PERSPECTIVES ON PRACTICE

Concept Maps:
Practice Applications in Adult Education and Human Resource Development

Barbara J. Daley
Professor Adult and Continuing Education
Department Chair Administrative Leadership
University of Wisconsin Milwaukee

Abstract

Concept maps can be used as both a cognitive and constructivist learning strategy in teaching and learning in adult education and human resource development. The maps can be used to understand course readings, analyze case studies, develop reflective thinking and enhance research skills. The creation of concept maps can also be supported by the use of the CmapTools software.

Concept maps, a teaching and learning strategy developed by Novak and Gowin (1984) based on the work of David Ausubel, (1963, 2000), have been used in education for over 25 years. There is an in-depth theoretical and research base that supports the use of concept maps in facilitating student learning across age groups, professional disciplines, educational contexts and geographic contexts (Cañas, Coffey, Carnot, Feltovich, Hoffman, Feltovich, & Novak, 2003; Novak & Cañas, 2006a). In addition, for the past six years concept mapping research from around the world has been presented at the International Concept Mapping Conference (see: http://cmc.ihmc.us/). Yet, the use of concept maps in adult education and human resource development (AE/HRD) has been limited to date. The purpose of this essay is to describe concept maps as a teaching and learning strategy and to discuss their potential application to graduate programs in AE/HRD.

Concept Maps: What are They?

Concept maps can be considered both a cognitive and constructivist learning strategy. Based on Ausubel, Novak and Hanesian's (1986) view of cognitive learning, when learners create concept maps they are focusing on determining relationships between and among concepts within their cognitive structures. They are also adding newly learned concepts to their existing cognitive structures. When the focus of the map is on depicting the relationships between concepts, a cognitive view of learning is operationalized. However, the focus of the map can also include linking concepts to lived experiences or linking lived experiences to each other. When the learner takes this approach the map tends to be more of a constructivist learning strategy that can be used to foster reflective thinking and analysis.

Novak and Gowin (1984) describe a concept map as "a schematic device for representing a set of concept meanings embedded in a framework of propositions" (pg. 15). In this view, we think and learn with concepts by linking new concepts to what we already know. In addition, concepts are stored hierarchically and differentiated as learning grows. Learning with concept maps means that the learner is making an intentional effort to link, differentiate and relate concepts to each other.

