Best Practices in Educational Psychology: Using Evolving Concept Maps as Instructional and Assessment Tools

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We describe the implementation of evolving concept maps in two different graduate-level educational psychology courses: "The Adolescent Learner" and "Theories of Learning and Cognition." We provide an explicit description of how we used evolving concept maps as instructional and assessment tools in our respective classes, changes in the application over time, and lessons learned from this process. Finally, we present the benefits and challenges of implementing evolving concept maps in teaching practice.

The teaching of educational psychology offers its own unique challenges. Whether the student population consists of preservice or practicing teachers, counselors, or future researchers, we contend that there are two core challenges that face educational psychology instructors. We refer to these challenges as the common sense and the complexity issues.

The common sense issue in the teaching of educational psychology refers to the tendency for students and lay people to assume that the findings of educational psychology are just plain old "common sense." Woolfolk (2004) addresses this concern in the introductory chapter of her undergraduate educational psychology text, noting that the "everyone knows that" aspect of common sense seems to permeate many students' impressions of educational psychology findings. Additionally, students—graduate students, in particular—tend to "own" the understandings of others without being able to support them. For example, some graduate students espouse faults in Piagetian theory based on their reading of others' critiques, without reviewing or analyzing the original work. Such an approach to educational psychology may result in misunderstandings about foundational theories and findings. Further, this approach may lead to the impression that there exists a "common" perspective in the field with regard to many influential theories. Because this perspective is "common," students may not see the need to defend or support their beliefs or assertions about foundational theorists.

The complexity of educational psychology is a second core challenge. Topics within educational psychology are not discrete. For example, cognition, emotion, beliefs, development, and perception occur in tandem in individuals. A teacher or researcher must recognize that multiple other factors are at play in any learning situation. However, in teaching educational psychology courses, instructors often separate the fields into segments that may appear discrete to the novice. Thus, there is a need to foster students' understanding of the specific aspects of our field as well as how the different components are interrelated.

These challenges may be addressed, in part, if students develop an integrated conceptual framework that they can support and defend. To facilitate this process, we implemented evolving concept maps in two graduate courses (i.e., Adolescent Development;

Learning and Cognition). The purpose of this article is to discuss how we used these evolving maps within our respective classes. First, we provide a theoretical review of the research on concept mapping to illustrate its effectiveness in various domains of study. Second, we describe how this technique was incorporated in two courses. Third, we offer lessons learned based on our reflections on this pedagogical approach and provide recommendations to others interested in implementing concept maps as an instructional and assessment tool. Finally, we conclude with our combined reflections on the use of evolving concept maps in educational psychology courses and highlight what we see as the benefits and challenges of this method.

Theoretical Framework

Concept mapping grew out of Ausubel's (1977) conceptualization of meaningful verbal learning as the cornerstone to human cognition. Ausubel (1977) claimed that meaningful learning takes place "if the learning task is related in a nonarbitrary and nonverbatim fashion to the learner's existing structure of knowledge" (p. 163). Thus, as learners interact with new sources of information, they must purposefully integrate these new concepts into their existing knowledge structure. The existence, contents, and organization of the learner's existing knowledge structure are crucial to the process of meaningful learning. According to this perspective, teachers, in order to be effective, must identify students' prior knowledge and devise instruction based on that foundation (Ausubel, 1963). Ausubel (1977) considered cognitive structures to be organized in meaningful and hierarchal relations, such that larger ideas subsumed less related concepts.

Starting from Ausubel's perspective, Novak, Gowin, and Johansen (1983) investigated the role of prior knowledge in the acquisition and use of knowledge. Ausubelian psychology recognizes that meaningful learning occurs through the assimilation of new concepts into existing cognitive frameworks. Novak and colleagues (1983) sought to develop a means for representing these frameworks and changes within them (Novak, 1990). To address these issues, the tool of concept mapping was developed. Concept maps provide a means of creating explicit descriptions of knowledge structures and changes in concept meanings over time (Novak, 1990).

The benefits of concept mapping on student achievement and attitudes have been well established (Horton et al., 1993). For example, concept mapping has been linked to a greater understanding of earth science concepts (Ault, 1985) and biology concepts (Okebukola, 1990), as well as a greater ability to justify correct answers and identify key topics (Barenholtz & Tamir, 1992). Concept mappers also demonstrated greater gains in knowledge of science content, problem-solving abilities, and responses to novel problems when compared to non-mappers (Novak et al., 1983). Ausubel's meaningful verbal learning offers a theoretical justification for these distinctions. Namely, students who engage in concept mapping are required to make meaningful connections between new and existing knowledge and to reflect on their developing schema of the content under investigation.

While much research has focused on the benefits of concept mapping among school-age populations, little work has explored its use with graduate students. Moreover, the focus of work on concept mapping has been to either establish its validity as a pedagogical tool or as a measurement tool in research. Little work has examined *how* this tool may be used with graduate students studying educational psychology topics (e.g., Battle, Fives, Moore, & Dreyer, 2003).

Objectives

We describe the implementation of evolving concept maps as instructional and assessment tools in two graduate-level educational psychology courses. Our goal is to provide our audience information about the use of these maps so that others can incorporate them into their own teaching. Thus, our objectives in this article are to:

1. describe how evolving concept maps were implemented in graduate-level courses in educational psychology, including the pedagogical practices and strategies involved in implementing this technique;
2. offer lessons learned in using and adapting this technique that may be useful to others; and
3. present the benefits and challenges of using evolving concept maps based on our reflections of using them in our courses.

