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ABSTRACT

Concept mapping is a technique for visually representing the structure of information, concepts, and the relationships between them. Concept maps are useful tools that help students learn about how they structure knowledge while supporting the process of knowledge construction or metaknowledge. This paper discusses the effect of concept mapping with different levels of knowledge to assist those with different learning styles. Discussion is as follows. After a brief definition of concept mapping in learning, the two broad classes of learning/cognitive styles-field dependent and field independent-are outlined. Discussion then moves to Ausubel's (1963) Meaningful Learning Theory, and how concept maps can foster meaningful learning. Next, a definition is provided of the principles of Component Display Theory (CDT), which is concerned with teaching individual concepts or principles, and classifies learning along two dimensions: content (facts, concepts, procedures, and principles) and performance (remembering, using, and generalities). Finally, a study on the effects of concept mapping on learning is briefly discussed. (Contains 10 references.) (AEF)

INFLUENCES OF CONCEPT MAPPING AND LEARNING STYLES ON LEARNING

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The effect of concept mapping with different levels of knowledge to assist those with different learning styles will be discussed. This paper will discuss the methods used to compare these influences and the differences in particular learning processes.

Concept mapping

Concept mapping is a technique for visually representing the structure of information, concepts and the relationships between them. They can be compared to road maps that help us find direction in the midst of numerous signs, roads, and other distractions. Substantial changes in the complexity of the knowledge structures take students beyond rote learning toward meaningful learning. Students using concept maps increase their domain knowledge (Ruiz-Primo & Shavelson, 1996) toward applications and assessments.

Concept maps are useful tools that help students learn about how they structure knowledge while supporting the process of knowledge construction or metaknowledge. In this way, concept maps help students learn how to learn commonly referred to as metalearning. A concept map requires the learner to function at all four levels of Merrill's (1983) content dimensions: fact, concept, procedure, and principle. Each of these dimensions identifies three performance levels: remember, use, and find. "Remember" causes the students to search their memory in order to reproduce or recognize a previously stored item. "Use" will require the student to apply some abstraction to a specific case. Use means to use a general rule to process specific information. Finally, "find" is the performance level that the student begins to derive or invent a new abstraction.

The concept map becomes an external representation presenting internal processes of information in structured graphs (Jonassen, Beissner & Yacci, 1993). It becomes a representation of the application of the dimensions of conceptual processes at different content levels. The nodes and links represent relationships between the concepts and demonstrate the depth of processing knowledge. Conceptual understanding can be described as the richness of interconnections and relationships made between concepts and the structure that organizes those concepts (Novak & Gowin, 1984).

Concept maps have been used successfully to promote learning. How do students internalize and organize readings, assignments and notes to prepare a concept map as a study tool for a test that evaluates different levels of learning? How do they process new facts, concepts, etc., to complete assignments and take tests? Can a concept map be a significant factor in facilitating different levels of learning? Will different learning styles affect the strategies used in creating a concept map and the follow-through when given a test on the subjects?

Learning Styles / Cognitive Styles

Attempts to describe patterns of information processing have led to the development of several theories in the field of educational psychology (Noring, 1993), but most commonly these approaches have been divided into two broad classes of learning styles (also called cognitive styles, see Kearsley, 1994), known as field dependent and field independent. Field dependent learners, the most prevalent, need to see each segment of instruction in relation to the preceding instruction and the overall aims of the course. Field independent learners, on the other hand, are apt to find their own structure in which to place the instruction and other, extraneous applications for the instruction. Whereas field dependent students learn best the material presented within its social context, field independent learners prefer a more clinical, analytical

presentation of material, and learn social material more as an intentional task than a natural response. In place of the external goals and reinforcements desired by the field dependent learner, the field independent student values knowledge for its' own sake, and often has a personal set of goals and rewards to strive for.

Differences in cognitive styles do not indicate differences in learning ability or memory (Witkin, Moore, Goodenough, and Cox, 1977). Cognitive styles indicate the preferences that an individual has for perceiving and processing information, not the ability to learn the material. Thus, students with equal learning abilities but different cognitive styles may experience different levels of success in the same environment.

