tech” endeavor. You can easily start with the following materials: paper (bond paper, manila paper, cartolina, notebook), writing instruments (pencil, pen, colored markers) and a ruler. A shape template is optional but handy.

Here are the steps in making a concept map.

1. Gather information from all your resources.
2. Take a bird’s eye view of the material; look at the whole, rather than the details.
3. Define the topic or the focus question.
4. Prepare yourself to communicate in a visual mode (as opposed to text).
5. Think of possible visual structures (tree, mushroom, pyramid, or flower); draw informal sketches.
6. Choose a starting point then “free associate” or go from general to specific.
7. Check for cross-links; you might find that one node of the map is actually connected to another node from a different branch
8. Review your concept map for completeness.
9. Review your concept map for clarity; use arrows, colors, different fonts.
10. Review your concept map for form; check the positioning of each concept and link; make the whole picture compelling, attractive and inviting.
11. Show it to others.
12. Revise and improve as necessary.

Now let’s try it out. Read the paragraphs below then try constructing a concept map.

Exercise 1

It's no secret that out of control cholesterol levels are a severe health risk and a major cause for heart attack and stroke.

To understand the importance of lowering your cholesterol, you should know exactly what cholesterol is and how you can get too much of it.

Cholesterol is a normally occurring waxy, fat-like substance that the body produces to support healthy cell function and hormone production. Like oil and water, however, cholesterol in the blood does not mix or dissolve. To make its way around the body, cholesterol requires two kinds of special lipoprotein carriers — low-density (LDL), or "bad," cholesterol and high-density (HDL), or "good," cholesterol.

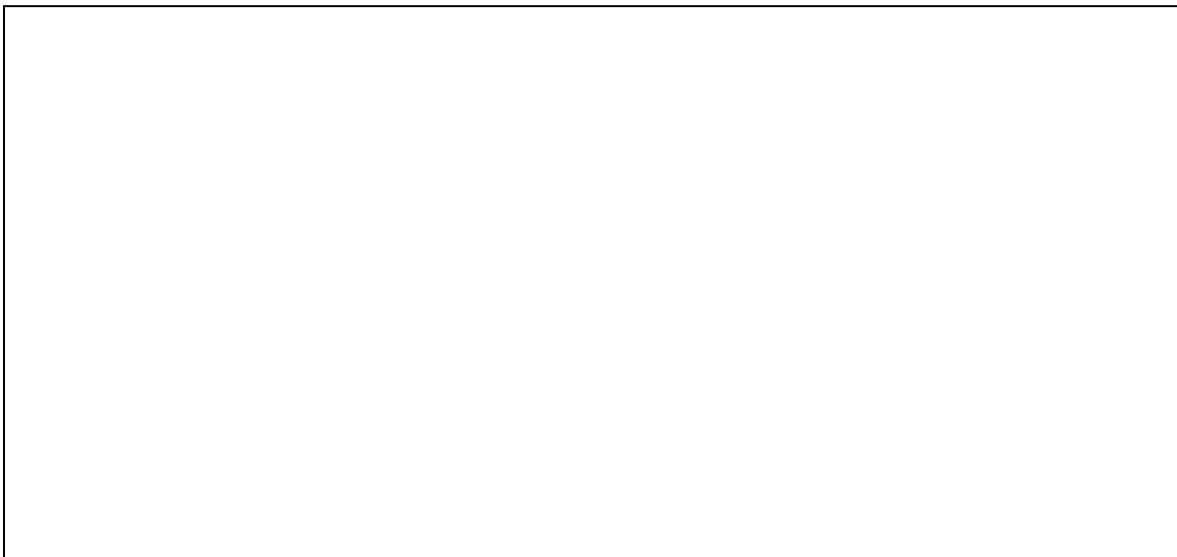
Too much LDL in the body can build up in the arteries and cause plaque. As this plaque accumulates arteries become smaller and less blood can squeeze through to the heart and other major organs.

Triglycerides are another component of your cholesterol profile that needs to be monitored. Triglycerides form in the body from the fatty foods we eat and are the most sensitive to diet. If you've had ice cream and pizza the night before your cholesterol is tested, your triglycerides level will give you away. The reverse is also true — a low-fat diet will quickly lower your triglycerides.

Studies show that diet alone can reduce LDL levels by 35 percent in just two weeks.

- Discovery Health (2004). Eight-Step Plan to Lower Your Cholesterol.
Available at <http://health.discovery.com/centers/heart/cholesterol/plan/plan.html>
Accessed 19 November 2004.

Draw your concept map here:



How can IT help?

