Concept Mapping as an Alternative Form of Assessment

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Abstract

This study examined the impact of concept mapping as an assessment tool on student learning in a freshman honors seminar. Using a qualitative design, we conducted a reflective investigation of three participants’ reactions to the use of an open-ended approach to the construction and scoring of concept maps. Findings indicated that the use of this assessment strategy promoted meaningful learning as evidenced by high levels of critical thinking associated with the creation elaborate hierarchical map structures and the linking of new information into existing knowledge bases. An unanticipated pedagogical advantage emerged in the form of concept maps serving as both an ongoing means of evaluating student work and a teaching tool.
Introduction

Research suggests that one of higher education’s primary purposes is to foster students’ abilities to analyze concepts and synthesize them into complex cognitive structures in order to understand their interrelatedness (Donald, 1983). However, measuring student progress in this process is problematic. Traditional modes of assessment produce static indicators of achievement such as relative class rank or percent of correct items on tests of recall and are often viewed by educators as flawed representations of student progress toward the goal of improved analytical reasoning (Markham, Mintzes, & Jones, 1994). Since its inception as a pedagogical tool in the 1970’s (Novak, 1990), concept mapping has gained recognition as a method to help teachers assess cognitive transformations that conventional examinations fail to detect (e.g., Stuart, 1985; Roth & Roychoudhury, 1993). The present investigation explores the impact of concept mapping on the teaching and learning process in a freshman seminar on the development of the self-concept.

Literature Review

Theory

Ausubel’s research on cognitive processes is the theoretical cornerstone of concept mapping research. According to Ausubel (1977), meaningful learning takes place when “the learning task is related in a nonarbitrary and nonverbatim fashion to the learner’s existing structure of knowledge” (p. 163). That is, a learner must actively integrate new concepts into an existing knowledge structure in order to truly understand them. In fact, Ausubel (1968) contended that the learner’s existing prior knowledge is the most important influence on learning. According to this perspective, teachers should identify what is known and develop instruction so that it corresponds with this prior knowledge (Ausubel, 1968).
Working from the perspective of Ausubel’s research, Novak, Gowin, and Johansen, (1983) developed concept maps as a means of representing knowledge structures and changes within them. Similar to Ausubel (1977), Novak and colleagues (1983) define meaningful learning as a process that “results when a person consciously and explicitly ties new knowledge to relevant concepts or propositions they already possess” (p. 625). Concept maps empower students to demonstrate their understanding of interrelationships amongst key concepts by offering a strategy for making content material more conceptually transparent (Novak, 1990). According to Novak & Gowin (1984), concept maps include two key elements: concepts and propositions. A concept is “a perceived regularity in events or objects designated by an arbitrary label” (Novak et al., 1983, p. 625). For example, snow is the label used for frozen white water flakes falling from the sky. A proposition is formed by connecting two concepts with a relational link, (Lambiotte et al., 1989). In the proposition “snow is a type of precipitation,” the link, “type” represents the relationship between precipitation and snow. In a concept map, the link would be drawn to connect these two concepts visually.

Novak and colleagues (1983) contend that networks of propositions are how concept meanings are understood, developed, and maintained. Thus, concepts alone do not have any “fixed” meaning, but are understood and derived as part of the framework of propositions in which they are encapsulated (Novak et al., 1983). In our example, snow is understood as a form of precipitation. However, different, but equally valid propositions are possible, e.g., “snow is dangerous,” or “snow is fun.” Thus, as propositions are created, concept meanings are derived.
The resulting map represents the knowledge structure existing within the mind of the mapper.

**Concept Maps as Assessments**

Research suggests that concept maps help educators assess complex conceptual change in students' thinking (e.g., Stuart, 1985; Roth & Roychoudhury, 1993; Wallace and Mintzes, 1990; McClure et al., 1999). Of particular interest in this discussion is Goldsmith and Johnson’s, (1990) description of an *ideal assessment* as one that meets four criteria: it is objective, reliable, limits the impact of context on responses, and taps into the structural nature of the respondent’s knowledge. Arguably, traditional assessments (e.g., multiple choice, fill-in, and essay) often only meet a few of these criteria. Multiple-choice assessments may be objective and reliable, but the context of the items may affect respondents’ answers. Additionally, this type of assessment does not assess knowledge structures. Essay questions can be relatively context independent and assess student knowledge structures, but are often at risk for reliability concerns with regard to scoring. McClure et al. (1999) contend that concept maps offer a balance by providing assessors with an objective tool that is context independent and sensitive to the structure of students’ knowledge.

