COLLABORATIVE BUILDING OF SOCIOCULTURAL AND CONCEPT MAPPING THEORIES

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Abstract. The power of concept maps can be seen in their ability to represent the complexity of knowledge and understanding at a number of levels including the theoretical and the practical. This paper recounts the collaboration in practical applications that lead to theory building between two scholars, Holbrook Mahn, whose main research interest is sociocultural theory, and particularly the work of the Russian psychologist, Lev Vygotsky, and Manuel F. Aguilar Tamayo, whose main research interests include concept maps and sociocultural theory. We collaborated together on several projects using Vygotsky's, Novak's and Ausubel's work as a theoretical foundation. Through these applications, we gained a deeper understanding of each other's main research interests at the same time deepening our understanding of the theory that is a primary focus of our own research. After describing our collaborative activities, we describe ways in which Vygotsky's theory and Concept Mapping Theory can lead to a deepening understanding and representation of the other. In the course of the collaboration, we saw the areas of similarity and dis-similarity between the two theories and are now collaborating on a chapter for a book on concept maps in which we will compare the two theories and describe ways in which each theory complements and can expands the other. In the Discussion section at the end of this article we give an overview of ways in which we feel Vygotsky's theoretical framework, methodological approach, and research, which led to his analysis of the origins and nature of concepts, can help in building a solid theoretical explanation of the concept concept.

1   Introduction

Sociocultural approaches are increasingly being used in a variety of different disciplines to study the role that language and culture play in the development of many distinct human activities. Similarly, approaches using concept maps have been used successfully to represent knowledge in these same activities, from education to business, from social and natural sciences, and from empirical research to applications with social and artificial intelligence. Both approaches emphasize the importance of social interaction and collaboration in the development and representation of conceptual knowledge and understanding. We first engaged with each other on a theoretical plane, but quickly began to collaborate on different types of projects together. These efforts have led us to propose a way in which sociocultural theory can make a substantial contribution to the theoretical framework of concept mapping theory. Vygotsky's work, which provides the theoretical framework for sociocultural theory, focuses on the development of concept formation resulting from the interrelationship between thinking processes and those involved with language acquisition and use. His analysis of concept formation as a key to the development of human psyche and consciousness involves looking at the way in which humans create a system of meaning through language use. We argue that Vygotsky's analysis provides an expanded theoretical foundation for concept mapping.

2   The Collaboration

2.1   *Theoretical Framework*

Vera John-Steiner (2000) in Creative Collaboration writes: "Generative ideas emerge from joint thinking, from significant conversations, and from sustained, shared struggles to achieve insights by partners in thought" (p. 3). John-Steiner studies the processes of collaboration and creativity by partners, groups, and communities in different disciplines in science and the arts. In explaining her theoretical framework, she writes, "I rely on L. S. Vygotsky's cultural-historical ideas that creative activities are social, that thinking is not confined to the individual brain/mind, and that construction of knowledge is embedded in the cultural and historical milieu in which it arises" (p. 5).

Our collaborative process is described in two dimensions in this paper. The first is in a narrative mode, which explains the scenarios, interactions, and the genesis of new perspectives on teaching and learning, in this case, based on Vygotsky's theory. The other dimension, which is more analytical, more logical-abstract than the narrative, presents the process of understanding concept mapping from a Vygotskian perspective, within the collaborative process in which concept maps are used. Concept maps and Vygotsky's theory are used as theoretical complements, with the teaching/learning process organized using Vygotsky's theory. While concept maps are used as tools for mediating communication and learning, they also introduce a new element to the Vygotskian theoretical framework. The narration of our collaboration reflects the dialectical process for understanding and for theoretical discussion as well as reflecting our practice in teaching, learning, and research.