Meaningful Learning

The idea behind concept maps was derived from Ausubel's theory of meaningful versus rote learning. Meaningful learning occurs when students intentionally attempt to integrate new knowledge with existing knowledge. A learner who attempts to integrate knowledge will most likely have a more extensive network of knowledge and therefore more retrieval paths. His subsumption theory involves reorganization of existing cognitive structures not development of new structures. A primary process in learning is subsumption in which new material is related to relevant ideas in the existing cognitive structure on a substantive, non-verbatim basis. Cognitive structures represent the residue of all learning experiences; forgetting occurs because certain details get integrated and lose their individual identity.

Rote learning occurs because a student simply memorizes information with no attempt or motivation to relate that information to prior knowledge. Therefore, the rote learner will have a less extensive network than the meaningful learner and less retrieval paths between knowledge concepts. Concept maps are one way to foster and measure meaningful learning in the classroom as instructional, student learning, and assessment techniques.

Instructionally, concept maps foster meaningful learning by teaching the connections among course concepts. As a student learning tool, concepts maps promote meaningful learning by encouraging the students to generate their own connections between concepts. In terms of assessment, concept maps evaluate if and how meaningful learning is occurring.

According to Ausubel's (1963) Meaningful Learning Theory, we build meaning every time we establish substantive rather than arbitrary relationships between the study material and existing knowledge. When students encounter new material they approach it from a series of concepts and representations acquired from previous experiences. These experiences are used as instruments of interpretation that partially determine what information the students will absorb, how they will organize the information, what types of relationships they will establish among the pieces of information, what problem-solving techniques they will use, and so on.

This explains why the concepts do not represent the same for the teacher as for the student—the concepts have neither the same relevancy nor the same explanatory power. Ausubel argues that when discipline is taught, it fundamentally transmits this conceptual structure to the students.

The appropriation of complex structures of knowledge implies an understanding of them, and that understanding cannot be reached only by routine procedures. The acquisition and retention of a body of knowledge implies the assimilation of a body of conceptual meanings—the product of meaningful learning.

In Ausubel's words, concepts are acquired by progressive differentiation—that is, those concepts that are ordered in a hierarchy that progresses from the most general to the most specific idea. New information is assimilated into existing conceptual hierarchies in the cognitive structure. These modifications are not merely juxtapositions of concepts, because the final meaning of a structure is not equivalent to the sum of the parts—it forms a new structure.

In the psychological structure, a related process of integrative reconciliation occurs that allows knowledge to relate to the discipline and modify preconceptions or misconceptions, thus reducing fragmentation and making possible a reflective and critical attitude.

The existing structure of knowledge influences the capacity to interpret reality and to take part in it. It creates a framework that will open or shut depending on the individual's capacity to understand. This capacity to approach and solve problems depends on the density of meanings in the existing structure of knowledge. There will be dominant areas in which the effect from an experience is quite broad and for which the structure of meanings is exceptionally powerful, and there will be others in which precisely the opposite happens.

From this perspective, attending to the potential of the study material to develop thought skills implies two things. First, the knowledge must be organized with the discipline and its methodology following a hierarchical relation scheme that is part of the most general and most inclusive concepts of the material and advances toward the most particular. This descending cyclical sequencing allows us to put relief in different relationships that maintain the concepts among themselves. Effective linkage results in subsumption; that is, new knowledge is meaningfully joined with other knowledge in the student's cognitive structure. Second, it must facilitate the assimilation of concepts (the progressive differentiation and the integrative reconciliation) through:

- the initial presentation of general ideas that provide one conceptual framework for subsequent knowledge
- using specific examples in real contexts that illustrate the concepts and their relationships in such a way that they acquire meaning and feeling
- the combination and the sequence of positive and negative examples that facilitate the conceptual differentiation
- representation of the knowledge in graphical systems, such as the concept maps, that help better understand the relationships among the ideas and the procedures

Progressive differentiation is presenting the most general and inclusive ideas first, followed by increasing detail. Integrative reconciliation is pointing out similarities and differences between old and new learning. Cognitive strategies are skills that may aid the learner in an internal process of attending, selective perceiving, coding for long term storage, retrieval and problem solving.

Concept mapping is a technique for visually representing the structure of information—concepts and the relationships between them—and can therefore aid the student in the process of meaningful learning. Concept mapping is also designed to encourage the mapper to make his or her own connections among knowledge concepts. The more meaningful connections a person can show in the map, the better s/he will understand the material. The process of mapping a map and the final product are dependent on prior knowledge, context, and constructed understanding.

