A New Model for Adult Literacy Education: Technology-Based Concept Mapping in GED Preparation

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Abstract: This paper explores the potential for the effective integration of concept mapping into the teaching of GED preparation programs in ways that benefit the academic achievement of learners through the implementation of a New Model of literacy education.

The Need for a Different Approach to GED Preparation

Of 39 million school non-completers, about 2.3 million (< 6% of those eligible) enroll in adult literacy programs yearly; 72% of participants are students of color (Keenan, 2009). About 1.5% of school non-completers take and pass the GED® tests each year (GED® Statistical Report, 2008). Longitudinal studies suggest only 2% of those who receive a GED complete a four-year college degree (Tyler, 2004). It is widely anticipated that the academic difficulties faced by these students will become even more challenging when a new version of the GED® tests is implemented in 2014 (GED® Testing Service, 2013). The 2014 computerized version will be based on Webb's (1997) Depth of Knowledge Model (DKM) (Webb, 2002). Aligned with the more rigorous career and college readiness standards being adopted nationwide, it is focused on four sub-tests: literacy, mathematics, science, and social studies. It is designed to examine learner's readiness at two performance levels: high school equivalency and career and college readiness (Hoffman, et al., 2013).

The new tests will target four knowledge levels: r*ecall and reproduction* (list, identify, and define); w*orking with skills and concepts* (go beyond recall and transform/process target knowledge before responding); s*hort-term strategic thinking* (the ability to analyze, explain, and support with evidence, generalize, and create); and e*xtended strategic thinking* (the ability to synthesize, reflect, conduct, and manage) (Hoffman, et al., 2013). It thereby requires test takers to demonstrate higher order thinking skills as opposed to basic skills. However, these learning requirements contrast sharply with current instructional practices which are characterized by behaviorist instructional approaches via teacher-directed classes, and the use of programmed workbooks, activities, and materials. Consequently, students' subject matter content knowledge tends to be unclear, unstable, and/or disorganized. Students thereby often fail to attain the critical thinking and transfer of learning skills necessary for both the workplace and transition into postsecondary education (Grubb, 1999). A new model is needed in the provision of adult literacy education that is intended to assist learners to take and pass the GED® tests, and to obtain a postsecondary degree. A model based the attributes of technology-based concept maps (Cmaps) could provide an opportunity to meaningfully enhance the educational and learning outcomes of GED preparation students.

Technology-Based Cmaps and Theory of Meaningful Learning

Accessible through free Internet-based technology (e.g., IHMC CMap Tools), concept maps are two-dimensional, node-linked schematic devices for representing verbal, conceptual, or declarative knowledge in a meaningful framework of propositions (Novak & Gowin, 1984). They are comprised of several elements: *focus questions*—specify the problem/issue; ten to twenty-five *key concepts*–mental images we have for words, e.g., objects/events; *linking words*—used with concepts to construct propositions that are stored in an individual's cognitive structure; *subsuming*—a hierarchy of concepts in which lower-order concepts are subsumed under higher-order concepts; and *progressive differentiation*–concepts are organized into more complex understandings. Cmaps represent one recent manifestation and operationalization of the Theory of Meaningful Learning.

The Theory of Meaningful Learning

The Theory of Meaningful Learning (ToML) argues that both concepts and propositions composed of concepts are the central elements in the structure of knowledge and the construction of meaning (Novak and Gowin, 1984; Ausubel, 1963). Concepts and propositional learning are the foundation upon which individuals construct their own idiosyncratic meanings. Through meaningful learning, learners must choose to integrate new knowledge relevantly with pre-existing concepts. Active learning supports acquisition of new concepts within preexisting, superordinate cognitive structures through a process of subsumption (Ausubel, 1963; 2000; Ausubel, Novak, & Hanesian, 1986). Consequently, memories of new material are enhanced, and the forgetting of that material is reduced. Knowledge is organized in hierarchical structures, such that general concepts (e.g., Plant) are parent concepts to more specific concepts (e.g., Flowers). Many of the ideas originally presented by Ausubel have formed the impetus for experimental studies on the use of Cmaps as pedagogical tools (e.g., Hagemans, van der Meij, & de Jong, 2013; Novak & Gowin, 1984). The ToML argues that knowledge is comprised of a set of hierarchies for which cognitive change involves the process of subsumption, whereby individuals assimilate new input into their internal hierarchical structure.

Hierarchies support deduction, such that concepts necessarily share the properties associated with their parent concepts (Sloman, 1998). These hierarchies form taxonomies which support the differentiation of different "kinds of things" within the same category (Murphy, 1982). They thereby support learning through both inductive and deductive learning. The subsumption process uniquely describes a system of learning that results from the taxonomic structure of knowledge. New input from the environment helps reorganize knowledge and strengthen connections between concepts, and the hierarchical structure of knowledge supports this process. Ausubel postulated two routes by which *subsumption* can increase cognitive change to learners' taxonomic structures. Correlative Subsumption—the acquisition of knowledge, which can be obtained by comparing new material with prior knowledge, and Derivative Subsumption—identifying previously unnoticed extensions of presented materials. In contrast, he argued that Obliterative Subsumption is the process of forgetting critical features of a concept after repeated presentation (or activation in memory) of this concept without its parent concepts.

Cmaps, present content in a way that delineates the hierarchical relations between concepts. They are effective tools for identifying and monitoring cognitive change because they offer a visual representation of the to-be-learned material in a form that models the internal representation of the concepts. They present information in an additional modality (i.e., the visual stream) compared to receiving the input only in one form, such as via text or through direct instruction (i.e., the phonological stream). Rather than taxing resources, the addition of the visual input supports encoding of material that would otherwise only be available in text form (e.g., Paivio, 1986). Accordingly, empirical research has found that Cmapping students (in K-12 schools and colleges) have better academic performance than those using text-based representations such as outlines or flowcharts (e.g., Nesbit & Adesope, 2006), and students' academic performance is statistically significantly superior with the use of Cmaps compared to other interventions (Arslan, 2006; Karpick & Blunt, 2011; Okoye & Okechukwu, 2010).