**Evaluating Concept Maps**

There has been contention in the literature on scoring strategies for concept maps, (Kinchin, 2001; Kinchin, Hay, & Adams, 2000; McClure et al., 1999; White & Gunstone, 1992). Stoddart et al., (2000) provide an overview of quantitative scoring techniques that vary with regard to the numbers of points awarded for elaboration and accuracy. Some researchers argue against the quantitative scoring of concept maps (Caine & Caine, 1994; Kinchin, 2001; Kinchin et al., 2000; White & Gunstone, 1992), citing the limitations of using a number or letter grade to represent the breadth of a learner’s knowledge (Caine & Caine, 1994) and potential negative
effects of quantitative assessments on students’ motivation to learn (White & Gunstone, 1992). Others have cited the inability of quantitative scoring systems to highlight student misconceptions (Kinchin et al., 2000). By scoring only valid propositions, one may miss valuable information about students' misunderstandings and the means by which they represent their knowledge. Kinchin (2001) sees the scoring of valid links only as “unsupportive of the learning process and at odds with the constructivist philosophy that underlies the use of concept mapping as a learning tool” (p. 1259). Given these concerns Kinchin and colleagues (2000) support a qualitative approach in which maps are evaluated primarily as a function of the thought patterns used in their creation.

Framework for the Present Study

Objectives

The present study illustrates aspects of the theoretical bases of concept mapping, specifically, its potential for facilitating meaningful understanding of psychological concepts. The choice of concept mapping as an assessment tool in this course was based on Ausubelian principles (1977), specifically, the role of prior knowledge in accommodating new information. The goals associated with concept maps were related to the first author’s belief that student understanding of the richly psychological content of the course would be demonstrated more accurately with concept mapping than with the constraints of a traditional exam format. The process was viewed primarily as an experiment in classroom pedagogy and was approached from the perspective that concept mapping would provide a tool for achieving two course objectives: (1) To help students gain in-depth knowledge and develop critical thinking skills about the development of self across the early lifespan; and (2) To help students apply empirical findings about the self to their own lives with the use of concept mapping as a strategic assessment guide.
**Orientation to Theory**

McPherson (1972) and Bogdon and Biklen, (1998) support the research practice of exploring phenomena of interest and later connecting the lived experience to existing theory. In correspondence with these principles, specific theoretical connections in this study were established following data collection. Consequently, our data collection was not conducted in order to prove a pre-existing theoretical point. Rather, we sought to explore the means and outcomes of concept mapping, followed by a post hoc analysis of research to evaluate the contribution of our work to current theoretical perspectives.

Our investigation was guided by three open-ended questions regarding the use of concept mapping: (1) How was concept mapping implemented in this course? (2) How were grades assigned to two graphically unique, but academically comparable concept maps? (3) How did students and instructor respond to the overall use of concept mapping? These questions were revisited during our data analysis and writing of this paper, providing a flexible structure for our reflection on this pedagogical experience.

**Methodology**

**Participants**

Two participant-observers (third and fourth authors) were white females, age 19 years old, electively enrolled in a freshman honors seminar on the self concept. Approximately four weeks into the semester, and as a result of their superior treatment of the demanding content and concept mapping assignment, the participants were invited by the instructor (first author) to participate. The third participant (course instructor, first author) was a white female, with a doctorate in Human Development and six years of teaching experience at the college level in the department that sponsored the course. The creation of this course and selection of concept
mapping as an assessment was driven by the first author’s interest in the content, desire to work with students in the first year of college, and curiosity about the potential of concept maps.

**Context**

The course was an advanced level undergraduate seminar designed to help students understand the developmental origins of the maturing self-concept, with emphasis placed on scaffolding students’ efforts to construct links between the content of assigned readings and the context of their lives. Lectures were used to enhance and validate, rather than dominate students’ thinking about the theoretical content. Pedagogical techniques included guided participation in discussion groups, student presentations, and routine review of students’ concept maps, the pedagogical tool under investigation in this study.

**Methodological Orientation**

A qualitative design was used in this study due to our interest in establishing grounded conclusions about the nature of a process that produced two equally sophisticated and academically valid, yet qualitatively different demonstrations of knowledge building. Additionally, through the qualitative descriptive process we are able to articulate how multiple participants responded to and participated in the concept mapping experience.