In constructivism, active and meaningful learning is encouraged as an educational philosophy. Learning is a structuring process where knowledge is derived from experiences. Ausubel argued that learning new materials depends greatly on the existing cognitive structure or what the person already knows. New information will be more easily learned if it is explained and also related to relevant ideas in the student's cognitive structure. Meaningful learning occurs when new information is linked to prior information in the learner's own cognitive structure. New information is more meaningful if it is related to existing knowledge.

The basis for this active learning role can best be described in Ausubel's (1963) theory of cognitive learning. Ausubel's principles of non-arbitrary assimilation of knowledge through concept differentiation and concept integration have become the fundamental principles for meaningful learning theory (Wandersee, 1990). Meaningful learning theory is based on these principles:

1) knowledge is stored hierarchically in idiosyncratic cognitive structures;

2) prior knowledge influences new learning, although misconceptions are acquired early and are resistant to
change;
3) humans construct new concepts and propositions through meaningful learning;
4) meaningful learning is at one end of a learning continuum with rote learning at the other

Component Display Theory

Component Display Theory (CDT) classifies learning along two dimensions: content (facts, concepts, procedures, and principles) and performance (remembering, using, and generalities). The theory specifies four primary presentation forms: rules (expository presentation of a generality), examples (expository presentation of instances), recall (inquisitory generality) and practice (inquisitory instance). Secondary presentation forms include: prerequisites, objectives, helps, mnemonics, and feedback. Merrill (1983) explains the assumptions about cognition that underly CDT. While acknowledging a number of different types of memory, Merrill claims that associative and algorithmic memory structures are directly related to the performance components of Remember and Use/Find respectively. Associative memory is a hierarchial network structure; algorithmic memory consists of schema or rules. The distinction between Use and Find performances in algorithmic memory is the use of existing schema to process input versus creating a new schema through reorganization of existing rules.

Component Display Theory is concerned with teaching individual concepts or principles, classifies objectives on two dimensions, and formats instruction to provide learner control. Component Display Theory is composed of three parts (Merrill, 1983):

- A performance/content matrix that includes the desired level of student performance (Remember Instance, Remember Generality, Use, and Find) and the type of content (Fact, Concept, Procedure, and Principle)
- Four primary presentation forms: Expository (Rule, Example) and Inquisitory (Recall, Practice)
- A set of prescriptions relating the level of performance and type of content to the presentation forms

Instruction will be more effective if all three primary performance forms—remember, use, and find—are present for the different types of content or information types. Primary forms can be presented by either an explanatory or inquisitory learning strategy. The sequence of primary forms is not critical provided they are all present. A concept map can be used to provide examples of the concepts as the learner elaborates on that particular concept.

Principles of CDT

1. Instruction will be more effective if all three primary performance forms (remember, use, generality) are present.
2. Primary forms can be presented by either an explanatory or inquisitory learning strategy
3. The sequence of primary forms is not critical provided they are all present.
4. Students should be given control over the number of instances or practice items they receive.

Using concept mapping provides a form of both remember and use. Students are asked to apply what they are learning as they draw the map. The generality is applied in the testing process. They are given control over their instances as they create their individual maps. Knowledge objects can be linked via component relationships: an entity can be a part of another entity, an activity can be a step of another activity, or a process can be an event of another process. The learner acquires knowledge of discriminating properties and is able to sort instances with respect to these discriminating properties. CDT identifies strategy prescriptions for different kinds of learning outcomes. Components of instruction provides a way to more precisely analyze subject matter content and more precisely design instructional strategies to present this material. A significant aspect of the CDT framework is learner control. This idea enables

learners to select their own instructional strategies in terms of content and presentation components. In this sense, instruction designed according to CDT provides a high degree of individualization since students can adapt learning to meet their own preferences and styles.

