Concept Mapping:
Developing Critical Thinking through Mind Mapping

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ABSTRACT:

This study analyzed the relationship between cognitive mapping and the curriculum taught in MS100, MS200, MD300, MX400 courses at the United States Military Academy. Cognitive mapping is the process of constructing visual maps in order to retain and apply information. The method is powerful because it serves as a template that helps students learn new concepts through organizational charts. This process requires an individual to graphically represent knowledge and information based on a picture or visual aids to assist in the learning process (Novak & Cañas, 2006a, pg. 2). The basic design of a concept map begins with a central node. The node is a picture that commonly represents a central thought or theme. As the learning process begins newly generated thoughts branch off from the central nodes into sub categories. This process continues throughout the links to form new ideas (Edwards and Cooper, 2010). In essence, each node symbolizes a new thought pattern but still ties back into the central idea. This form of cognitive learning allows students to venture into many areas of learning from problem-solving, organizing ideas, and building storylines for information they have to retain and use at a later date. One researcher stated that constructing concept caps (CMs) gives learners improved confidence of the content incorporate information into their knowledge frame (Jonassen et al. 1997). Some researchers—has stated that it is easier to have called this process as constructing a visual language. This review will examine concept mapping that students can construct as it relates to learning theories, by achieving meaningful learning through learning new ideas, concepts, and principles by formulating descriptive visuals maps through prior learning experiences and new concepts integration.

Definitions: Cognitive learning strategy, constructivist learning strategy, concept mapping, mind mapping, concept mapping, argument mapping, spatial learning.

Concept Maps

Cognitive thinking has been researched and examined to show the correlation of students who perform well in their course of study. Cognitive learning strategy provides students the acquisition of information through personal experience. This exchange can happen in two forms through the cognitive learning or constructivism learning (See Figure 2). The basic concept of cognitive learning is that students learn through personal experience through the five senses. They process information through watching, reading, listening, and touching (Novak, 2002). Once this stage is completed the student will then process the information through remembrance based on the visual correlation of the information.

Cognitive learning is often referred to as passive learning simply because it requires no motor movement. However, it is actually a very active type of learning in that the student processes and remembers the information mentally (“Cognitive Learning”, n.d.). This is the basic form of
learning because no understanding is currently involved in this process. The student is only required to view the information and formulate visual aids in order to retain the information for later use.

Constructivism learning is the process that allows people to form their own understanding of knowledge through their own personal experiences. Therefore, when a student’s comes into contact with new concepts or ideas the student attends to process understanding of the information based on their cultural experience. Whenever students encounter something new, students have to reconcile it with their previous ideas and experience, maybe changing what they believe, or maybe discarding the new information as irrelevant (See Figure 2). In the classroom, the constructivist view of learning can point towards a number of different teaching practices ("Constructivism as a Paradigm for Teaching and Learning", n.d.). Hence, concept maps add a new option to retain new ideas through cognitive structuring by formulating visual maps of a student’s ideas. When used effectively students should be able to take a central idea and be able to link various supporting ideas in an concise thought process or personal experience.

To incorporate both learner styles students need to understand and successfully perform a concept map. Novak and Gowin (1984) described concepts maps as “a schematic device for representing a set of concept meaning embedded in a framework of propositions” (p. 15). Based on this definition students learn by building and linking new ideas to pre-existing ideas and experiences. By utilizing this format in their course of study students can begin to foster and create reflective thinking and critical thinking as it relates to their course of study.

There are two ways teachers and students can incorporate concept maps into a classroom setting. Teacher generated concept maps are produced based on the course material for the university. These maps are constructed to maximize communicative potential. In other words, they only provide the key information for the material in a clear precise material as it relates to what the teacher wants the main topics to be applied (McCagg & Dansereau, 1991, p. 317). These maps are designed to link each lesson plan together in order to blend every subject together cohesively. The student’s starts from a basic topic and as the student process to the next course from year to year the same example are carried over into the new course material.

Student concept maps are less formal than the teacher concept maps because they do not require intensive structure. Student concepts maps represent the students relation to the information presented to them. Unlike the teacher concept map where its fact driven student concepts to make can shift based on interpretation. Research has shown that these maps enhance learning from traditional charts because they enhance group discussions, student writing, and creative thinking (Irvine, 1995). Nevertheless, student concept mapping is a good tool however it can be time-consuming trying to master the technique across course work. In the beginning, because of their complexity, many students find it hard to memorize the maps they create and often times feel overwhelmed. This could lead to disconnect from the topic and cause them to go back to their original study habits of note taking.

Various Mapping Concepts

The basic design of a concept mapping is similar to all other mind mapping tool. The overall intent is similar to a student who brainstorms for a writing project. Any student who can
manipulate or design a diagram or pie chart, is more likely have a better understanding of how to construct and analyze a concept map. These visual aids build onto what many researchers have described as “deep” learning and not “surface” learning (Biggs, 1987). Many students have confirmed that visuals aides are much easier to learn than written or verbal descriptions. The reason behind this understanding is because the process requires a more active engagement on the part of the learner. The student is challenged to formulate personal scenarios which activate parts of their short term and long term memory.