**Data**

**Data Sources**

1. Weekly concept maps and journal entries of two student participants. Quotes, taken from weekly journal entries are used to illustrate examples of Jaime’s (JW) and Erin’s (EW) work. Student maps appear in Appendices A and B.

2. Written instructor feedback and grade assignments on the maps and journal entries. The instructor’s written comments (IC) on the student work demonstrate examples of ongoing
feedback.

3. Quotations from end-of-semester reflection papers by the students (JR or ER) and the instructor (IR) are presented to convey their perspectives on concept mapping. For comparison purposes, specific questions were used to orient the three participants to a consistent, organizing set of ideas for reflection. The reflection questions were: (a) Discuss the pros and cons of using concept mapping in this type of course and as an alternative to traditional assessment strategies; (b) Describe the points at which you felt most liberated and/or constrained by concept mapping as a device for assessing your evolving knowledge base; (c) Describe the relative level of difficulty of using concept mapping compared to the amount of effort needed to do well on exams, papers, etc; (d) Comment on the relative level of anxiety associated with using a concept map as opposed to taking an exam; (e) How valid do you think concept mapping is as a tool for demonstrating your knowledge of the subject? (f) Was concept mapping an evaluation or a learning tool?

Data Analysis

We started with the assumption that the use of concept mapping in this course generated an interesting and important educational experience. Further, we felt that other instructors could benefit from an exposition of how this tool was employed in a specific classroom context. First, we documented impressions generated by the first author at the end of semester that produced the guiding questions cited above. The questions were used to conduct a deductive analysis of participants’ experiences. Following this analysis procedure, we chose specific excerpts from the written data that would best illustrate the critical processes we had identified.

In order to avoid “imposing a preordained structure on phenomena” (Isaac & Michael,
1997, p. 220), we also used inductive data analysis to describe (1) interdependent processes that contributed to learning outcomes, and (2) the extent to which those processes supported or challenged the empirical literature on concept mapping.

Implementation of Concept Mapping

Teaching the Technique

On the first day of class students participated in an interactive blackboard exercise in order to become acquainted with concept mapping technique. This activity utilized the university structure (e.g., academic departments) and students’ experiences with the university to create personalized “Self-as-University Student” concept maps. This group activity was used to teach the basic tenants of Novak’s (1995) concept mapping process, including the meaning and use of concepts, propositions, hierarchical structuring and cross links. Once the students demonstrated their understanding of these fundamental skills, the concept mapping assignment for the course was explained. Students understood that there were eight basic areas of empirical research in the course and that over the semester they would construct an evolving map on which they would plot central concepts of their choice from the theoretical material presented, creating a “geographical model of the perceived relative importance of the concepts to the student’s core sense of self.” Students also learned that they would write weekly journal entries to explain the map’s graphic representation of concept interrelatedness. In the journal entries, students were expected to present a theoretical and academic rationale for (1) selecting the concept as personally salient; (2) placing it in its relative position to other concepts on the map, and (3) repositioning any concept from previous weeks to another location on the grid.

Weekly, the instructor closely examined changes in the landscape of each student’s map and contrasted them against the written language of the journal entry to assess the consistency
with which the student was translating critical thinking into the graphic evolution of the map. Student feedback was provided with: (1) written instructor comments on both journal entries and maps; and (2) consultation with students about the development of the project, which may have included discussion related to a journal/map entry and its treatment of specific concepts, or at some points during the semester, help with more general re-orientation to the overall project.

**Scoring**

Research has highlighted (Caine & Caine, 1994; Kinchin, 2001; Kinchin et al., 2000; White & Gunstone, 1992) the questionable worth of exhaustive, quantitative scoring of concept maps, suggesting that the approach is counterintuitive to the constructivist nature of the learning experience the maps are intended to create and that finely titrated mathematical feedback to students’ concept mapping work is both an inappropriate and inadequate response to complex alterations in their knowledge base. Therefore, given the relatively open ended nature of the assignment under study, the scoring system that developed was primarily qualitative (see Kinchin et al., 2000). To assign a final project grade for the end of semester map of A (superior), B (above average), C (average), D (below average), four criteria were assessed: (1) creativity of map design; (2) quality of weekly journals and maps; (3) evidence of critical thinking; and (4) writing style. These grading criteria were explained to students following the initial concept mapping exercise on the first day of class and as described in the following sections.