Self-Study Perspective

The work presented here follows a self-study perspective in which we focus on "the space between the self and the practice engaged in" (Bullough & Pinnegar, 2001, p. 15). Specifically, we focus on our own actions, reactions, and dialogues regarding the creation, implementation, and use of evolving concept maps. According to Bullough and Pinnegar (2001), the ultimate goal of self-study research is "to gain understanding necessary to make that interaction [between self and other] increasingly educative" (p. 15). We began with a desire to develop sound educational experiences for our students that would address some of the concerns we held regarding our pedagogy. Through in-depth discussion, peer-mentoring practices, and self-reflection, we examined our own teaching practice in light of the needs of our students.

Context and Evolution of Practice

Herein we describe reflections on our respective courses, which included evolving concept maps from 2004 to 2005. Helenrose taught a graduate-level course entitled "The Adolescent Learner" that was required for students in the middle-level certification master's program but was also taken by a few doctoral students in the spring of 2004 (n=16) and 2005 (n=15). Michelle utilized concept maps in a graduate-level course titled "Learning and Cognition" for both master's level and doctoral students taught in the summer of 2004 (n=8), the fall of 2004 (n=11), and the fall of 2005 (n=23). Although the majority of Michelle's students were enrolled in programs in a college of education, her students had a variety of career plans, and only some intended to teach or were teaching in K-12 settings.

In the spring of 2004, we were both in the second semester of our first academic positions. Having attended graduate school, worked under the same advisor, and published together, we developed a professional peer-mentoring

relationship that helped us to clarify and respond to our respective teaching and research expectations. In the spring of 2004, Helenrose used the evolving concept maps. Through phone calls and visits with Michelle, Helenrose shared the experience with Michelle. In the summer of 2004, Michelle applied the strategy to her content and students.

Next, we describe the concept-mapping assignment that was developed and implemented by Helenrose and how it was modified across semesters when implemented by Michelle. Our description of the evolving concept-mapping assignment and its use in graduate-level educational psychology courses is supported by evidence gathered as part of course instruction. Such evidence included course materials (i.e., course syllabi, assignment details, scoring rubrics, discussion notes [used to facilitate class discussions], PowerPoint presentations [when used], and feedback messages to the class discussed following the return of the first concept-mapping assignments) as well as our individual reflections on our process and progress.

Voices and Organization of Findings

Throughout this manuscript, we vary voice. In the presentation of a self-study, we attempt to negotiate between "confessional and traditional research" to present our experiences in a way that is informative to both scholarship on and practice with concept mapping (Bullough & Pinnegar, 2001, p. 15). Thus, at times in this chapter the term "we" is used to represent the collective perspective of both authors. At other times, we use the first person "I" to refer to the unique perspective or experience of one of us. In these sections, the voice of the author is clearly indicated in the section heading.

Description of Evolving Concept-Mapping Assignment

We refer to the concept maps as "evolving" because students did not build discrete and complete maps on the topics studied. Instead, over the course of the semester, students added to their maps on a weekly or biweekly basis. Based on their reading of course materials, students submitted a map of the topics addressed as well as a written explanation of the map. Students were then encouraged to refine and add new information to the map based on feedback from the instructor, their developing understanding from class lectures and discussion, as well as assigned readings. The evolving maps and explanations were intended to impress on students the need to develop their own understandings and perspectives on the field and to defend those beliefs in writing. Additionally, the evolving maps allowed students to demonstrate graphically the relations they perceived among theories and constructs within educational psychology. Below we detail Helenrose's development and use of the assignment as well as how Michelle applied and modified the assignment for a different course.

Adolescent Development – Helenrose Mapping assignment

Students were expected to construct an evolving concept map over the course of the semester. Each week, as they read textbook chapters and assigned readings, students added constructs and links to their existing maps and made necessary changes. Students were also required to offer a

written explanation of their maps. The framework for this assignment was drawn from the work of Battle et al. (2003), who described the use of creative evolving concept maps in an undergraduate honors seminar on self-processes in development. Below is an excerpt from the assignment directions offered in the 2004 and 2005 syllabi:

> On this concept map, students will plot central concepts from the theoretical material presented in the readings. The map will provide a geographical model of the perceived relative importance of the concepts to the student's developing understanding of adolescence. Students will also write weekly "explanations" for the meaning behind the map's graphic representation of concept interrelatedness. In these explanations students are 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.

Thus, each week students were expected to (1) select important constructs for inclusion on their map; (2) place constructs in meaningful locations on their map; (3) make links across and among constructs included; (4) explain the significance of the constructs included; (5) rationalize the placement of constructs on the map; and (6) explain any changes in the map from one week to the next. Over the course of the semester, students were expected to complete 12 iterations of their evolving concept map and 12 explanation papers. For some students this led to the construction of a large 3-sq-ft (0.28 m^2) map with new information included each week. For others, this led to the development of "master maps" that outlined main themes with submaps for each week that could be tracked back to the "master map."

In addition to the weekly mapping assignments, students were expected to submit a final map, paper, and archive. Students turned in their final map, wrote a paper describing the constructs they found most personally relevant to their future in the classroom, and provided an archive of all previous versions of the map and their weekly explanation papers (i.e., the archive included all previous maps and explanation papers with instructor feedback). The details of this assignment were offered on the syllabus.

Evaluating the assignment. The course assignments and grading structure for each semester we used the evolving concept-map assignment are presented in Table 1. In spring 2004 and spring 2005, the students completed 12 weekly concept maps and papers with the option to drop their two lowest, nonzero (given for noncompletion of the assignment) concept map/paper grades. Each map/paper assignment was assessed using a 13-point rubric (Appendix I). Three criteria were used to assess the map construction: (1) the inclusion of key constructs from the assigned reading; (2) placement of constructs in theoretically meaningful locations; and (3) the incorporation of logical and correct links among the constructs on the map.

