CONCEPT MAPPING IN KNOWLEDGE ORGANIZATION THROUGH A SEMIOTIC LENS

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Abstract. Concept maps (which show the relationship among concepts) are often discussed in the field of education as elements that facilitate the learning experience. In this study, I analyzed whether the concept maps used by knowledge organization researchers employ semiotic theory. I examined the following conference proceedings in their entirety: *The International Society for Knowledge Organization* (ISKO) and *Advances in Classification Research: proceedings of the American Society for Information Science and Technology* (ASIS SIG/CR). My findings determined that Peirce's framework was the basis for the largest number of maps, that concept maps are the most frequently used form of visual representation, and that most researchers who use concept maps in their presentation use only one. Additional analysis revealed that the majority of contributors who used concept maps following Peirce's framework were employed in the United States as professors. I deployed content analysis as my methodology to measure the most frequently used terms.

1 Introduction

Concept mapping has been used in academic and business settings since the late 1980s to provide visual representations of knowledge structures and argument forms. Concept mapping is often discussed in the field of education as a device that facilitates the learning experience and provides teachers with a method of imparting knowledge. Friedman (2006) has found that content mapping is frequently used in academic conference papers by scholars in the field of knowledge organization. Given the growing popularity of the technique in conference proceedings, a better understanding of how knowledge is represented in the academic research environment is necessary. This study selected the field of knowledge organization as its unit of analysis. Knowledge organization is a domain concerned with the "ordering of what is known," particularly for information retrieval (Smiraglia, 2005). Nowadays, with the increasing variety of non-printed material, defining the field of knowledge organization has become more complex (Hjørland, 2003). Many researchers of knowledge organization study the philosophical and semiotic aspects of language to support their particular foci. By portraying the concepts inside the maps as signs, semiotics can allow us to analyze the relationships among a set of concepts (Friedman, 2006). The aim of this research is to provide greater insight into the role that "signs" play in the specific, cognitive procedures employed by knowledge researchers who utilize concept mapping. I hope it will both open the discussion about whether or not concept maps can be classified and examine the context of semiotic theory as an academic tool for representing new knowledge.

2 Methodology

I examined whether the concept of "sign" that Peirce and Saussure define could be enlisted to measure the concept inside the maps that presenters used in their research papers. I selected two major conference proceedings in the field of knowledge organization: *Advances in Classification Research: proceedings of the Special Interest Group for Classification Research of the American Society for Information Science and Technology (ASIS SIG/CR)* and *International Society of Knowledge Organization* (ISKO). While the former collection represents an annual meeting, the latter is biannual. Both conferences had their inaugural proceeding in 1990. The last printed publication of the *Advances in Classification Research* occurred in 2002.

The study progressed through four steps. First, I examined the entire contents of both sets of conference papers to discover the nationality and occupation of the authors who most often used concept maps. In the second stage, I measured whether or not I could identify and classify the concepts found in the maps according to Peirce's or Saussure's definitions of the "sign." The third stage measured the "most-frequently used" terms in Peirce's triangle and Saussure's dyadic classifications. In the last stage, I examined the most-used mapping formats in the entire proceedings of both conferences. By employing Peirce's and Saussure's classification, I hoped to answer a very important theoretical question: Is there a relationship between nationality, occupation, and the specific conceptual process that an author uses?

3 Literature Review

3.1 Introduction

Semiotics emerges from philosophical speculations on signification and language (Chandler 2004, 5). During the 19th century, two major schools of thought established competing interpretations of the term "sign." The American philosopher Charles Sanders Peirce proposed a triadic foundation of the term and argued that anything can be considered a sign as long as it refers to, or stands for, something other than itself (Peirce 1931-58, 2.302). Alternately, Ferdinand de Saussure espoused a "dyadic," or two-part model, of the term "sign." According to Saussure, the "sign" is made up of the *signifier* (the mark or sound) and the *signified* (the concept or idea). Peirce also discusses the terms "signifier" and "signified," but for him the theory of the sign is not about language, but the production of meaning. Peirce uses a triangular model consisting of object-sign-interpretant. He maintained that a "sign" is anything that stands for something in somebody's mind. The signifier, for Peirce, stands for the *Representamen*, which is the form, not necessarily material in nature, which the sign takes. The signified for Peirce is the *Object,* which is that to which the sign refers. Peirce adds an additional element, the *Interpretant*, which is the sense made of the "sign" (Peirce, 1931-58, 3.399).