*Creativity of map design.* The emphasis on “creativity” was an academic, rather than artistic, concern. Students were expected to choose a personally meaningful theme for depicting concepts and propositions in their maps. A student athlete may have chosen a football field as the “site” of the map, with certain crucial plays representing fundamental propositions and positioning of offensive or defensive players as the secondary linking patterns between
propositions. A student majoring in music may have chosen a symphonic composition for the map’s “environment,” wherein essential instrumental contributions to the overall symphony may have represented critical propositions. This “creative” requirement fulfilled academic objectives by virtue of being (a) consistent with Stoddart and colleagues’ (2000) recognition of open-ended mapping techniques as a means of promoting students’ intellectual ownership of the process; (b) an effort to deeply contextualize the terrain of the map so that the end result would be a personally salient representation of each student’s individual knowledge structure; and (c) supportive of a course objective to develop critical thinking and analytical skills.

Jaime and Erin reflect:

Developing a concept map gave me the freedom to graph words, thoughts and feelings on a new plane...Concept mapping first enables the mapper to soak up the material, then gives him/her time to process the information and finally encourages the student to creatively reapply the information. (JR)

I felt I was able to turn the course into whatever I wanted to. I had the freedom to either make a lot out of it or brush it off. I choose to make a truly meaningful experience, and I feel that it paid off. (ER)

These students felt a sense of ownership over their personal learning as in Erin’s case or in their perspective on mapping in general as illustrated by Jaime. The common theme here is the reported sense of autonomy and control, which we believe is qualitatively different from the perspective students typically associate with more traditional assessments like exams.

Creativity was also included as a criterion for assessment so that students would connect the course content to prior knowledge in personally meaningful ways. The maps of our two students illustrate excellent examples of how this might be done equally well, but with the use of two very different graphic representations.

Jaime, a biology major, represents her concept map via the human body (see Attachment A). For example, here she describes the placement of the concept of infant-parent attachment as
the stomach of the body.

...I have placed this concept inside the stomach area of the human outline because I felt that this most simply and logically marked the inception of my existence...the placement of the infant attachment/synchrony concept is central to the body, leaving space above, below and on both sides to relate all other concepts to come.” (JW 2-12-02)

Later, as the course progressed and new concepts emerged, Jaime expanded her initial human form with the addition of inanimate objects to better express her developing knowledge. One week, she added imitation, a central process in early childhood, to her map with the addition of a mirror reflecting the stomach in the right hand of her human outline. She explains:

...In my attempt to achieve autonomy as a young child, this mirror shows that at this stage my actions are not independently-orchestrated, but rather a reflection of (most often) my parents’ actions and reactions. The image in the mirror is a stomach to emphasize that the process of imitation propagates that initial lack of separateness from attachment relationships...(JW, 2-19-02)

Jaime was able to articulate her developing knowledge with the use of her map. Moreover, she allowed herself the creativity to expand on her initial intent to add only additional organs and body components by including inanimate objects as a means of further illustrating her understanding of the content.

Creativity and critical thinking are often simultaneous procedures. Invoking creative landscapes as an assessment criterion was intended to encourage critical thinking by students. The description of the maps provided thus far illustrates the nature by which creativity lent itself to critical thinking. By establishing a landscape to illustrate course content the students were required to employ analogical reasoning as a corner stone of critical thinking. Jaime’s use of a mirror to demonstrate imitation in young children and Erin’s use of horseshoe magnets (see Attachment C) to demonstrate indirect relationships among constructs reveal the connections these students made between creativity of design and critical thinking.

Both students made logical and well articulated choices about themes for their maps, each
of which bore relevance to their lives. Jaime proposed a linking system based on her understanding of biology and human anatomy. Erin designed a pre-ordained linking system that imparted order and predictability to her weekly mapping. Each approach resulted in highly developed end projects.

**Quality of weekly journal and evolving map assignments.** On their weekly journal and map assignments students received vigorous written and verbal feedback and a score of “check plus” (above average), “check” (average) or “zero” (missing assignment). That score depended on the extent to which the entry: (a) correctly defined the theoretical construct(s) included in their map; (b) used a combination of theory and life experience to support the choice of the concept as personally salient, or “worthy” of inclusion; (c) provided theoretical rationale for the placement of the concept relative to other existing concepts on the map; and (d) explained the movement of any concept from a previous week to another location as a function of hierarchical restructuring. The following section highlights specific instances of the students’ work and evaluates them based on the above-mentioned criteria.