The written explanation paper was also evaluated using three criteria.

Students were expected to (1) correctly identify and describe the constructs included on the map; (2) explain why constructs were placed as they were on the map (i.e., provide a justification for construct placement within the context of the map); and (3) offer logical and appropriate interpretations of the content described. Finally, the overall work quality was assessed; students were expected to turn in professional maps and typed explanation papers; and papers were to be free of spelling, grammatical, and citation errors. It was important to provide guidance to students on what was expected of a "professional" map. Maps were not required to be computer generated nor aesthetically beautiful. Rather, the maps needed to demonstrate care, thought, and effort on the part of the student, such that the map could be easily understood.

In addition to the above listed criteria, students were also expected to describe any changes they made to their map from one week to the next and offer a rationale for those changes. Frequently, changes were made based on feedback from the instructor. At other times, students changed their maps as a result of class discussion or when new constructs were learned.

The final assignment (i.e., map, paper, and archive) was evaluated based on three main categories: the final map, the reflective paper, and the archive. The rubric used to evaluate this assignment was not constructed until the midpoint of the first semester (Spring 2004; Appendix II) this assignment was implemented. This allowed for an explicit tailoring of the rubric to best meet the needs of the assignment as it developed during this first implementation attempt. For example, the final map was evaluated based not only on its representation of course content but also as to whether the student made appropriate changes to the map per instructor feedback over the semester.

Introducing the assignment. On the first day of class, I provided students with explicit instruction in concept mapping. Following the initial first day of class activities (i.e., meeting one another, overviewing the syllabus, explaining course expectations), I explained concept mapping in general and the expectations for our class in particular. Using PowerPoint and direct instruction, I overviewed the conceptual and empirical uses for concept maps, emphasizing concept mapping as a means to facilitate *meaningful learning* (Ausubel, 1977). Students were also exposed to the basic components of concept maps (i.e., concepts, prepositions, links, and nodes; Novak & Gowin, 1985 and three key purposes of concept maps—(1) planning; (2) instruction and learning (Ausubel, 1963, 1977; Bruner, 1960); and (3) assessment. Additionally, students were provided with examples of concept maps used for the purposes described. For example, I shared with students a lesson-planning map I have used in the past to help me prepare for a lesson on cognition (Figure 1) as well as the map I actually used when teaching the lesson (Figure 2).

Following the minilesson on concept mapping, student pairs or triads were provided a section of Steinberg and Morris' (2001) review of adolescent development. The article is organized into nine subsections that address past and future trends in research on adolescent development. Each group was assigned a section and constructed a concept map of the reading using chart

paper and markers provided. Following the group map construction, the class visited one another's maps "gallery style" to examine the content presented and the mapping techniques employed. Each group presented their map to the class, focusing on how they constructed their map, links between constructs, and decisions made. Class members were encouraged to ask questions as each map was presented. Finally, we discussed the mapping processes (e.g., What were good strategies? What didn't work?). For the majority of this discussion students identified the strengths and weaknesses of the maps and articulated strategies used. When necessary, I asked pointed questions directing students to as yet unmentioned strategies.

Following the team mapping activity, students were directed to the weekly concept-mapping-assignment directions in the syllabus and were offered a copy of the rubric (Appendix I). We then discussed the assignment in detail. I responded to questions both of a practical nature (i.e., Where can I find chart paper?) and of a more theoretical nature (i.e., How can links be differentiated?). I ended the class and concept-mapping discussion with a quote intended to remind students of why we were using concept mapping and hopefully convince them of the potential benefits of this assignment:

> "Students who are required to make knowledge structures graphically explicit are forced to consider possibilities, construct new understandings, and think critically, all of which are essential to learning." (Jonassen, 1996)

Managing the assignment. The evolving nature of the assignment created some challenges in terms of assignment management. Specific challenges included the time-sensitive nature of the assignment and feedback mechanisms.

Students were expected to turn in an evolving concept map and paper weekly. However, they were also expected to build on that map each week and to include recommended changes from me as the instructor and those identified by the students themselves in our class discussion. From a managerial perspective, this meant that students needed their ongoing maps with feedback in order to complete the following week's assignment. Fortunately, the class met on Thursday afternoons from 4-6 p.m. I would then grade the maps on Friday, over the weekend, or Monday morning and leave the maps in the college resource center for students to pick up by 3 p.m. on Monday. Students then had from Monday to Thursday afternoon to build on their existing map. The frequency and immediacy of this feedback was a challenge to keep up with as the instructor. However, it was also one of the major strengths of this as a learning activity.

In addition to being frequent and fairly immediate, feedback also needed to be sensitive to the creative nature of these maps for learners. The maps were *theirs,* a representation of each student's personal understanding of the content. Thus, it was imperative to offer feedback in a way that was constructive and meaningful without stifling the knowledge construction process.

Additionally, there was a practical concern. These maps were very elaborate and were expected to be completed at the end of the semester as a single representation of each student's conceptual understanding of

adolescence. Therefore, I did not feel it was appropriate to write on students' actual maps. Instead, I used sticky notes to place notes on the maps themselves regarding the connections, inclusion of concepts, and representations that were particularly interesting or innovative (see Figure 3). Students could then *choose* to follow my suggestions, adapt those suggestions to their own beliefs, or remove the notes and ignore my suggestions.