The importance of semiotics to both knowledge organization and the field of education is that it provides a framework for the connection between language and its meaning with regard to knowledge representation. The use of concept maps by researchers in knowledge organization has never been examined through the lens of semiotics. Furthermore, no existing study has analyzed the demographics of authors who use concept mapping. This study corrects both of these deficiencies in the current literature.

3.2 Concept Mapping

3.2.1 History

Concept mapping was developed by Novak and Gowin (1984) in order to provide better tools for lecturers, teachers and their students. They describe the logic of concept mapping through the definition of three key terms in cognitive processing: concept, proposition and learning. According to Novak and Gowin (1984), concept mapping is a process for representing concepts and their relationships in graphical form. Lambiotte, et. al (1984) provide a different definition. According to them, the relationship between the nodes and arcs represents the relationship between the concepts. A relationship can be directed or undirected between two nodes. A directed relationship points from one node to another. Unlike Novak and Gowin, Lambiotte, et. al do not incorporate the learning processing. I used Lambiotte et. al's definition because of its close connection to the framework of semiotics.

Concept mapping has mostly been employed to facilitate collaborative learning in the educational paradigm (Roth & Roychoudhury, 1994). Kankkunen (2004) utilizes Peirce's framework to describe how to track a student's real progress in learning. In linguistics, Graesser and Clark (1985) have developed a method for analyzing argument forms in terms of structured concept maps that have eight node-types and four link-types. Following Graesser and Clark, Woodward (1990) has developed tools to extract such maps from provided texts. In the field of knowledge organization, Priss (2004) has studied the structure of programming language by using Peirce's definition of signs to examine the correlation between structured programming languages and concept mapping.

3.2.2 Current Research

Friedman (2006) examined the sixth and eighth ISKO conference proceedings with regard to Peirce's definition of the term "sign." He found that concept mapping was a standard element of cognitive processing at both events. However, I did not find any studies that employed semiotics to examine and define the frameworks of the author's concept maps.

3.2.3 Summary

Many researchers in the field of education use concept mapping to improve student comprehension. Even though many researchers use it as a presentational tool, few use it as a meta-theoretical practice to classify and organize information researchers used.

4   Study Findings

I examined the entire collection of conference papers in the field of knowledge organization. I reviewed a total of 652 papers that showed 327 concept maps between the two conferences (ISKO and ASIS SIG/CR). Out of the 158 papers in the ASIS SIG/CR conferences, 125 concept maps were found. In the ISKO conference series, 202 concept maps were found in 494 papers. Although the ISKO proceedings included more concept maps, the ratio of concept maps to number of papers per conference indicated that the ASIS SIG/CR presenters embraced concept mapping more readily. The reason for the difference is the relatively larger number of papers presented during each ISKO conference.

4.1   The characteristics of the authors in both conference proceedings

I first examined the nationality and line of work of each author who included a concept map. The line of work was divided into three categories: professor, practitioner, and student. Regarding occupation, I found no major differences between the two conference proceedings. In both series, the majority of researchers who employed concept mapping were professors: accounting for 227 of the 327 total maps. In addition, I examined the country in which the researchers worked. In both series, the majority of the participants who employed concept maps were based in the United States. This trend was more prevalent at the ASIS SIG/CR events, where the majority of presenters worked in the U.S. In distinction, the ISKO presenters were a more international group. Out of 101 ISKO presenters who used concept-maps, only 21 worked in the USA. Researchers from Germany ranked second, with 10 concept maps out of 42 presenters. In addition, I also examined the strategy those authors most often employed with regard to the number of concept maps in their papers and found that the majority of researchers used a *single-map-per-paper* strategy. In the combined proceedings, 129 out of the total 327 concept maps employed a single-map-per-paper strategy. The fifth ISKO (in 1998) shows the highest numbers of authors, 12, who included this single-concept-map strategy. In comparison, the highest rate of occurrence for the ASIS SIG/CR occurred at the 2000 conference, during which 4 authors utilized this method.

4.2   The semiotics framework and concept maps

The concept maps I analyzed fell into three categories: "Peirce," "Saussure," and "other." The "other" category was reserved for concept maps that did not adhere to either Peirce's or Saussure's structure. Using Peirce's triadic theory, I classified a total of 148 concept maps (81 from *ISKO* and 67 from the *ASIS SIG/CR* conferences), which represents 62% of the maps examined, making it the highest-ranking classification. The second-highest ranked category was "other," with a total of 117 maps (85 from the *ISKO* proceedings, 32 from *ASIS SIG/CR*), representing 35% of the total. The lowest-ranked category was Saussure's dyadic theory, with only 62 maps (36 from *ISKO* and 26 from the *ASIS SIG/CR*), representing 18%. Analyzing the terms inside the concept maps, I found 299 terms that I could identify as "signs" according Peirce's framework. Using Saussure's framework, I could only produce a total of 161 terms. Table 1 presents the top 5 terms that I uncovered using both semiotic frameworks.