In the first example, Jaime provides a correct definition of the construct and creates an analytically sophisticated rationale for the link between it and other concepts on her map by explaining its metaphorical relationship to the human eye. Although this journal entry does not explicitly outline her reason for choosing the concept (one aspect of the grading criteria), it addresses the other scoring items at an extremely high level of analysis.

*The ‘I’ self, a.k.a. the pure Ego or consciousness, directs the innate process by which one conceivably constructs a subjective reality for himself. The ‘I’ self exempts the individual from having to achieve ‘universal intuition,’ (an impossible feat) by systematically breaking down the proposed overwhelming sea of senseless sensations and perpetuating self-variations. This concept is represented by the addition of eyes on the human outline. Just as the intricate cooperation among the lens, retina and cornea allows one to focus countless jumbled reflections of color into easily perceived and comprehensible images, the ‘I’ self and competence, because an individuals’ cognitive development, must lie within an expectable range in order to support*
an adept and critical ‘I’ self. (JW, 3-12-02)

This next excerpt from Jaime’s work demonstrates her engagement in the hierarchical structuring component of the grading criteria. She makes direct reference to an earlier concept (I self) and its relation to a new concept (Moral self). She establishes a theoretical rationale for their association.

…the moral self is linked directly to the ‘I’ self, the empirical self, good enough/super parents, identity moratorium, contradiction, and sentiment of rationality. Each of these past concepts either reinforces, challenges or helped create my current sense of morality. The ‘I’ self proposes multiple variations of the self for experimentation, and some of these selves proffered for judgment doubtlessly test for the modifications of the moral self…(JW, 4-9-02)

We begin to see that while these knowledge representations are highly sophisticated and creative they are not always completely correct from an evaluative standpoint. Another example of this is seen in Erin’s work:

This week I added pragmatism, survival of the fittest selves and perceptions to the outside bubble. I think that everyone goes through the survival of the fittest selves process. I find this process to be very relevant. I have tried on various selves, selves that fit into many categories, and have decided which were ‘practical’ by the reactions I received and compatibility with the environment, and if they ‘felt right.’ The feeling right is the ‘sentiment of rationality.’” I also feel that my perceptions of the environment affect my selection, and my selection, who my selves are, in turn affect my perception. Perceptions are what guides everything in the bubble, and I feel that much of life, if not all, has relied heavily on what I felt I was or had happened, not on the objective reality of the matter. Pragmatism is at the top because I felt fairly agreeable with that theory and it tends to govern my map and thus my life. (EW, 3-12-02)

Erin provides a strong theoretical and experiential rationale for her choice of concepts. Although the definition of the concepts is not completely apparent in her writing, her understanding of them is implicitly expressed in detailed explanations of the propositions (perceptions connected by a direct link to survival of fittest self and sentiment of rationality; pragmatism as an overlying arch above the graph of the entire map) she created between the concepts. However, in this example, the evaluator is faced with a dilemma. One can establish that the concepts were understood through the connections made, but the specific criterion of
defining the concepts is not present. Does one decrease the grade because Erin didn’t include “the definition of pragmatism is…”? Or does one concentrate on the global presentation of ideas in the map and journal entry? In this case the instructor relied heavily on the latter approach. Rather than awarding point values for each component of the rubric, a more qualitative assessment of the overall journal entry and map was made. For example, on this journal entry, the instructor awarded Erin a "check plus" and commented "Good work…Scholarly reference back to the theory base, contextualized to a creative map" (IC on EW, 3/12/02). Typically, the type of mapping "error" Erin had made in omitting the definition of the concept was one that had occurred with many students. In these cases, the instructor would review with the entire class her perceptions of overall strength and weakness "trends" across the class for the week, emphasizing, with respect to this example, the need to provide theoretical definitions of the concepts in the maps. In this way, needed interventions with individual students were translated to additional guidance for all and a general increase in the quality of the maps relative to the particular criterion being referenced would emerge in the following week’s assignments.

**Critical Thinking/Analytical Rationale.** In this project, concept mapping was used to enhance critical thinking and help students demonstrate the evolution of their overall understanding of the total course content. Final student maps were most closely related to the “net” pattern described by Kinchin (2001) in which multilevel interconnections were woven together in individually complex, but academically valid representations of knowledge.