Also, the notion that Cmaps can facilitate memory retention has important educational implications for GED preparation teachers. Students' errors or misrepresentations in internal representations (i.e., student misconceptions about the material) can be corrected by presenting more accurate representations of the targeted material. Lastly, teachers can use Cmaps as assessment tools to identify both student misconceptions, and the areas for which students require appropriate learning scaffolds.

Teaching via Concept Maps

In general, teachers can facilitate the use of Cmaps among GED students, and assist them to incorporate (subsume) new information by presenting new material in relation to students' existing background knowledge of relevant concepts, so that an individual has a basis from which to subsume new input. Teachers can use "organizers" (i.e., overarching concepts) to introduce material at a higher level of abstraction, generality, and inclusiveness than the learning task itself (Ausubel, 1963). The function of the organizer is to provide an overview concept (a superordinate concept) from which other, more specific concepts (subordinate concepts), will be subsumed. Concepts should be presented which are clearly discriminable from each other. Progressive differentiation can be employed by creating organizers, and discriminable concepts nested within them, such that material is presented to scaffold learning from the most general concepts (organizers) to the more specific embedded concepts. The conceptual hierarchies modeled by teachers should be structured such that broad concepts include the general properties shared among all of the concepts. The teaching of GED content can be more effectively and efficiently delivered through the employment of expert knowledge models, and scaffold maps.

Expert Knowledge Models (EKMs) and Scaffold Maps

Expert Knowledge Models (EKMs) should be developed by GED content-knowledge experts to include all of the appropriate content in a specific concept domain (e.g., the four new GED® tests). Students with limited literacy skills may benefit from the use of EKMs because processing the information in the EKM does not have the same demands required for generating the same cognitive representation from text (Kintsch, 1988). GED preparation teachers can use EKMs to serve three goals: 1) a model to guide instruction, and thereby assist the presentation of lessons in a pedagogically sound manner; 2) the creation of scaffold maps to guide students' creation of individual Cmaps and personal knowledge models (PKMs); and 3) assessment of and feedback on the Cmaps created by students. The EKMs are often used as an alternative means of measuring student learning outcomes and as formative assessments of learning.

In addition, Scaffold Maps should be developed by teachers. Based on component elements of EKMs, these maps should be composed of a small number (10-15) of concepts arranged hierarchically by an expert (teachers) in the knowledge domain for learners to use as a starting point to "scaffold" their learning. Possible additional concepts may be suggested in a "Parking Lot" to be integrated into the scaffold Cmaps (Novak and Cañas, 2006). GED preparation teachers should create maps of the content that is relevant to the tests. They should not attempt to develop maps of the test questions, or provide answers to the tests. Scaffold maps with fading (a scheduled reduction in use) is a more effective approach to introduce Cmapping to students and assist them to sustain the use of Cmaps as learning tools (Chang, et al., 2001).

Students' Cmaps and Personal Knowledge Models (PKMs)

Technology-based Cmaps should be created by students. Students can use all of the features of IHMC CMap Tools Software (e.g., color coding, embedding text, collaboration tools, etc.) to build over a span of days or weeks a "personal knowledge model" (PKM) for the domain studied (Novak and Cañas, 2006). The process of composing Cmaps forces students to: a) engage in metacognitive processes; b) decide under which proposition to catalogue new knowledge and thus establishes a basis for them to reconcile conflicts between new content and their existing knowledge; and c) monitor their learning methods hence the opportunity to make sense of the material on their own (McKeachie, 1988; Triffone, 2006). The PKMs of the content learned in classes and from other sources can be loaded onto computers and used as study aides in preparation for the GED tests. GED students should make Cmapping a routine practice in their learning efforts, and they should be encouraged to add to their maps before, during, and after instruction. Classes that create maps during these instructional periods tend to score significantly higher on academic achievement measures than classes that receive either traditional instruction or add to their maps during other periods (Pankratius, 1990).

EKMs and Feedback

It is difficult for students to improve their learning efforts when they are not aware of their academic limitations. Timely feedback to students on the progress of their Cmaps is of critical importance as they develop their knowledge base (Hwang et al., 2011). Through feedback on students' PKMs teachers can provide immediate learning guidance to assist students to reflect on and revise their knowledge structures (Hwang et al., 2011). Frequent feedback should allow teachers to assist GED students to become highly proficient mappers. Proficiency is a demonstrated understanding of: how to hierarchically organize concepts from most to least inclusive; how to propositionally link together several different concepts provided to the student by the teacher; and how to cross-link two related "branches" of a Cmap (Trifone, 2006). Crosslinks are reflective of what Ausubel (2000) referred to as integrative reconciliations. Highly proficient mappers produce Cmaps with a high degree of structural complexity. Highly complex maps are a consequence of students making deeper and more meaningful leaps in understanding, and can therefore represent large gains in conceptual learning.

Conclusion

The current approaches to providing test preparation instruction to GED students are well intended, but ineffective for this highly educationally, socially, and economically disadvantaged population. The current teaching and learning practices extend the ineffective practices that were unsuccessful for many of these learners when they last attended middle and high school. Through dead-end jobs, high levels of unemployment, technological disfranchisement, and truncated educational careers, they have suffered from their lack of academic excellence. A new model for adult literacy education offers the promise of a new and different way to realize the provision of education to this segment of the adult low literate population.

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