Two types of knowledge are part of the levels of learning that Merrill describes. Concepts are categories of experience bounded by a definition and given in a name. They are groups or classes of things that have something in common. Concepts are arbitrary groupings that are invented by people. This is displayed by key terms, items, processes, and categorizing items. An important consideration for learning concept classification is prior knowledge. Robert Gagné (1985) has shown that the skill of applying a concept always has some "prerequisite" skills, skills that must be mastered before it is possible to learn any given classification skill. A principle is a relationship among factors. It is composed of two or more concepts having an ordered relationship to each other (Gagne, 1971). Students display this knowledge by applying the principle. Some examples are: control, predict, infer cause, explain, troubleshoot, vary the task based on new conditions. There are two phases to learning a principle at the application level. The learner needs to comprehend the principle. This is referred to as the acquisition phase. After it is acquired, the learner needs to learn to generalize it to new situations, which is called the application phase.

The instructional sequence to be used is based upon performance levels designed by Merrill. His model suggests that the instructional sequence should include application and examples of each order of learning: remember, use and find. This involves establishing an instructional strategy for each phase. I will add another tool, feedback, to the sequence to improve learning.

Order	Instructional sequence
1. remember	Provide the learner with examples that lead to an expectation of successful accomplishment of the skill
2. use	Give learners the responsibility to practice and use the new skill in a supportive learning environment
3. find	New examples will be added to the concept maps
4. feedback	Provide feedback through expert maps to learners on how to improve their concept maps based on instruction on concepts and principles

This Study

In this study students were asked to create concept mapping and some were given feedback and instruction to assist in their knowledge integration. Effects of different treatments were established with the students to compare the differences with feedback and extra training on knowledge application. After reviewing the literature and issues raised, the researcher has concluded that the use of concept mapping can assist students in separating information and organization of it for recall. Concept mapping does assist in learning and developing skills for meaningful learning. However, does learning concept mapping with instruction on concepts and principles with feedback result in more learning for field dependent learners? Does a field independent learner do better without feedback on concept mapping and instruction on concepts and principles since they tend to favor less structure? The purpose of this study is to determine if more learning takes place when using concept mapping with instruction on concepts and principles, with or without feedback. In addition, the purpose of the study is to determine if field dependent learners tend to do better with structure, framed by instruction on concepts and principles, than field independent learners.

Summary

Concept mapping is tool that can be used for facilitating learning and assessing meaningful learning. It helps in gaining better and more comprehensive understanding of learning information. This study will attempt to determine if using concept maps will have a significant effect on both concept-type

and principle-type learning. Concept maps serve to clarify links between new and old knowledge giving an opportunity for the learner to externalize the links through test taking. In conclusion, this study will look at what can be done to help students create more effective concept maps using treatments such as instruction on concept mapping and instruction on concepts and principles, with or without feedback, to assist them in better learning techniques.

References

Ausubel, D. P. (1963). The psychology of meaningful verbal learning: An introduction to school learning. New York: Grune &Stratton.

Gagné, R. M . (1985) . The conditions of learning and theory of instruction. 4th edition . New York , Holt, Rinehart and Winston, Inc.

Jonassen, D. H., Beissner, K., & Yacci, M.A. (1993). Structural knowledge: Techniques for representing, conveying, and acquiring structural knowledge. Hillsdale, NJ: Lawrence Erlbaum.

Kearsley, Greg. (1994). Cognitive/learning styles. in explorations in learning & instruction: The theory into practice database. (WWW Version 1.1). [On-line]. Washington, DC: George Washington University, School of Education and Human Development.
Available: http://gwis2.circ.gwu.edu/~kearsley/styles.html

Merrill, M. D. (1983). Component display theory. In C. M. Reigeluth (Ed.), Instructional-design theories and models: An overview of their current status. Hillsdale, New Jersey: Lawrence Erlbaum Associates. Inc.

Novak, J.D. and Gowin, D.B. (1984). Learning how to learn. New York, Cambridge University Press.

Noring, J. (1993). A summary of personality typing. (Revision 2.5). [On-line].
Available: http://sunsite.unc.edu/personality/faq-mbti.html

Ruiz-Primo, M. A., & Shavelson, R. J. (1996). Problems and issues in the use of concept maps in science assessment. Journal of Research in Science Teaching, 33(6).

Wandersee, J.H. (1990). Concept mapping and the cartography of cognition. Journal of Research in Science Teaching , (27).

Witkin, H.A. Moore, C.A. Goodenough, D.R. Cox, P.W. (1977). Field-dependent and field-independent cognitive styles and their educational implications. Review of Educational Research, 47(1).