For example, Figure 3 is a student map with my feedback notes still in place. Note 1 states, "Not sure why these guys are here," referring to the connection of Piaget and Vygotsky to intelligence theories. By presenting the concern as a question, the student had the freedom to keep the connection and explain it to me or to do something different with it. Similarly, Note 2 stated, "I'm not sure what you mean by hyp[othesis] 1 and hyp[othesis] 2—will check paper." Thus, although I was initially uncertain as to the inclusion of these statements on the map, and wanted to capture those thoughts while in the moment of assessment, I was also aware of my own knowledge limitations and knew that the student's paper may provide a sound explanation for these items on the map. This also ensured that the map was their construction, and not a network of terms shaped into place through my direct interference on their maps.

Feedback on the explanation papers was aimed at helping students develop an academic writing voice. In my course, an academic writing voice meant that students offered sufficient scholarly arguments, used American Psychological Association (APA) style and conventions, and offered appropriate theoretical support for their selection of concepts and geographical location.

In addition to individualized feedback on maps and papers, with the return of the first mapping assignment each semester, I also provided students a general feedback memo in which I highlighted common errors. This feedback was offered around three main themes: maps, explanations, and writing issues. For instance, many of the students initially treated the explanation papers as reading summaries when I was hoping for something much more critical and analytical in nature. Thus, on the feedback sheet I attempted to clarify this by stating:

- The explanations should *not* be a summary of the reading.
- The purpose of the explanation is for you to *explain* why you chose to include certain constructs on the map and why you put them where you did. This will need to include in some cases an explanation of the construct, so you can defend your reason for including it on the map. You may want to explain a larger concept (e.g., theories), why is that important, and then, perhaps, state that you included these five specific theories because they were highlighted in the text.
- I am confident that you are all capable of reading and regurgitating the text. I am interested in what you thought about it, what you felt was important, why it merits inclusion on your map, and how it relates to other constructs.
- Feel free to use "I" statements.

The following year I shared these comments with the students on the first night of class in an effort to prevent basic summarization.

Learning and Cognition – Michelle
Decision to implement concept maps. I was aware of the concept-mapping assignment Helenrose implemented with her adolescent development class in spring 2004 and was intrigued by the thought of using the assignment in my course on learning and cognition. In fall 2003, I first taught the course to master's and doctoral students with varying levels of prior knowledge, experience, and writing abilities. As a new assistant professor, I struggled to offer enough stimulation for those familiar with the content to develop a deeper understanding while at the same time helping those new to the content reach a basic understanding of the theories and their applications. Further, I felt that the more knowledgeable students sometimes relied on information they gained in previous classes and did not challenge themselves with the content that was less familiar. I also questioned the extent to which students recognized the similarities and uniqueness between the theories and perspectives we discussed.

I decided to implement concept maps with my learning and cognition class starting in the summer of 2004. I viewed the assignment as a way to meet the needs of all students with regard to their content knowledge and writing (i.e., providing them with a self-constructed visual representation of the content and regular feedback on their writing and APA style). I subsequently implemented the evolving concept-map assignment in two additional semesters (fall 2004 and fall 2005). Here I describe how I implemented and modified the assignment across semesters.

First concept-mapping endeavor: Summer 2004. In the summer of 2004, I implemented the assignment in my learning and cognition course. The class met twice a week (Tuesdays and Thursdays) for four hours over a five-week semester. There were eight students from the College of Education in this course (three master's students and five doctoral students).

Helenrose shared all of her materials with me, and I implemented the assignment with few deviations from her original format. On the first day of class, similar to Helenrose, I overviewed the semester and described the concept-mapping assignment, utilizing her slides. Class time was provided for students, working in groups, to develop a concept map, share the maps with the class, and discuss how they approached the activity and the techniques they used. Time was also provided during the second class period to discuss students' individual experiences creating their first maps and the strategies and techniques they found beneficial.

With respect to feedback, I also employed the sticky-note technique instead of writing directly on student maps. When I returned the first graded map and explanation paper, I provided a feedback memo of common errors, problems, and issues I observed across the maps. Some of the errors were similar to those Helenrose noted, whereas others were unique to my class.

The changes I made to the assignment reflected the shortened summer semester. Specifically, students turned in maps once a week on Thursday instead of every class period. Consequently, there were only five maps

and explanation papers, four of which counted for the final grade, and one final map, synthesis paper, and archive. I scored each weekly map and explanation using the 13-point rubric and the final map and archive on the 30-point rubric developed by Helenrose. A listing of all course assignments is provided in Table 1.

Additional changes to the assignment in summer 2004 pertained to the return of feedback and the rubric for the weekly concept maps. My intention was to have all maps and papers graded and available for student to pick up on Monday morning so that they could add to the maps throughout the week. However, several students had work schedules or commutes (e.g., more than an hour and a half each way) that prevented them from coming to campus on nonclass days. Thus, some students did not receive their graded maps and papers until Tuesday, with the next additions to the maps due by Thursday.

Second concept-mapping endeavor: Fall 2004. In the fall of 2004, the learning and cognition course met once a week on Thursday evenings for three hours over the course of 13 weeks. There were 18 students initially enrolled in the course (i.e., 14 master's students, three doctoral students, and one graduate specialist student). Seven master's students dropped the course before the end of the semester. Some indicated they dropped the course due to the workload and time required. In response to student feedback and my experience with the assignment in summer 2004, I made several changes to make the assignment more manageable before the semester began. These changes pertained to selection of terms, differentiation for master's and doctoral students, and the scoring rubric.