There are several advantages to using IT in concept mapping:

- Editing is easier
- The designer has a wide range of colors, fonts, arrows and shapes to choose from
- The concept map can be saved in digital format
- Copies can be printed out and distributed
- Files can be shared electronically
- As an image, it can be integrated in presentations and websites
- Nodes and links can be hyperlinked to other files – thus making a hypergraph
- Students who want to work with computers will actually see this as a fun activity

There are various software that can be used to create concept maps. For starters, I would recommend CMap, produced by the Institute for Human and Machine Cognition (<http://www.ihmc.us/index.php>), a research institute affiliated with the University of West Florida. In addition to the functionalities listed above, CMap further allows users to:

- Share concept maps on servers (CmapServers) anywhere on the Internet,
- Link their Cmaps to other Cmaps on servers,
- Automatically create web pages of their concept maps on servers,
- Edit their maps synchronously (at the same time) with other users on the Internet, and
- Search the web for information relevant to a concept map.

CMap has versions for different platforms: Windows, Mac OSX, Linux (Intel), and Solaris (Sparc). Best of all, it can be downloaded for free from this site: <http://cmap.ihmc.us/download/>

[DEMONSTRATION OF CMAP FEATURES.]

What difficulties might we encounter?

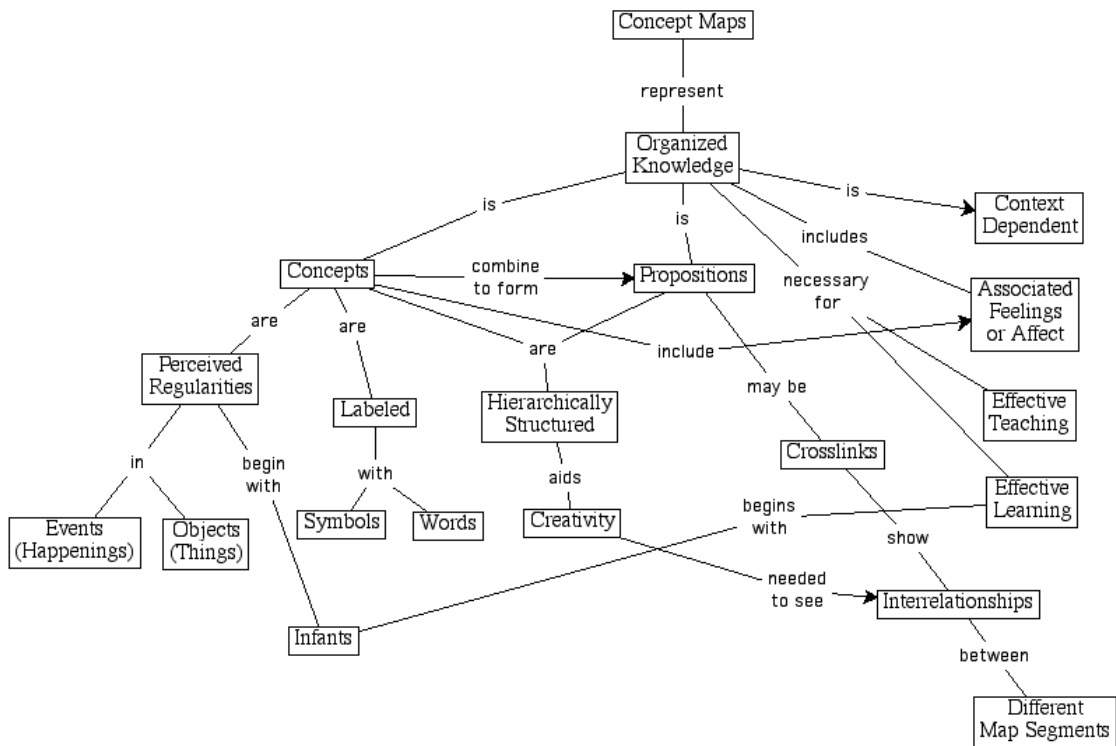
For novices, concept mapping from scratch might cause a cognitive overload – mainly because they do not know where to start and how to proceed with each step. To help them out, present them with a concept map with some of the nodes and links unlabelled. This way, they already have a scaffold to work with, and won't be intimidated by a blank page. Encourage them to build upon the original scaffold by adding new nodes and links.

Concept mapping has been found to be particularly beneficial for "lower ability learners" because it helps them adapt an "active, inquiring, orderly approach to learning (Canas, et al., 2003)." Don't be afraid to try this out with students who are doing poorly in class. Conversely, you might want to introduce concept mapping specifically for those students with learning difficulties.

When doing a concept map activity in a computer laboratory, don't forget your role as a facilitator of learning. Teachers act as "cheer leaders" who guide students in achieving clarity, consistency and completeness, and make sure that group members work well together (Canas, et al., 2003).

Finally, don't forget that concept mapping is a tool, and just like any other tool it must be used appropriately in order to derive the fullest benefits.

To summarize, here is a concept map about concept maps (IHM, undated).



References

Canas, A.J., Coffey, J.W., Carnot, M.J., Feltovich, P., Hoffman, R.R., Feltovich, J., Novak, J.D. (2003). A summary of literature pertaining to the use of concept mapping techniques and Technologies for Education and Performance Support. Available at <http://www.ihmc.us/users/acanas/Publications/ConceptMapLitReview/IHMC%20Literature%20Review%20on%20Concept%20Mapping.pdf> Accessed 19 November 2004.

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