2.2   First Encounters

We first met when Aguilar Tamayo was visiting the University of New Mexico. On hearing of Aguilar Tamayo's interest in sociocultural theory and particularly Vygotsky's work, Mahn gave him an article he had written for Educational Psychologist on Vygotsky and sociocultural theory. The next day Aguilar Tamayo showed his concept map of the article to Mahn, who was so impressed with the way that the concept map represented the essence of the ideas in the article, that drawing from Casablanca he said, "Manuel, I think that this is the beginning of a beautiful friendship." He then invited Aguilar Tamayo to attend a doctoral-level seminar, he was teaching, to plan a course to prepare teachers for teaching linguistically and culturally diverse students.
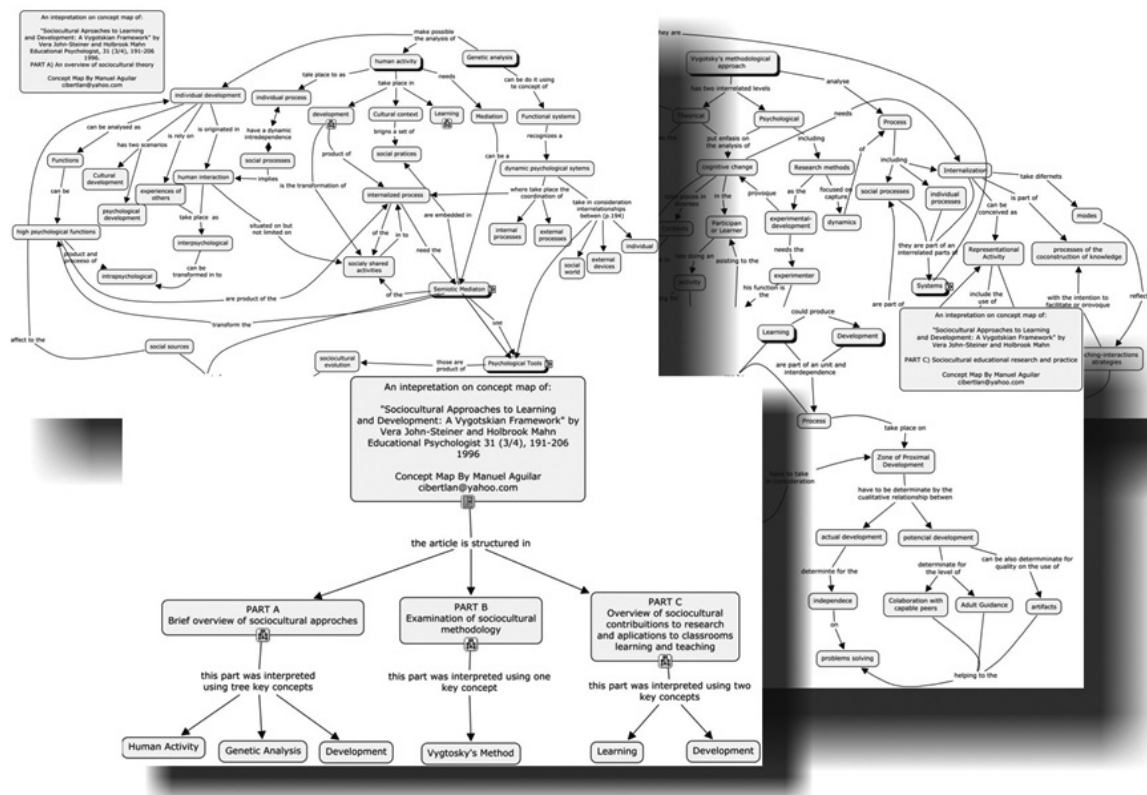

Figure 1. The analysis using a concept map of Mahn's article was presented as a knowledge model. The concept map at the front explains the concepts used for the analysis and links to the three concepts maps making it possible to navigate through them and access the article.

2.3   Facilitating Learning in a Planning Seminar

The rationale for that course was that while increasing multilingual, multicultural, and multiethnic diversity is reflected in US classrooms, teachers have generally not had the education to effectively respond to the needs of their linguistically and culturally diverse students. In order for educators to value and draw on the linguistic and cultural resources that students bring to the learning context, they need to better understand their students. Understanding the larger sociopolitical contexts of education, the nature of diversity, the way in which language and culture shape students, and the ways in which they learn, helps teachers fashion education that not only helps linguistically and culturally diverse students but all students. Therefore, the planning seminar looked at cultural diversity, second language acquisition processes and programs, curriculum and pedagogy, and ways to empower students by drawing on their strengths and their lived experiences and developing their confidence in their abilities to learn.