With respect to selection of terms, in summer 2004, students often included terms and topics from the text that I viewed as less central. Students also commented that they felt overwhelmed by the amount of reading and information to include in the maps and papers. In fall 2004, I provided students with a list of terms for each week and encouraged students to add any additional terms they felt appropriate. By providing students with the terms, I focused their reading on the content I saw as most important. However, by encouraging them to add terms as they saw as necessary, their individual understandings and creativity were still supported.

Another change pertained to differentiated assignments for master's level and doctoral- level students. All students completed weekly maps, but only doctoral students were required to write weekly explanation papers. In lieu of the explanation papers, master's students wrote two application papers and completed a midterm writing assignment in which they analyzed a written case using course content (Appendix III).

Given the changes in requirements, adjustments were also made to the rubrics and weighting of assignments (Table 1). All other assignments—including individual article critique and share, a group presentation and discussion, and participation—were required of both master's and doctoral level students. All students were still expected to submit a final concept map, archive, and statement. However, I provided some additional guidelines for the final statement, focusing on how students could use the course content

and concept maps to write a philosophy of learning and teaching statement (Appendix IV). Students in nonteaching fields were encouraged to speak with me to identify alternative applications.

Third concept-mapping endeavor: Fall 2005. I used the concept-mapping assignment in the fall of 2005 for the same course in learning and cognition. The course was offered on Thursday evenings with 12 class meetings. At the start of the semester, 25 students were enrolled, and 23 students ultimately completed the course (i.e., eight doctoral students and 15 master's students). In this semester, I again presented students with the terms to include in their maps but made additional modifications to the assignments in response to the number of students enrolled in the course, logistical issues encountered in previous semesters, as well as student feedback. For instance, in an effort to address issues related to "delayed" feedback and map changes as well as students' concerns about being assessed on their understanding of material that we had not discussed in class, I made a distinction between weekly maps and unit maps. Weekly maps were turned in every week by all students. These maps were scored using a 3-point rubric (i.e., 2 = *Good*, 1 = *Fair*; 0 = *Inadequate/Missing*; Appendix V) and feedback, written on sticky notes, was provided. Students completed 11 weekly maps, and the lowest grade was dropped for a total of 10 graded weekly maps.

Unit maps were submitted after major units within the course (i.e., behaviorism, social cognitive theory, information processing, and constructivism). Unit maps were scored using a 12-point rubric in which students received a score of 0 to 3 in each of the following areas: inclusion of terms, placement of terms, links among terms, and quality of the map (Appendix V). Because unit maps were due after students had received feedback and discussed the content in class, I expected high quality maps that included any necessary changes. Students completed four unit maps throughout the semester and all counted toward the final course grade.

Explanation papers were only required for the doctoral students' unit maps. Thus, students completed four unit-map-explanation papers throughout the semester, three of which counted toward their final grade (i.e., the lowest paper grade was dropped). These papers were graded using a 15-point rubric (Appendix V) to provide more specific feedback. In fall 2005, master's students did not write application papers. Instead, working in groups, they gave a presentation and led a discussion related to a specific instructional application based on the theories from the course. As part of the preparation for their presentation, students identified an appropriate reading for the class and assigned the terms students were to map.

Lessons Learned

In addition to the structural aspects of using evolving concept maps, we learned several important procedural lessons that are pertinent to other instructors who may use this technique.

Instructor Modifications

Perhaps one of the most important and obvious lessons learned from our experiences was the need for each instructor to tweak and modify the instructional strategy. This is evident in Michelle's multisemester reframing of the assignment. Although the initial

iteration worked relatively well, she made changes each additional semester until the assignment best met her own and her students' needs. In many respects, changes were made in an effort to balance students' deep understanding of the material and the practical considerations on Michelle's and her students' time. At the same time, Michelle found it beneficial to use Helenrose's initial format and materials as a starting point.

Additionally, student comments provided insight into what they perceived as useful and beneficial about the assignment and how it could be improved. In both of our classes, particularly in our first attempt (spring 2004—Helenrose, summer 2004—Michelle), we both indicated that we were trying out a new instructional and assessment strategy and emphasized an openness to students' feedback, which was readily offered. Furthermore, Michelle administered an instructor-developed course evaluation at the end of the semester, in which students were explicitly asked what they liked about the assignment, what they did not like, and what changes they would suggest if the assignment was used again. Subsequent changes in fall 2004 and 2005 were based, in part, on students' suggestions.

Despite the benefits of student feedback and suggestions for change, it was also important for us as instructors to remain committed to the assignment throughout the semester. Helenrose frequently remarked to her students in that first semester, "Let's see how it goes. This is an experiment; put forth your best effort and you'll do well." Similarly, Michelle remained clear that substantial changes would not be made to the course midsemester. The decision not to make substantial modifications during the semester was based on two factors.

First, the benefits of concept mapping may not be readily apparent to students. Thus, it is important not to abandon or change the assignment before the benefits are reaped. One warning Helenrose gave to Michelle, based on the former's experience with maps, was that the students would *hate* the mapping assignment for at least three or four weeks. Michelle found similar evidence in her classes when one graduate student remarked in class that she really hated the maps at first, but after several weeks of doing them, she realized how much she was learning and recognized how valuable they were.

Second, the nature of the evolving concept-map assignment required that it be a centerpiece within the course. Substantial changes midsemester could be too disruptive to the course structure. This could influence students' perceptions of the assignment and have a negative impact on their learning. Consequently, although it is important for an instructor to change the assignment to make it one's own, such modification must be well-informed and made judiciously, preferably before the semester begins.