Ausubel (2000) and Ausubel, Novak and Hanesian (1986) believe that when we think and learn with concepts we use three processes; subsumption, progressive differentiation and integrative reconciliation. In the subsumption process lower order concepts are subsumed under higher order concepts. This subsumption process creates a hierarchy of knowledge structures. In the progressive differentiation process concepts are broken down into finer and finer components. In this way, progressive differentiation is similar to an analysis process. Finally, integrative reconciliation is a process where the learner attempts to reconcile and link together concepts from the left side of the map to those on the right side of the map. This is similar to a synthesis process.
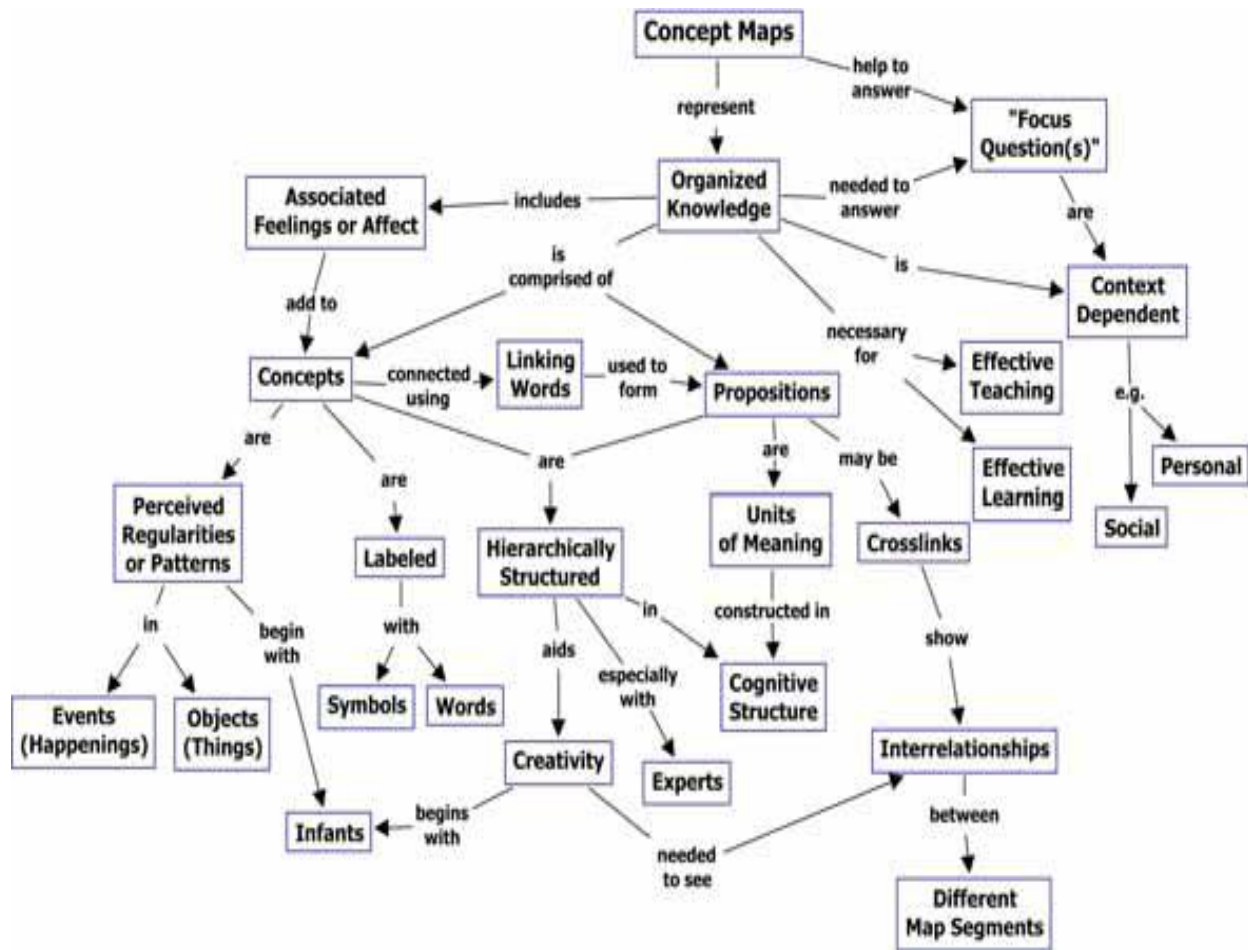

Figure 1: Concept map showing key features of concept maps (Novak & Cañas, 2006a, pg. 2). Reprinted with permission of Novak, J. & Cañas, A.

Figure 1, a concept map of a concept map, depicts these three processes. In looking at this map, one can see how the lower order concepts are subsumed under higher order concepts, how concepts are differentiated, and how concepts are horizontally reconciled. Integrative reconciliation is demonstrated by the horizontal links on the map. For example, at the bottom of Figure 1 note how the concept of *creativity* is linked to *interrelationships*.

To create a concept map the learner engages in an active process that uses these three ideas. First, the leaner identifies the most general concepts and places them at the top of the map. Second, the learner identifies more specific concepts that relate to the general concepts in some way. Third, the learner ties together the general and specific concepts with linking words that make sense to them. Finally, the learner actively looks for cross-linkages that tie concepts from one side of the map to the other.

Choosing linking words is one of the most difficult and yet, most important parts of creating a concept map. Whatever linking words the learner chooses will change the relationship between the concepts. To take a simple example, if as in Figure 2, a learner indicates that *trees grow leaves* one meaning is portrayed.
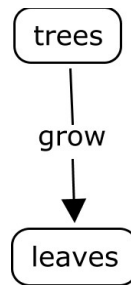

Figure 2: Sample linking words in concept map

However, if the learner changes the linking word and as in Figure 3 depicts that *trees drop leaves* a totally different meaning is portrayed.
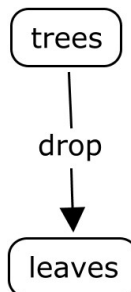

Figure 3: Changing linking words in a concept map

Thus, the linking words serve to create propositional statements that ultimately frame the meaning that the learner is attempting to convey or to construct.