In the following journal entry, Jaime uses a sophisticated series of metaphorical images, e.g. holographs, magnifying glasses, and anatomical linkages, to convey her analysis of not only the relationship between one of this week’s concepts, **adolescent peer relations** and the overarching seminal concept of the course, **the self**, but also to childhood processes depicted in
last week’s map. The critical thought verified by this journal entry demonstrates an intellectual hierarchical nesting of associations which then also causes her visual map to increase in graphic complexity, exemplifying Ausubel’s (1977) definition of meaningful learning as an active and purposeful integration of new ideas into the student’s existing knowledge base.

In my mind’s eye, I see all the peers who have ever influenced me assume a holographic image of sorts, shifty, yet honest, objective but cruel … I have represented ‘peers’ ubiquitous presence on my concept map with the addition of the magnifying glass in the left hand of the human outline, representing the scrutiny the adolescent receives from all angles from surrounding individuals. This concept has a blood vessel linkage to ‘imitation,’ because while younger children primarily imitate the actions of their parents, adolescents also follow a modified monkey-see, monkey-do approach, looking to their peers for feedback and reinforcement. JW 2/26/02

Emergent Findings

Structure

The open-ended approach used in this course is supported by Stoddart et al. (2000) as a way of promoting critical thinking by requiring students, with few prompts, to make important decisions about how the map should be drawn and which concepts should be included. One initial concern was that young college students would become frustrated by the wide range of justifiable end products and possible perceived lack of instructor guidance about expected outcomes for either the visual presentation of the map or the choice of critical concepts that should be included. Early on, there was some discomfort about a perceived lack of direction. Jaime comments:

There was little guidance given as to the appearance of the developing and completed map. This lack of direction prompted my initial insecurity about the evolution of my map. It seemed more like an abstract idea than a tangible project. (JR)

Additionally, Erin also alluded to this open-ended nature in her reflection, stating:

The way I saw it, there wasn’t a right and wrong answer. This often times makes the assignment harder, but also easier… (ER)
Both students selected well-structured landscapes for their maps, suggesting that in the absence of structure dictated by the professor, they created their own. Jaime employed the terrain of the human body, which as a biology student she was knowledgeable of, as the structure for her concept map. In her first journal entry she describes her selection and explains that new concepts will be incorporated in the map as major components, i.e., organs of the human body, thereby establishing a structure with images she both understood and could visualize. In her reflection, Jaime describes insecurity related to “little guidance” about the appearance of the map. Arguably, she was able to ease her own insecurities through the selection of a map context that provided her with the control of a personally salient format.

In contrast, Erin generated structure in her map through the specific identification and use of symbols related to her existing knowledge base in engineering/physics. In her opening journal entry she explained that the symbols employed in her map represented her interest in these subjects. Additionally, Erin created a detailed key (Attachment C) that explained the symbols she would use in future maps. She stated:

...the horseshoe connectors are magnets, which represent electromagnetic force. Electromagnetic force is indirect - no contact is physically made - but it is still a strong force. This connector is used for things that have affected me positively and indirectly, but not “physically.” (EW, 2-12-02).

Other symbols Erin describes include a spring, arrows, and atoms. The symbols she chose, created, and defined, provided her with a personally relevant structure for the development of her evolving concept map. Erin’s key is located in Attachment C.

These two students created structure for themselves by employing outward signs of their competence in another academic area. Thus, the open-ended nature of this assignment gave them an opportunity to partially direct their own academic experience. We see evidence of this in Erin’s reflection:
Concept mapping is one of the most liberating experiences I have had with an “examination.” I felt I was able to turn the course into whatever I wanted to. ...I would have felt restrained or had trouble making the map if we had to have had a set number, either maximum or minimum, number of terms or concepts a week. (ER)

Thus, we see that in addition to finding the experience liberating, Erin also suggests that if some attempts had been made to provide a more structured experience her thought processes may have been limited.

It is important to note that while the physical manifestation of the map was open-ended, other forms of structure were applied. Specifically, maps and journal entries were collected, read, and returned with written and verbal feedback every week. The assignment also included an expectation for appropriate application of course content into the concept map and journal explanation. Erin alludes to this when she describes her impression that concept mapping “would be difficult for most professors...but with a small class and a persistent professor...the benefits...are irreplaceable” (ER). In this statement we see her recognition of the instructor’s persistence and continuing efforts as necessary to support this learning experience.