Organization and Management

There were many organizational and management issues involved in using the evolving concept-mapping assignment. For instance, issues related to late work, the returning of maps, and class sizes must be carefully considered. In both of our classes, there were substantial penalties for turning in late work. Due to the evolving nature of the assignment as well as the time involved, we did not want the students to get

behind. Additionally, in order to return the maps in a timely fashion each week, we scheduled specific time for grading. Not having all of the assignments at one time was disruptive to this schedule and other competing responsibilities. The physical returning of the maps also needed to be considered. We both sought manageable methods for getting students their work back prior to the next class that were responsive to our respective students' needs.

Maps as formative and summative assessment

Another lesson pertains to how the concept-mapping assignment could be used as both a formative and summative assessment. We viewed the assignment as formative in that students had the opportunity to develop their skills without penalty (i.e., we both dropped the lowest grades) and the opportunity to modify their maps throughout the semester based on instructor feedback and their deepening understanding. However, the weekly maps were also summative in the sense that they were a major component of students' semester grade (i.e., a terminal decision) and that they were used to judge students' understanding of the reading.

The modifications Michelle made in her third iteration (i.e., fall 2005) attempted to emphasize the formative nature of the weekly maps. Specifically, each weekly map received feedback but was worth a limited number of points. Unit maps were weighted more heavily, but students had the benefit of feedback and class discussion. Finally, we both had students submit a final map at the end of the semester that served as a summative assessment of what they had learned. Additionally, the synthesis paper associated with the final map provided students the opportunity to reflect on all that they had learned and make connections to future practice.

Technology-Generated Maps

Across all sections of the evolving concept-map implementation, several students used a variety of digital technology to construct their maps. The most common programs used were word processing (e.g. Microsoft Word) and Inspiration (available for free to the students at both universities). The use of either of these tools was not supported by either instructor, meaning that students were welcome to use them but that we would not be able to help them navigate the actual software.

Students who used word processors tended to use color, text boxes, shapes, and lines to map their developing understanding. Some students used Inspiration, a software package that allows students to construct concept maps, diagrams, and outlines, and to shift among these "views" of the information. Two of Helenrose's students attempted to use Inspiration with varying results. Interestingly, both of these students were women in their late 40s to early 50s who were pursuing doctoral degrees in educational psychology. The first student embraced the use of this tool, and her maps were judged to be fairly simple and linear in comparison to the maps of other students. Early in the semester, this student remarked that using Inspiration was effective, since she could just construct an outline and Inspiration would build the map. Later, she found that this technique was not working to demonstrate her growing understanding of relations among concepts and needed

to spend considerable time learning how to use the program. Whether this was an accurate reflection of how Inspiration works is beyond our ken. The second student abandoned Inspiration after the fourth week because she felt too constrained by the program. She wanted to incorporate more links than it would allow her. It may be that learning how to use this software requires time and effort that may add to the complexity of the task.

Michelle also had several students who chose to use Inspiration for their maps. Although some were linear and simplistic, others demonstrated the complexity seen in those created by hand or in Word. However, students' experience with the software seemed to play a considerable role. Students with the more complex technology-generated maps were familiar with the software and the idea of concept mapping before entering the class.

In general, we have mixed perspectives on students' use of technology. In the cases that featured word processing as a drawing tool, the maps were similar in quality to those drawn by hand (albeit a little neater). However, unless they had previous experience, students who used a concept-mapping program seemed to have maps with limited complexity or gave up on the program early on.

Benefits and Challenges

Based on our experiences using the maps, course evaluations, and student reflections, we outline what we see as the benefits and challenges of using evolving concept maps.

Benefits

Student knowledge construction and ownership. One of the greatest benefits of the concept-mapping assignment is the emphasis placed on students' active construction of knowledge and their ownership of the learning process. Although we each endorse constructivist views of learning, the concept maps provide a way to enact these beliefs in a way that is explicit to the students. On the first day of class, we each stressed students' ownership and active role in the construction of knowledge when we discussed the uses and benefits of concept maps. However, this point is made apparent by the literal construction of knowledge in the physical map, the flexibility afforded to the students, and the way feedback was provided.

Each student was individually responsible for making meaningful connections between concepts examined in the course and representing these connections on their maps. Consequently, the students actively engaged with the content to create a map that provided physical documentation of what they knew. The written explanation papers also highlighted the individual construction of knowledge in that students had to justify the connections they made.

Additionally, students were encouraged to be creative and adopt a mapping style that was best for them. Students used a combination of color, different types of lines, as well as different shapes, icons, and font sizes in the creation of their maps. Some students drew everything by hand; others used a computer for all or part of their maps. In all cases, they developed techniques that best represented their developing understanding of the content.

The feedback, rubrics, and in-class discussion also emphasized the

individuality of the knowledge construction process. For instance, we emphasized that there was no "right" way to go about this process and that the maps were personal. All feedback was provided on sticky notes, often in the form of questions or open recommendations (e.g., "You may want to consider…"). Students choose how concepts were ultimately incorporated into the maps.

Students' comments and feedback indicated that most recognized their role in the learning process and that they gained from the experience. Students were clearly proud of their maps, and they indicated that they intended to save their maps for future reference (e.g., for comprehensive exams). Furthermore, in course evaluations, students commented on how much they learned from the experience. For instance, in an anonymous course evaluation, one student stated that the maps "made the information more meaningful and allowed me to synthesize the concepts."

