Engaging Learners in Critical Analysis Through Concept Maps: From Theory to Practice

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Keywords: Concept maps, critical analysis, adult learning theories

Abstract: This paper addresses the use of concept maps to engage adult learners in critical analysis. The discussion is situated within four adult learning theories. Examples from different contexts using concept maps and connections between theories, learning process, locus of learning, teacher's role, manifestation in adult education, and activities are presented.

Adult learning theories can help educators become more effective practitioners and meet the needs of the learners they serve. Understanding how adults learn best through different lenses can provide insights into the learning process. In this paper, we focus on four adult learning theories and discuss their manifestation in adult education through the use of concept maps as a way to engage learners in critical analysis.

Based on the results from a literature review of practitioners using concept maps to foster critical analysis, we answer the following questions: How does the use of concept maps foster critical analysis of adult learners in different contexts? How can concept mapping help promote critical analysis? For the purpose of this paper, we define critical analysis as an assessment based on careful systematic evaluation. Critical analysis involves processes of reflection, higher order thinking, and synthesis leading to meaningful learning, knowledge construction, perspective transformation, or solving of community problems.

Theoretical Foundations of Concept Maps

Concept maps have been used in education since the 1970s when Joseph Novak and his research team at Cornell University began applying them in their work with science students (Novak & Cañas, 2006; Novak & Gowin, 1984). Later, educators starting utilizing concept maps as a tool to increase meaningful learning in other subject areas. They were also used to represent expert knowledge of individuals and groups in different contexts such as business and government. Concept maps have their theoretical foundation in constructivist theory and focus on learners' active construction of knowledge.

A review of the literature shows that concept maps have become a highly effective method to facilitate critical analysis. A concept map is a schematic device for representing a set of concept meanings embedded in a framework of propositions (Novak & Gowin, 1984). It provides a visual representation of conceptual meanings used to develop shared meaning. A special form of a web diagram for exploring knowledge and gathering and sharing information is created to represent these meanings.

Concept Maps and Adult Learning Theories

In this paper, we focus on four adult learning theories that involve critical analysis: cognitivist, constructivist, transformative, and social learning. These theories involve individual

or social construction of knowledge and use reflection as a way to critically analyze content, experience, context, interaction, or systems. Based on the premise of these theories, concept maps can be used as a strategy for engaging adult learners in critical analysis. Although these learning theories have similarities, such as the integral role of critical analysis, they also possess differences in the learning process, locus of learning, and the teacher's role.

From Theory to Practice

In **cognitivist learning**, concept maps can foster cognitive development as students build new knowledge on previous knowledge in order to form new mental schema or internal cognitive structures (Piaget, 1972). Instructors using concept maps help students develop the capacity and skills to learn new knowledge and structure content for learners in content areas such as computer programming, in which "the ability to express information and knowledge diagrammatically" is important (Keppens & Hay, 2008, p. 40). Another example is when students use concept maps in medical schools to recall content and diagnose by visualizing and critically analyzing symptoms and connections in body systems (Atay & Karabacak, 2012). In their study in Turkey, Atay and Karabacak's (2012) experimental group of nursing students used concept maps to develop care plans, which "was an important factor in increasing critical thinking disposition" (p. 236).

Jafari, Akhavan, and Akhtari (2011) worked with Iranian tunnel experts and reported that concept maps had "meaningful effects" on participants' capability to produce knowledge, an aspect important for these adult learners to produce expert knowledge and communicate this knowledge (p. 250). With physiology students, the problem-solving exam grades were higher with the students who used concept maps and demonstrated a statistically significant difference from the group that did not use concept maps (González, Palencia, Umaña, Galindo, & Villafrade, 2008). Greene, Lubin, Slater, and Walin's (2013) study suggests concept maps allowed educators to critically analyze prior knowledge and current information from sessions in order to "restructure existing schema" (p. 296). These examples show cognitive development over time and ability for learners to think critically by learning how to learn.

In **constructivist learning**, a concept map can be a tool to integrate new knowledge from experience through the internal construction of reality by the individual (Ausubel, 1963). Reflection allows the adult learner to become aware of the integration of new sources of knowledge. By concept mapping with self-reflective journaling, learners can prioritize ideas, critically analyze concepts, and make decisions about what is meaningful to them. Learning how to think and evaluate content helps students make meaning of information and construct new knowledge at a deeper level. Instructors using concept maps can facilitate and negotiate meanings with the learner.