There are three different types of mapping students and teacher can use mind mapping, concept mapping, argument mapping. Mind mapping allows a student to explore association between concepts and is free-forming (See figure 3); constructing maps allows students to link thoughts and ideas (See figure 4); argument mapping allows the student allows to link thought independently of each other in order to evaluate them in terms of validity of argumentative points (See figure 5). Each map has its own descriptive quality but the overall intent of each map is to add the personal relationship of the person to the coursework (Irvine, 1995). It is through this interaction that information is stored the students permanent memory because they are now able to mirror key concepts with personal memories or events.

Spatial learning using concept mapping

The main idea or reason behind concept mapping is the benefit it adds to learning. Research has shown that meaningful learning requires that the student is able to connect the newly introduced material to prior learned concepts and ideas (Biggs, 1987). This form of learning comes to completion when these new linked ideas become a part of the student’s long-term memory. The key link between meaningful learning and concept mapping is the student motivate to become interactive with the material (Csir, 2010). As the student works through the mapping process they begin to relate to personal ideas and this locks that principle or idea into a student’s long-term memory (Jarvis, 1992, See figure 2). Therefore, have a relation with the information being given students can now begin linking material together to “scaffold” new learning. As noted by Jarvis (1992) map-making improves the usability of information and also compliments what the brain can do imperfectly. Study of the effectiveness of cognitive maps has shown that the process has helped teachers successfully engage students in the course of study. A map can provide the teacher and student a guideline or visual road map to keep both teacher and student in sync during the learning process.

Teaching West Points MS100 Courses through Concept Mapping

West Point’s current course of study aligns perfectly with the concept of concept maps. Many of the course taught at West Point requires some form of literature review, research projects, and analyzing qualitative data for review. Concept maps that applied in the classroom can provide records for students to utilize throughout their years of academic progress. A classroom example is West Point’s military science course. Many of the information taught in MS100 (freshman course) course transfers and feeds into the MX400 (senior course) course. Therefore, students who begin to build concept maps in MS100 can have a framework as it relates to key principles and ideas. As they progress to the MS200 course they can begin to branch off the current knowledge they had from MS100. This process then proceeds throughout the MS courses. This is how concept mapping can become an active project that facilitates the learning process.
The first area concept mapping can assist students at West Point is through literature reviews. The map assists students during the brainstorming process by organizing key themes and ideas that they would like to address throughout the paper (Davies, 2011). It can also build links and relationship between ideas allowing for students to identify transition points throughout their coursework.

The second area concept mapping is through the use of research projects. These maps allow students the opportunity to show how each problem statement relates to a central theme. It also allows the student to formulate a solution based off of similar problems (Budd, 2004). This address the problem-solving steps that usually follow after research has been performed. In the end, the map will give the student a clear and identifiable direction to the solution of their problem.

The final area concept mapping can be used is through analyzing qualitative data for review. The use of maps allows the student to display overall data that once consumed over 30 pages of noted into one to two page triangular formed equation. This eliminates the data being lost in pages of research notes but brings the information to the forefront (Johnson and Lipp, 2007). It also affords the student the opportunity to locate their problem faster if they get the wrong conclusion because all data is confined and easy to locate.

**Conclusion**

This study analyzed the relationship between cognitive mapping and the curriculum taught at the Unites States Military Academy. Cognitive mapping is the process of constructing visual maps in order to retain and apply information. The method is powerful because it serves as a template that helps students learn new concepts through organizational charts. As stated by Novak and Canas (2006a) from a glance concept maps may look like another graphic representation of information, it may look like a simple arrangement of words into a hierarchy, but when care and time are put in organizing the concepts represented by the words, and linking words, a student can begin to see that a good concept map is at once simple, but elegantly complex to capture the idea of the material and give a more profound meaning (p. 31). Any student who takes the idea to invest in concept mapping can expect to tap into the spatial learning process and coursework becomes a part of their personal learning experience rather than random assignments.
References


Figure 1: Concept map showing key features of concept maps (Novak & Cañas, 2006a, pg. 2).
Figure 2: Jarvis (1992) states that the person most important element in any learning model. This is because the person defines the way information will be registered. According to Jarvis, model there are nine possible outcomes of learning these are facilities learning through memorization.
Figure 3: Mind map example

Figure 4: Concept map example
THE STRUCTURE OF A CADETS CONCEPT MAPPING THROUGHOUT HIS MS EXPERIENCE. THE ENDS STATE IS A STANDARD OPERATING PROCEDURE (S.O.P) THE CADET CAN USE FOR FUTURE LEADERSHIP.