Academic writing. Another benefit of the concept-mapping assignment was the improvements observed in students' academic writing abilities. The consistent feedback provided students the information necessary to identify problem areas and improve their writing. Submitting multiple papers for which writing was explicitly assessed and commented upon provided students an incentive to take note and implement the feedback they received.

Instructor awareness and classroom instruction. The concept-mapping assignment also provided us, as instructors, greater access to students' thinking and understanding during the semester. That is, we had regular glimpses into their understanding of the content, not just on an exam or occasional comments in class. Thus, we were better able to address misunderstandings and target students' needs. In both classes, the concept maps led to interactive class discussions in which students openly discussed points of confusion or issues that were unclear.

Modeling effective strategies for teaching and learning. An added benefit of the concept mapping assignment is that students were exposed to a technique they could apply to other areas. Although some students knew of concept maps, few had extensive experience before our respective courses. Students' developing expertise in concept mapping could be transferred to their experience in other classes or in their own teaching. All of Helenrose's students and many of Michelle's students were preservice or practicing teachers. Thus, they were provided with a technique they could use as a learning and/or assessment tool. As evidence, one of Michelle's students reported in class that he employed concept maps in a social studies class with his low-achieving middle school students. Another student, a middle school math teacher, indicated that she was previously familiar with concept maps, but she doubted they could be implemented with her students. After her experience in class, she was considering ways they could be used.

Time. Despite the observed benefits of concept mapping, there were also very specific drawbacks. Perhaps the biggest of these pertains to the issue of time. The concept-mapping assignment is time consuming, both for the students and for

the instructor. From the instructor's perspective, considerable time is needed to give substantive feedback on both the maps and the papers each week. Although the time required for evaluation of the maps and papers decreased over the course of the semester as students' understandings and writing improved, we each devoted a day or more a week to this task. Often more time was required at the beginning of the semester. Furthermore, feedback needed to be returned immediately. This was useful in preventing a backlog of work to be graded, but it also required that we made time for the grading each week, despite competing demands from other responsibilities. Some of the changes Michelle implemented were in response to trying to manage the time issue.

The assignment also required a great deal of time from the students. The active construction of knowledge is not necessarily a quick process. Consequently, students needed to devote considerable time and attention to reading the assigned material and determining how constructs are related to one another. Further, the evolving nature of the maps required that students regularly revisit different sections of the map to make modifications and additional connections. Additionally, at the beginning of the semester, students had to develop the concept-mapping approach that worked best for them. Based on student comments, this seemed to take some time and contributed to students' feelings of frustration, especially if students were unfamiliar with concept mapping.

Representations of meaning. Students varied in their previous knowledge and experience with concept maps at the beginning of the semester. Although their mapping abilities developed over time, there was still variation among students. Some students appeared to be much better at organizing and representing the relations among the concepts on paper. Thus, there are concerns as to how well the maps may represent students' understanding of the concepts. This is addressed in part by the explanation paper portion of the assignment. However, in Michelle's case, only maps were required for some students. Consequently, it is important to consider if the maps adequately capture what students understand.

We hope this article will be of use to course instructors in educational psychology. We offered a detailed discussion of the implementation of a research-based teaching technique. Ideally, our descriptions of this technique will serve as touchstones to other instructors interested in implementing evolving concept maps as well as signals to researchers and teacher educators interested in developing pedagogical practices that may yield impressive learning outcomes.

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Figure 1. *Helenrose's Lesson Planning*