González et al.'s (2008) study showed how instructors facilitated meaning construction with learners based on their concept maps. This process demonstrated higher learning outcomes for physiology students. In dental education for adult learners, concept mapping was explored as a supplemental form of learning and an alternative means of testing as explained by Hay, Tan, and Whaites (2010). Their study comparing adult learners with traditional aged college students indicated that adult learners' concept maps immediately reflected an "integration of theory and work practice," which traditional testing failed to do (Hay, Tan, & Whaites, 2010, pp. 588-589). Adult learners indicated that the integration of life experience was important to their learning process and the instructors saw much richer connections in content with concept maps than in traditional assessment, which may have disadvantaged the adult learner.

In another context, Pegg's (2007) research explored school leadership through participatory research and suggests that concept maps helped teams explore every day experiences in their work as administrators at various levels. Concept maps were used to help the learners and the researcher "establish a picture of the way in which concepts of learning were used…by leaders in their daily lives" (Pegg, 2007, p. 265). Administrators processed and critically analyzed how they learned to lead by examining linkages.

In **transformative learning**, the learning process focuses on the critical reflection of assumptions (Mezirow, 1991). The learning process is based on the change in the learner's preconceptions and worldview. The instructor's role is to foster critical reflection with the ultimate goal of student's development of thought and understanding. For example, Kandiko, Hay, and Weller (2013) explained the process of reflection and dialogue students went through when creating concept maps over a formal education course. In this case, students modified and adapted meaning making over time, challenging previous assumptions. The authors assert that the social and psychological meaning making through the learning process with concept maps was a complicated one and difficult to categorize into the individual or social. They consider feedback on concept maps as a process of dialogue with the student rather than simply assessment:

> …having a series of concept maps can facilitate dialogue between students' personal understanding of public knowledge and the understanding of others, such as instructors and peers. Reflection on maps created over time can allow both student and instructor to engage in dialogue about the student's development of thought and understanding. (Kandiko, Hay, & Weller, 2013, pp. 82 – 83)

Within management learning, Gray (2007) discusses important strategies and includes concept mapping as an essential input to the learning process. Concept mapping on individual and group levels can help learners critically analyze and reflect upon critical incidents and metaphors, which can foster transformative learning. This analysis promotes positive change in individual, team, and organizational processes.

Also based on a cognitivist process, in **social learning**, concept maps can be a tool to cooperatively critically analyze problems and potential solutions for change through observation and modeling (Bandura, 1977). Reflection and collaborative learning with concept maps allows adults to become aware of systems and networks in which they are situated. The instructor plays an important role in providing a knowledge map for learners to model behavior through attention, situating the activity within a relevant social context, reinforcing learner behavior through feedback and rewards, and using strategies that keep the learner motivated to complete the task.

Continuing professional education for teachers is an area in which social learning using concept maps has been explored. Rye, Landenberger, and Warner (2013) studied professional development for middle and secondary science teachers in team project-based learning within a summer program. The program focused on project-based learning units investigating and critically analyzing content related to local watersheds. Teachers were taught computer-based concept mapping and exchanged ideas with peers with different levels of expertise. After learning about the tool and returning to the classroom, teachers reported using concept mapping to critically analyze content collaboratively with students as well as in team planning and organizing lessons. By modeling each other's behavior, learning was based on the interactions of participants, their behavior, and the environment.

Meagher-Stewart, Solberg, Warner, Macdonald, Mcpherson, and Seaman's (2012) study focused on 90 health care practitioners working in public health. The professionals developed concept maps in small groups, which served as "meaningful ways for participants to clarify the connections between people and concepts, and to understand the role of various types of communities of practice in stimulating evidence informed decision making" (p. 727).

Moni and Moni (2007) examined group concept maps in physiology where students needed to critically analyze content as a group and generate one concept map to be assessed. In this case, students needed to examine logic and understanding as teams. González et al. (2008) report that students talked to each other about their concept maps of physiology, which helped them to self-reflect and recognize misconceptions in connections. This peer learning was an important part of the process of concept map development in a social context.

Table 1 provides a comparative table of the four learning theories indicating the learning process, locus of learning, teacher's role, and manifestation in adult education; and provides examples of activities how concept maps can be used in adult education.