The theoretical foundation for the seminar was provided by the work of Vygotsky. One of the challenges in the workshop was tying this framework to pedagogy and then providing coherence to a proposed curriculum. Using concept maps, Aguilar Tamayo helped the seminar integrate theory and practice.
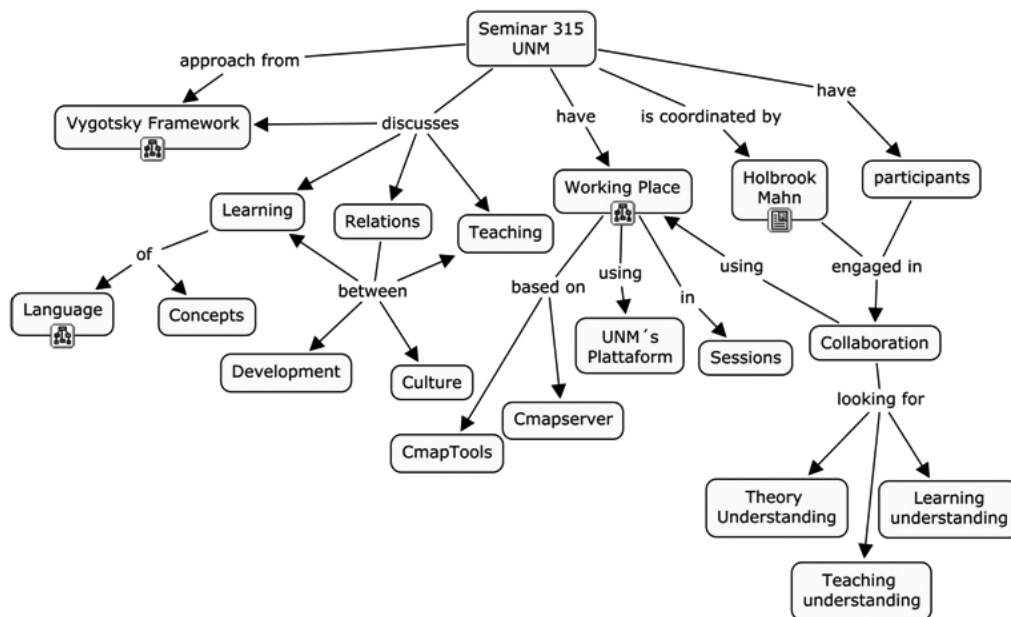

Figure 2. The concept map of the doctoral planning seminar

2.4   Preparations for Conference Presentations

Following their collaboration in the planning seminar, Mahn and Aguilar Tamayo collaborated in the preparation of presentations for both the 2005 and the 2008 International Society for Cultural and Activity Research (ISCAR) conferences in Seville, Spain and San Diego, CA. The diagrammatic representation of concepts that Mahn learned from Aguilar Tamayo helped him design a diagram that was at the center of his analysis of Vygotsky's concepts of System of Meaning and Concept Formation. This diagram and the concepts it describes are detailed in Mahn (2008).

In organizing their presentations, Mahn and Aguilar Tamayo discussed the relationship between Vygotsky's theory of concept formation and representation through concept maps, drawing on the respective research communities. Aguilar Tamayo discovered the interest of the ISCAR community in the uses of concept mapping, but at the same time saw the community's limited understanding of the implications for pedagogy and research on the learning of concepts represented in the use of concept maps. They were perceived as an incidental technique in the field of education, despite the possibilities for concept maps transforming educational practice (Novak & Cañas, 2004) and

educational research (Novak & Gowin, 1984). Because Aguilar Tamayo thought how this perspective could be related to the Vygotskian theoretical perspective, he started working on the deconstruction and reconstruction of the concept map, (2004, 2006). The concept map as an external representational system could now be subjected to interpretation and questioning from a different theoretical perspective.