	Term	# of times	%
Peirce	1. Knowledge	12	5.43%
	2. Organization	10	4.52%
Saussure	1. System	3	2.64%
	2. Document	3	2.64%

Table 1. The most used terms defined as "signs"

Future studies need to examine if those terms represent the nature of the field. In addition to studying the significance of particular "signs," I analyzed if the concept maps used most often by presenters could be applied to three types of maps.

4.3   The most used concept maps form used

Out of the 327 maps I reviewed, I found three main classifications: concept maps, mind maps, and conceptual graphs. Concept Mapping consists of text, images, and links, all of which describe the relationship between specific nodes and arcs that yield the semiotic essence of any given presentation. Mind Mapping is a diagram used to represent words, ideas, tasks or other items that are linked to, and arranged around, a central word or idea. Conceptual Graphs are systems of logic that are based on the existential graphs of Charles Sanders Peirce and the propositional logic. Table 2 presents the findings.

	Concept Maps	Mind Maps	Conceptual Maps
ISKO	128	23	51
ASIS SIG/CR	78	13	34
Total 327	206	36	85

Table 2. The form of concept maps most used

Accounting for 62% of the total, the concept map was the most-used format. Additional analysis revealed that presenters who used Peirce's or Saussure's classificatory schemes relied most heavily on concept maps. As the preferred method of displaying scientific information in *ISKO* and *ASIS SIG/CR* conferences, concept maps integrate graphics and text most efficiently. It is interesting to note that most researchers added further graphic representations to their maps, without providing detailed explanation of their meaning. This apparent oversight should be examined in future studies.

5   Conclusion

I found that concept maps have frequently been used by researchers in the field of knowledge organization to present their findings. The majority of concept maps that researchers used applied to one dominant model: Peirce's triadic theory. The importance of this study is that it is the first to examine the manner in which knowledge organization researchers' use of concept maps to illustrate their findings. More research needs to address how researchers used concept maps and how can we classified the concepts inside the maps and their formats of maps. In addition, more research needs to address whether or not researchers used Concept maps or any other software applications to illustrate their findings.

References

Friedman, A. (2006). Concept mapping a measurable sign: Knowledge Organization for a Global Learning Society. *Proceedings of the Ninth International ISKO Conference*. Vienna, Austria, (10): 131-130.

Novak, J. D. & Gowin, D. B. (1984). Learning How to Learn. New York and Cambridge, UK: Cambridge University Press.

Hjørland, B. (2003). Fundamentals of knowledge organization. *Knowledge Organization*, 30(2): 87-111.

Smiraglia, R. P. (2005). Content Metadata-An analysis of Etruscan artifacts in a museum of archeology. Cataloging & classification quarterly 40 (n3/4):135-51.

Chandler, D. (2004). Semiotics for beginners. Oxford, U.K.: Routledge. Retrieved November 9, 2004, from http://www.aber.ac.uk/~dgc/semiotic.htm

Peirce, C. S. (1998). "What is a sign?" In the essential Peirce: Selected philosophical writings. Vol. 2 (1983-1913): 483-491 ed. By the Peirce Edition Project, Nathan Houser [et al.], Bloomington: Indiana University Press.

Saussure, F.D. (1916/1983). Course in general linguistics (trans. Roy Harris). London: Duckworth.

Lambiotte, J.G., Dansereau, D.F., Cross, D.R., & Reynolds, S.B. (1984). Multirelational semantic maps. Educational Psychology Review, 1(4): 331-367.

Roth, W-M. & Roychoudhury, A. (1994). Physics Students' Epistemologies and Views about Knowing and Learning. Journal of Research in Science Teaching, 31(1): 5-30.

Kankkunen. M. (2004) How to acquire "the habit of changing habits": the marriage of Charles Peirce's semiotics paradigm and concept mapping. *Proceeding of the first International Conference on Concept Mapping.* Spain

Graesser, A. C. & Clark, L. F. (1985). Structures and Procedures of Implicit Knowledge. New Jersey, Ablex.

Woodward, B. (1990). Knowledge engineering at the front-end: defining the domain. *Knowledge Acquisition* 2(1): 73-94.