Knowledge Demonstration

The choice of an open-ended scoring approach to concept mapping that allowed students to decide which concepts they would represent on their maps conceivably jeopardized the opportunity for students to demonstrate all or possibly even most of what they may have learned in the course. One concern emerging from this process was that students enrolled in a rigorous Honors program may be uncomfortable with a learning paradigm in which they would not be able to demonstrate the full scope of their knowledge. Jaime remarks:

*One notable limitation of the process is that our ... demonstration of knowledge was somewhat incomplete. Each week I selected an average of three new concepts to add to my map, which I investigated in relative depth in the accompanying journal entry. But, I did not have to demonstrate any extensive knowledge for the many concepts I chose to omit each week.* (JR)
Here Jaime expresses some feelings about an assessment strategy that did not allow her to demonstrate the full range of her learning in the course. Concerns regarding this aspect of the assignment also surfaced in the instructor’s comments:

One of the unanticipated drawbacks was that a few students did not become fully engaged in the process. Their weekly journal entries and maps were marginally completed and did not demonstrate a full understanding of the week’s content. It is possible that students who did marginal work on the maps had not read or learned the material...It is also possible, however, that the concept map assignment simply did not interest them, ... or did not impress them as a fair or accurate means of representing their knowledge...it is still possible that some students may have experienced a course in which they felt they could not demonstrate their learning. (IR)

Apparently, concept mapping is not immune to the problems that exist with traditional exam formats and may not be a venue for demonstrating the full scope of any student’s knowledge. Additionally, the success of the concept-mapping format seems to rely on student engagement in the process, such that lack of engagement, regardless of learning, may lead to lower performance outcomes.

Effort Associated with Concept Mapping

As Novak and Gowin (1984) suggest, creators of concept maps must first construct a plan for conveying a system of concepts with interrelated propositional associations before they are able to begin demonstrating their knowledge via that proposed strategy. In a traditional undergraduate exam format, students respond to prescribed formats for communicating their knowledge. (Seldom are students asked to write the exam that will allow them to demonstrate their knowledge.) Additionally, given the ongoing nature of the assignment and the amount of feedback the instructor needed to provide, it became a concern that concept maps may involve more effort and time for all participants than traditional assessments. In fact, all three of our participants report that this was the case.

Overall, the amount of time required to develop the concept map was probably
comparable, if not slightly longer than that to prepare for a biweekly exam... (JR)

Probably more time went into the map overall since exams are not given weekly, but instead more like once a month. If homework and class time are not considered studying, but instead just reviewing time is counted, then I definitely spent more time on the concept map a month... (ER)

(relative to) issues of 'containment'... The first would be associated with the pressure I felt each week to attend and appropriately respond to the rich and involved work of 20 students. This was a hugely time-consuming process, one that nearly wore me out at the end... I found that the amount of effort I put into assessing students' knowledge via concept mapping was considerably more than that which is needed to grade a traditional exam. (IR)

Each remark acknowledges increased time required to attend to concept maps on a weekly basis. However, each acknowledgment of greater time spent included an emphasis on other positive outcomes. Both students expressed feeling decreased anxiety and increased processing of content as a result of using concept mapping. Erin attributed her decreased anxiety to the fact that concept maps did not force students to “perform on the spot.” Similarly, Jaime discussed the value of concept mapping in relation to both decreased anxiety and deeper understanding of the content. The following is a continuation from Jaime’s previous remark:

... But, I must also factor in the exponential decrease of anxiety associated with my concept mapping experience. The simple mention of an exam makes my stomach turn. I get extremely nervous while preparing for and subsequently taking exams. ... However, for this course, in the absence of a ticking clock and feverishly scribbling pencil, I found myself able to delve further in to the material. I wasn’t just naively accepting information at face value. Rather, concept mapping allowed me to explore personal connections to the subject matter. (JR)

Erin also describes concept mapping as having other valuable aspects in comparison to traditional exams. She continues:

However, time spent mapping and thinking is much more fun than time spent studying for a traditional exam... I feel that I learned way more through mapping than I ever could have through an exam. (ER)

For these two students, concept mapping required more time than preparing for a traditional exam. However, their responses illustrate that they also perceived increased
independence, more opportunity for self-regulation, increased enjoyment, decreased anxiety, and more meaningful learning as a result of having used the technique.