In his presentations on the use of concept maps Aguilar Tamayo incorporated aspects of Vygotsky's theory (Aguilar Tamayo, 2008) and also presented a paper on concept maps and Vygotsky's ideas at the 2006 Second International Conference on Concept Mapping (Aguilar Tamayo, 2006), which is described below in the Discussion section. Aguilar Tamayo and Mahn also began to consider another important issue, the concept of concept, from Mahn's (2005, 2008) interpretation of Vygotsky's work on the genesis, the structure, and the function of the concept. In this process Vygotsky's theory became more explicit for Aguilar Tamayo, helping him gain new insights into Novak's and Musonda's article (1991) where the process of the construction and development of conceptual understanding are explained. These insights made explicit the need for building more bridges between Vygotsky's and Novak's perspectives on concept formation and learning.

Aguilar Tamayo and Mahn were able to work on building these bridges through their preparation and implementation of a workshop on Vygotsky. A central aspect of planning this workshop was discussion of Vygotsky's notion of the system of meaning and it relationship to the system of concepts, including the relationship between academic/scientific concepts and everyday concepts. In the course of the workshop planning, a number of questions were raised. What does a concept map represent? When is it intended to represent the domain of knowledge? Is it capturing the students' uses of scientific concepts? How is the emotional aspect of learning part of the learning of concepts in school? What are the misconceptions related to everyday concepts? If a student's previous knowledge or prior understanding is to be considered for teaching in order to provoke meaningful learning, what is the relationship between their use of everyday concepts and academic concepts? Many of these questions have been addressed in constructivist and/or cognitive perspectives; however, Vygotsky's analysis afforded Aguilar Tamayo and Mahn new ways to understand research findings and to explore different interpretations. The next step was to test these theoretical perspectives in the learning and teaching in the workshop on Vygotsky.

2.5   Workshop on Vygotsky Using Concept Maps

Aguilar Tamayo and Mahn collaborated on this workshop on Vygotsky's theory held at Aguilar Tamayo's university in Mexico. The workshop planning concept map provides an overview of the workshop.

2.5.1   Academic Literacy for All Protocol and Concept Maps

A central activity that Mahn and Aguilar Tamayo used in the workshop was based on a project directed by Mahn in the United States designed to help secondary teachers understand how they can facilitate the language and literacy development of their English language learners (ELLs) at the same time that they are teaching the content concepts. To help with this professional development effort, Mahn created a protocol based on Vygotsky's work on conceptual thinking in which students, who are organized in groups of four, write two sentences based on a prompt, about which every student should be able write two sentences and one that encourages students to draw on their prior knowledge. Then students in pairs create two new sentences drawing on the concepts from each partner's sentences and then in groups of four create two more sentences. These are written on poster paper and displayed at the front of the class. The students all analyze them and decide which one, other than their own group, best represents the concept. They then analyze the groups' sentences looking for common themes and vocabulary. Finally, they look at words that are logical connectors, such as "because" "if…then" which hold the key to understanding the concepts represented in the sentences (Figure 3). (Details can be found at http://ala.unm.edu/).
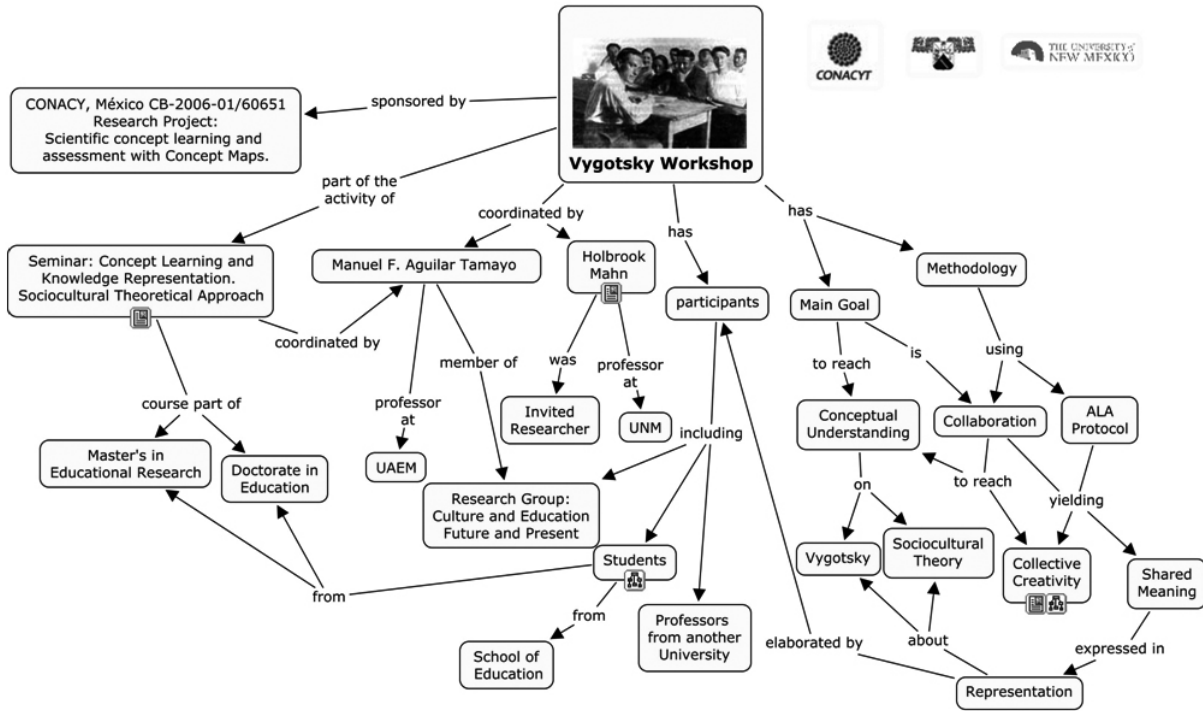
Figure 3. Here we describe an activity used in the workshop that shows the theoretical and practical relationship between sociocultural theory and concept mapping theory.