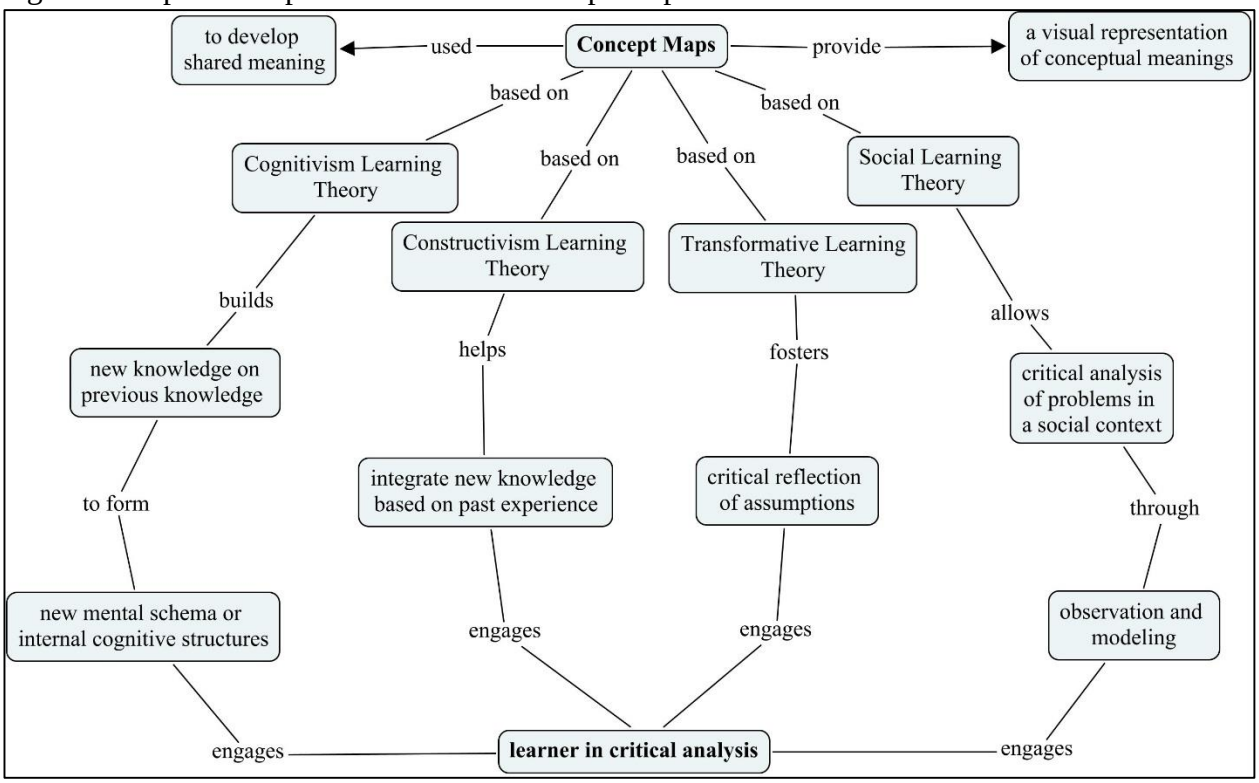
Table 1: Concept Mapping and Learning Theories

Learning Theory	**Learning Process**	**Locus of Learning**	**Teacher's Role**	**Manifestation in Adult Education**	**Activities**
Cognitivist	Internal mental processing	Internal cognitive structures	Develops learner capacity and skills to learn Structures content of learning for learner	Cognitive development. Critical thinking. Learning how to learn.	Concept mapping as an assessment tool. Concept mapping to develop plans. Concept mapping to solve problems. Concept mapping new vocabulary and concepts.
Constructivist	Construction of meaning from experience	Internal construction of reality by individual	Facilitates and negotiates meaning with learner	Experiential learning. Reflective practice. Learn how to think.	Concept mapping new ideas by connecting life experience and/or practice. Generating individual and group concept maps.
Transformative	Change in learner's preconceptions and worldview	Learn new meaning schemes to transform perspective	Fosters critical self-reflection	Values and ethics education. Diversity training. Transformation of practice in Continuing Professional Education. Perspective transformation.	Concept mapping critical incidents. Concept mapping as a supplement to a reflection. Creating individual concept maps and then coming together to share meaning over time.
Social	Interaction with others in social context	Interaction of person, behavior, and environment	Models and guides new roles and behavior	Collaborative/ cooperative learning. Mentoring.	Using concept maps to come to a shared understanding of a situation for organizational and

Learning Theory	Learning Process	Locus of Learning	Teacher's Role	Manifestation in Adult Education	Activities
				Modeling behavior.	community change and problem solving. Peer map exchange.

Figure 1 shows a graphical representation of a concept map and how it can be used in adult education courses as a strategy for critical analysis. The example provides a synthesis of the concepts and examples addressed in this paper.

Figure 1 Graphical Representation of a Concept Map



Conclusion

By theorizing from the literature and making connections between the fields of concept mapping and adult education, we can broaden our understanding from theory to practice. Concept maps can be easily integrated into adult education classes that involve reflection and critical analysis. The examples we provided can be a start for any adult educator trying to incorporate theoretical knowledge into practical application. Future research is needed to examine how concept maps can be a tool to understanding forces of oppression and domination. Concept mapping conflicts in social settings such as community organizing may facilitate a more in-depth individual and cooperative critical analysis of power and learning.

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