The reflections of the students were validated by the instructor's feelings:

> For the most part, the excitement of watching the student's knowledge grow in unique and important ways did everything but make me anxious. I felt exhilarated, impressed, and gratified in ways that I do not usually experience when grading a traditional exam.” (IR)

### An Evaluation and Teaching Tool

The initial intent in this course was to use concept maps as a form of assessment. However, what occurred over the implementation process was that “assessment” evolved into a teaching-learning-evaluation tool. It helped the instructor evaluate student learning as well as shape and modify instruction. Here the instructor describes how this technique, originally intended for evaluation, developed into a means by which her teaching was guided.

> What I did not anticipate was how valuable it became in terms of guiding my teaching, not only to the individual student whose map I was assessing, but with the class in general. Some weeks, it became clear, from assessing 20 maps, that a concept I had presented had been misconstrued by a number of students. At other time, it was evident that the majority of students were choosing to leave what I had considered to be a major concept off their maps. These weekly “clues” often led me to re-address the class with regard to those particular concepts. (IR)

### Scoring Spreads

If the concept mapping technique were to be used again by the same instructor, several aspects would be modified. First, the use of “check,” “check plus,” and “zero” to award weekly scores on the journal entry and map did not render enough point spread to honor important hierarchical distinctions between the quality of the work of students who were performing at superior, above average, average, or below average levels. The net effect of using this system was that students whose work was slightly or moderately below the level of that presented by the two superior students who participated in this study were likely to receive similar weekly grade grades, assuming that other assignments in the course were completed satisfactorily. Secondly,
although most students eventually understood the requirements associated with journals and maps, it was not until a considerable amount of instructor feedback had occurred that many of them seemed certain of these expectations. The course syllabus should include a more detailed assignment description and corresponding grading rubric. Furthermore, a practice session should give students the opportunity to generate one journal entry and map in class, where the instructor is immediately available for feedback.

Personal Expression

The use of concept mapping in this course required student self-disclosure. Most students reported that the process was not overly invasive since they were able to choose which parts of their lives they wished to have represented on the map. However, it is possible that giving students the choice of using either concept mapping or a traditional form of assessment would be more consistent in a course exploring theory related to self-regulatory processes associated with a mature sense of self.

In general, the use of concept mapping in our course on the developmental roots of the integrated young adult self-concept appears to have been both personally rewarding and academically potent as means of constructing knowledge and promoting critical thinking. Jaime reports:

_All in all, concept mapping proved to be a powerful learning tool for me in this honors seminar. My concept map thrived off the freedom to intertwine descriptive words with colorful images, boasting an eventual labyrinth of linked concepts. The entire process was creatively empowering, highly emotive and rewarding._ (JR)

Similarly, Erin concluded:

_It was nice to have a project that I added to every week, to watch it grow, and to have something I felt proud of at the end, that resulted from gradual, steady work. I think that the decreased anxiety was also correlated with the fact that I was learning a lot and enjoying it along the way._ (ER)
Conclusion

Our implementation of concept mapping supported many of the theoretical assertions established in the literature. The use of open-ending scoring techniques to support future instruction produced results similar to those predicted by Kinchin (2001). Participants engaged in meaningful learning as demonstrated by their high levels of critical thinking and creation of elaborate hierarchical map structures (Novak, 1990). Furthermore, this experience created an opportunity for participants to construct and demonstrate their developing knowledge as it related to course content and as a function of their prior experiential knowledge about their own self-development. This process evoked meaningful learning as described by Ausubel (1977) through the purposeful connection of new information to the participant’s existing knowledge structures.

Furthermore, the concept mapping assessment process led to an unanticipated approximation of Kinchin’s (2001) approach, in which qualitative assessment of concept maps serves simultaneously as an ongoing means of evaluating student work and a teaching/learning tool. Consistent with Kinchin’s research, students’ valid propositions were evaluated with the use of the maps as well as their misconceptions about theoretical associations between concepts. This process scaffolded a constructivist approach to the preparation of future class sessions and interventions with individual students. The original objective was to evaluate the progression of students’ knowledge of self-psychology across an academic semester. As the semester progressed, the concept mapping also served as an indicator of needed instructional modifications to address students’ flawed academic treatment of incontestable aspects of the course content such as basic definitions of theoretical constructs.
References