During the Vygotsky workshop the concept of generalization was presented as the prompt for the protocol. As one of the participants stated, "the discussion generated from the review of the sentences from each of the groups enriched the knowledge of the individual's and the group's concept, and it provided new important concepts about generalization." After doing the protocol, the workshop participants worked in groups for initial discussions on the development of the structure of generalization that is at the center of Vygotsky's work on concept formation.
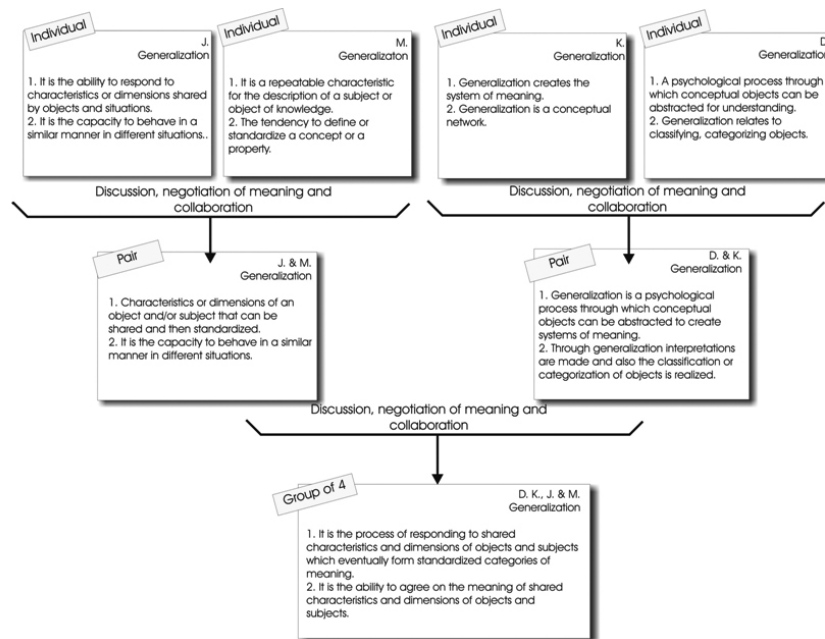

Figure 4. The ALA protocol process, in which the production of text is related to individual writing, collaboration in pairs, and then pairs of pairs, which produced the group's final text. Note the sense of each new text, in which key concepts, are integrated more generally or abstractly.