Concept maps can be created by hand with paper and pencil or they can be created using a number of different computerized programs designed for this purpose. With either method, what is most important is for the learner to be aware of the thinking processes that go into map creation and also for the learner to identify and connect concepts with linking words that depict the meaning that is important to the learner.

Using Concept Maps in Facilitating Learning in Adult Education and Human Resource Development

As described thus far, concept maps are designed to support learners' efforts to learn in a meaningful way in an effort toward eventually understanding how they construct knowledge. With that in mind concept maps have multiple potential applications in AE/HRD.

Mapping Readings

In graduate programs in both AE/HRD, students are exposed to a wide variety and large amount of theoretical, research and practice-oriented readings. This vast amount of literature often presents challenges for students, not only to understand but to integrate this new information into their understanding of the field of AE/HRD. Concept maps have an important role to play here. Asking students to create concept maps of their readings is a very powerful way for them to more fully understand literature in the field. In courses I teach I often ask students, over the course of the semester, to create four to five different maps of their readings. These maps can be based on any one single article or a combination of articles. The intent here is to have the student develop a map that highlights the major conceptual pieces of the article they are reading and then to link those concepts either to other readings or to their own experiences. This mapping process assists the students to read more in-depth, to read for understanding and to seek out connections across readings that they may not have seen before.

Mapping Case Studies

Another application for concept mapping within graduate programs in AE/HRD, is their use in teaching and learning with case studies. Case studies can provide a rich learning experience for students, especially if they can be integrated with course readings and the student's own experiences. Concept maps can assist with the process. One strategy that I have used in this area is following the presentation of a case, I will ask students to map out their understanding of the case. These initial maps are designed to have students identify the major conceptual areas in the case and how those conceptual areas relate to their own experiences. Following this activity, students complete the readings, as well as, class or on-line discussions related to the case. After completing their study of the case, I then ask students to create a second map that builds on and expands their initial map. The second map is designed to help the student integrate the new concepts they have gained in their readings and discussion into their understanding of the case. In comparing their second map to their first map the students are not only able to identify how their learning has grown, but also to see other potential actions that could be taken in a particular case based on their new learning.

Mapping to Promote Reflective Thinking

Promoting reflective thinking is one of the many goals of most graduate programs in AE/HRD. Yet, it is often a challenge to find ways in which students can be encouraged to develop this type of thinking skill. As Brookfield (1995) indicates, it is helpful to first have students create a record of what they were thinking at a particular point in time, and then to go back at a later point in time and analyze that thinking. Concept maps can serve as a record of a student's thinking that allows for later reflection and analysis. For example, in one of my courses I ask student to create a concept map of their own development as an adult. At a later point in time, I ask these student to reflect on the meaning of their life experiences to them and then to link adult development theories to their own personal growth and development. They are able to do this through the creation of concept maps depicting their individual development. The maps are then enhanced by linking different developmental theories to their own experiences. The concept maps the students create provide a record of their own experiences and the various developmental theories. These maps allow for a relatively high level of reflective analysis in the papers they then write analyzing their individual adult developmental processes.

Using Concept Maps in Teaching Research Skills

Finally, concept maps can be used in multiple ways to enhance the teaching and learning of research skills in AE/HRD. Concept maps have been helpful in three areas of teaching research skills; writing literature reviews, creating research designs, and analyzing qualitative interview data.

One of the most helpful applications of concept mapping is in assisting students to write literature reviews. I find it a worthwhile exercise to have students do a concept map of a proposed literature review before they begin writing. The concept map assists the student to identify the major themes to be covered in the literature review and then to identify which studies or theoretical materials demonstrate these major themes. Additionally, the maps assist the student to search out connections and relationships between the different parts of the literature review and to ultimately situate their research questions within the framework of the literature they have reviewed.