Mahn has used concept maps with the teachers in the ALA project to help them develop a better understanding of the concepts that they are teaching. The processes involved in the protocol can be compared to those used in constructing a concept map: "Propositions are statements about some object or event in the universe, either naturally occurring or constructed. Propositions contain two or more concepts connected using linking words or phrases to form a meaningful statement" (Novak and Cañas, 2008, p.1, italics in original). The ALA Protocol helps students formulate propositions and then with partners discuss their propositions in order to create a new one. This involves negotiating between participants, discussing the sense of their propositions, and then deciding which specific concepts to include or exclude, similar to the process of elaboration in creating a collective concept map.

In the Vygotsky workshop four groups of four students were involved in the protocol activity. Figure 3 represents the text creation process for one group. Each new text was discussed, negotiated, and created in collaboration between pairs and then pairs of pairs, resulting in a group text. The appropriation of the new text was a product of collaborative discussion; the final text represents the synthesis and consensus of the participants' thinking. This discussion and negotiation process was recorded and followed using a Livescribe pen (www.livescribe.com), which captured the collaboration process and the production of text. For instance, if we follow J's initial writing in Figure 3, and then the collaboration in a pair, J&M, producing the new text (recorded including the writing synchronized with voices), then it is possible to follow J&M's collaboration with D&K in the final discussion between all 4 participants.

The discussion and the texts produced allow for a wider interpretation of the final text, beyond just the inclusion or exclusion of concepts and the negotiation of the meaning. The participants frequently expressed what they understood for one term and in this process, they learned new terms and were able to clarify the meaning. The new texts also reflected changes in writing style, as they expressed a shared meaning, which included all ideas, resulting in a more complex construction, without exceeding the two-sentence limit.

Students also reflected an emotional aspect in their discussions. For example, students defended their opinions, in personal ways, such as a student, in the discussion between pairs, said: "…yes, I am more of a global thinker. I like to think taking into consideration more aspects…" For every collaboratively written text, students assumed authorship: "Our definition includes cultural and social aspects…" Personal satisfaction reflects an interested and willing participation: "My personal experience was at the beginning of the activity, easy; however, when we start working in pairs and putting our ideas on the table, it turned out to not be so easy. It becomes more complicated when we started working in groups of four and we put our diverse perspectives into the discussion, trying to get something in common and in the end, we did it!"

2.6 Future Research and Theory Building

With its analysis of the relationship between the individual and the social and how it relates to learning and development, Vygotsky's theory provides a substantial foundation for examining group learning with concept maps. Daley, et al (2008) have argued that concept mapping theory should investigate the use of concept maps as a means to engender group learning. "Studies have shown that shared mental models can develop through collaborative learning and from the interaction of individuals in the development of a group map" (p. 90). Group learning with concept maps in the Vygotsky workshop helped promote collaborative understanding of complex concepts. A participant reflected on this process: "The negotiation of meaning helped us move from awareness to understanding, and at the same time enabled and encouraged the development of higher mental processes, which encouraged reflection, discussion, cooperation, and enriched the formation of concepts, leading to more complexity and depth."

3 Discussion

3.1 Concept Maps and Vygotsky's Theory

As Aguilar Tamayo (2006) notes, Novak (2002, 2004) has acknowledged the importance of Vygotsky's best-known concept – the zone of proximal development. He also describes the importance that Novak ascribes to language as an important component of cognitive development. Similarly, both sociocultural theory and concept mapping theory focus on the impact that education has on children's learning and cognitive development. Aguilar Tamayo (2006) also

compares Vygotsky's emphasis on the importance of social interaction in child development and the fact that one of the design principals of Cmap Tools is cooperation and shared knowledge (Novak and Cañas, 2004).

In an article giving an overview of the theory underlying concept maps, Novak and Cañas (2008) describe the interrelationships between the key memory systems that create a unified whole. The interrelationships among mental functions as a determining factor in the nature of the human psyche was also fundamental to Vygotsky's approach. They describe a fundamental idea in Ausubel's cognitive psychology "that learning takes place by the assimilation of new concepts and propositions into existing concept and propositional frameworks held by the learner. This knowledge structure as held by a learner is also referred to as the individual's cognitive structure" (p. 3). While there are differences, this resonates with Vygotsky's (1987) theory of System of Meaning, which examines the development of an internal mental system through language development and concept formation (Mahn, 2008).

3.2   Differences Between Concept Mapping Theory and Vygotsky's

Aguilar Tamayo (2006) details how Vygotsky (1987, p. 126) in sociocultural theory and Novak (1998, p. 58) and Ausubel (2002, p. 31) in concept mapping theory see the relationship between word and concept as primary. However, a fundamental difference between the two theories is the way that they define and analyze concepts. For concept mapping theory, Cañas and Novak (2009), drawing on the work of Novak, Ausubel, and Toulmin, define "concept" as "a perceived regularity or pattern in events or objects, or records of events or objects, designated by a label" (p. 1). Vygotsky described the key role that words, or labels, play in concept formation, but went beyond the perceived regularities or patterns which are aspects of the concept, to analyze the unification of the thinking and language processes that is the foundation upon which concepts are built. "A central and basic aspect of the structure of mental functions is the use of the sign as a means of directing and mastering mental processes. In the problem of interest to us, the problem of concept formation, this sign is the word. The word functions as the means for the formation of the concept. Later it becomes its symbol. Only the investigation of the functional use of the word and its development from one age to the next…provides the key to the formation of concepts" (1987, p. 126).

Vygotsky's major work, Thinking and Speech, details the ambitious research plan that he and his colleagues carried out investigating the development of the concept through an analysis of the development of the system of meaning with the structure of generalization as its foundation. Vygotsky's work on concept development can help expand the common definition used in concept mapping theory and the analysis of the origins of concepts used by concept mapping theory.

Drawing on McNamara, Cañas and Novak (2009) write, "The question sometimes arises as to the origin of our first concepts. These are acquired by children between birth and three years of age, when they recognize regularities in the world around them and begin to identify language labels or symbols for these regularities. ... This is a phenomenal ability that is part of the evolutionary heritage of all normal human beings" (p. 2). The question is how does this process unfold? What sort of development in the children's mental system is necessary for them to be able to recognize regularities? How do they begin to identify language labels or symbols – what is the relationship between language use and thinking processes? Questions Vygotsky addressed in his research, the results of which are presented in Thinking and Speech. His answers can provide an important enhancement to concept mapping theory by expanding the understanding of concept and revealing its origins and course of development. Unlike concept mapping theory, Vygotsky felt that when the child first acquired a word, the development of the concept had just begun. The main point of his research and theory building was "that the development of the corresponding concept is not completed but only beginning at the moment a new word is learned. The new word is not the culmination but the beginning of the development of a concept" (1987, p. 241). He focused on qualitative transformations in the development of the system of concepts during which a child's thinking processes undergo a profound change, so that children's use of concepts differs depending on where they are in the process (Mahn, 2005, 2008). One of the participants in the Vygotsky workshop addressed this important concept: "It is interesting and important in education to know that the conception that each one of the learners has about a concrete or abstract object can vary depending on when it is developed."

Another central area in which Vygotsky's work can enhance the theoretical framework of concept mapping theory is his analysis of how children learn scientific concepts, how they learn science. He studied the processes

through which children acquire everyday, or spontaneous, concepts and how this established the foundation for the learning of scientific concepts (1987). Unlike others at his time who posited that scientific concepts replaced everyday concepts, Vygotsky analyzed the relationship between the two and in the process developed the theory for which he is best known – the zone of proximal development, which he described as the link between scientific concepts and everyday concepts. Concept mapping is an activity that could help to develop scientific concepts in that zone; however, more specific research has to be done to understand how to represent the relationship between scientific and everyday concepts in concept maps.

Exploring ways in which Vygotsky's work can amplify the theoretical framework of concept mapping theory has been a goal of the collaboration of Mahn and Aguilar Tamayo. By applying both theories in practice and seeing ways in which each can help inform the other, they have seen the power of the combined theories. Mahn's and Aguilar Tamayo's next step in their collaboration will be in amplifying concept mapping theory using Vygotsky's analysis of concept formation.

4   Acknowledgements

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