Concept maps can also assist the student in creating research designs for their studies. By creating a concept map, students can demonstrate how the problem statement, research questions and the research design are all integrated. The maps require that the student show how all parts of the research process build on each other and are related to the goal of answering the research questions.

Finally, concept maps can be used as a data analysis strategy within qualitative research (Kinchin & Hay, 2000). One of the strengths of using concept maps in qualitative research is that they allow the student to reduce the data in a meaningful way. By using maps it is possible to display an average 20-page interview transcript on a single page. Using concept maps in the data reduction process, allows for the visual identification of themes and patterns within the data. It also allows the student to capture the meaning of the participant interviews because the maps

display concepts in both a horizontal and vertical fashion. It is these linkages that facilitate the process of understanding interconnections and meanings in the data. The vertical linkages display how the participant being interviewed differentiated concepts and the horizontal linkages display how the participant connected and related different areas within the interview. In addition, reducing qualitative data to a one page concept map can facilitate the process of cross-site or cross-group analysis. Sorting the one page maps by groups or sites can facilitate the process of comparing for similarities or highlighting differences. As students go through the process of creating a concept map from an interview in a research project they start to understand the subtleties and intricacies of depicting the meaning of an interview in the research process. Additionally, as a faculty member reviewing the student's work, I can grasp the meaning of the interview the student conducted by reviewing the maps they create.

CmapTools: Computerized Mapping

The previous parts of this essay identify what concept maps are and discuss multiple teaching and learning applications in AE/HRD. The last thing I would like to discuss is the computerized program CmapTools and how it can support both teaching and learning with concept maps. This software program is free and in the public domain, having been developed by the Institute for Human and Machine Cognition. To download a copy of CmapsTools go to: http://cmap.ihmc.us. The instructions for downloading the software and its use are described in the extensive help manual found online at this site.

CmapTools allows the student to create and edit concept maps on their computers. However, CmapTools has been designed to be much more than just a concept map editing tool. It is meant to support a concept map-centered learning environment, where the concept map is not seen as an "add-on" activity, but as the "glue" that can link together large portions of the student's work (Cañas and Novak, 2005). CmapTools offers a number of advantages to students creating concept maps. First, using CmapTools emphasizes that creating a concept map is an iterative process that requires multiple changes and alterations, especially as the student decides how concepts are subsumed and related to each other. Additionally, the creation of linking words often takes multiple tries before the student is satisfied with the linking words chosen. The use of CmapTools to create concept maps allows the student to focus on the thought processes in which they are engaging and the content of their concept maps without having to worry about how often or how many changes are made. Second, using CmapTools allows the student to link other forms of media to their maps. Students can incorporate other word documents, websites, graphics and/or pictures to their maps to further develop the concepts they are creating. Third, CmapTools allows for the development of "knowledge models", or in effect three dimensional concept maps. Students can create an overall concept map and then link other concept maps to the overall map, thus allowing for in-depth exploration of many concepts. Fourth, CmapTools provides a synchronous component where multiple students or students within groups can work on the same map at the same time. This is particularly useful within online courses. Finally, CmapTools allows for maps to be easily shared between instructor and student or between students. Maps can be exported to an image file and emailed or printed and thus shared between multiple people.

In summary, concept maps can be used as both a cognitive and constructivist learning strategy in teaching and learning in AE/HRD. The maps can be used to understand course

readings, analyze case studies, develop reflective thinking, and enhance research skills. The creation of concept maps can also be supported by the use of the CmapTools software described here. As Novak and Canas (2006a) state,

> While at first glance concept maps may appear to be just another graphic representation of information, understanding the foundations for this tool and its proper use will lead the user to see that this is truly a profound and powerful tool. It may at first look like a simple arrangement of words into a hierarchy, but when care is used in organizing the concepts represented by the words, and the propositions or ideas are formed with well-chosen linking words, one begins to see that a good concept map is at once simple, but also elegantly complex with profound meanings (pg. 31).

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