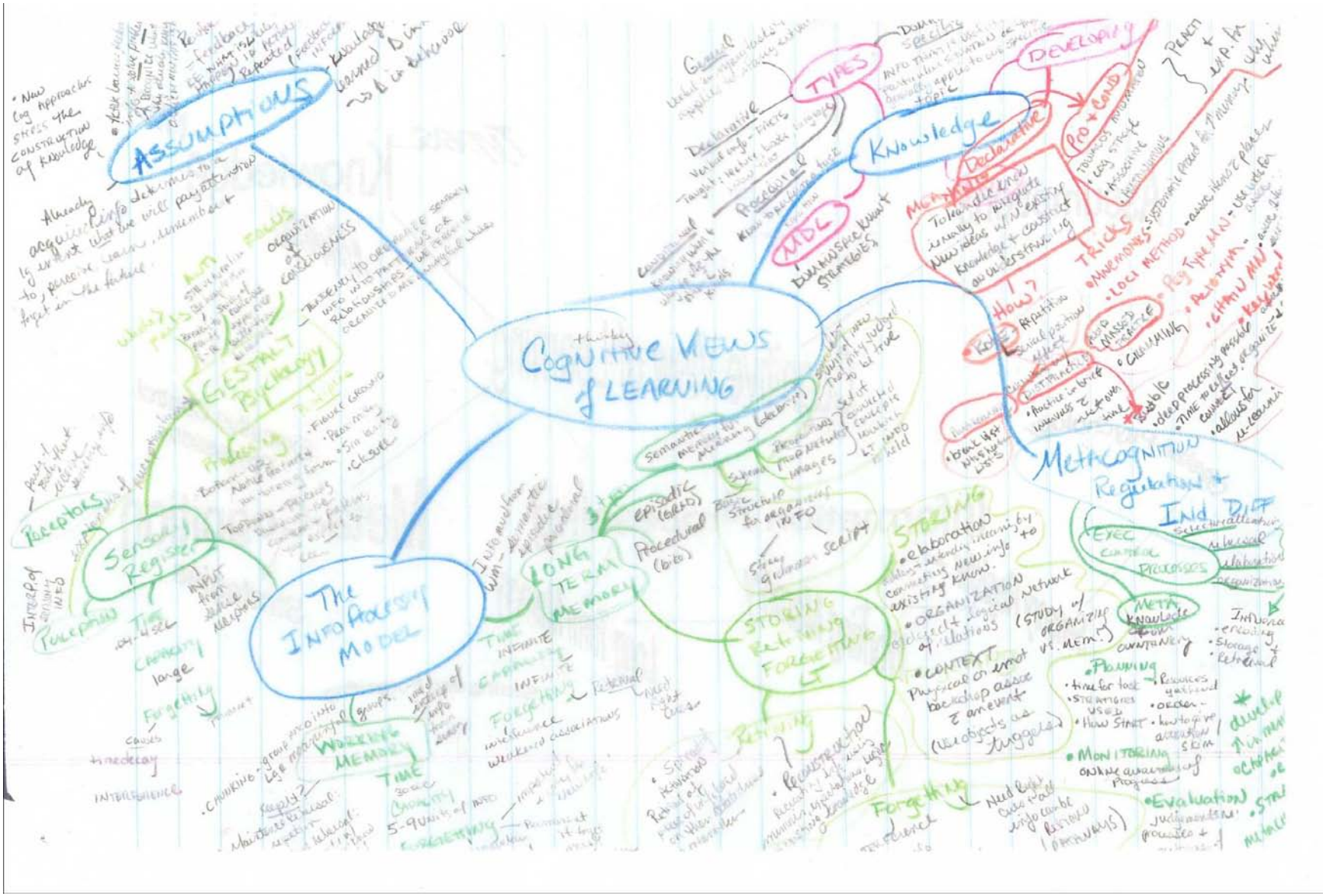


Figure 2. *Helenrose's Teaching Map*

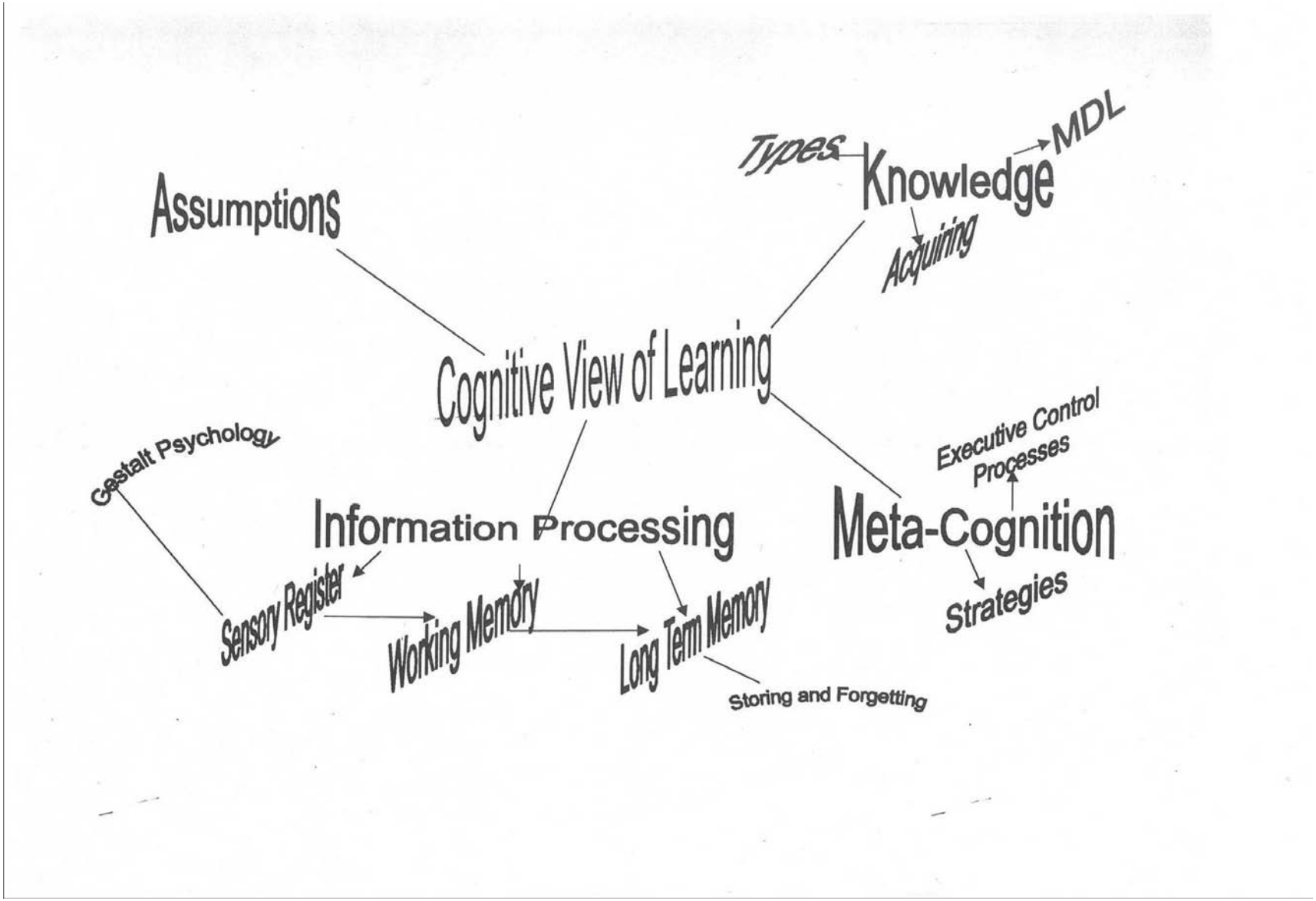
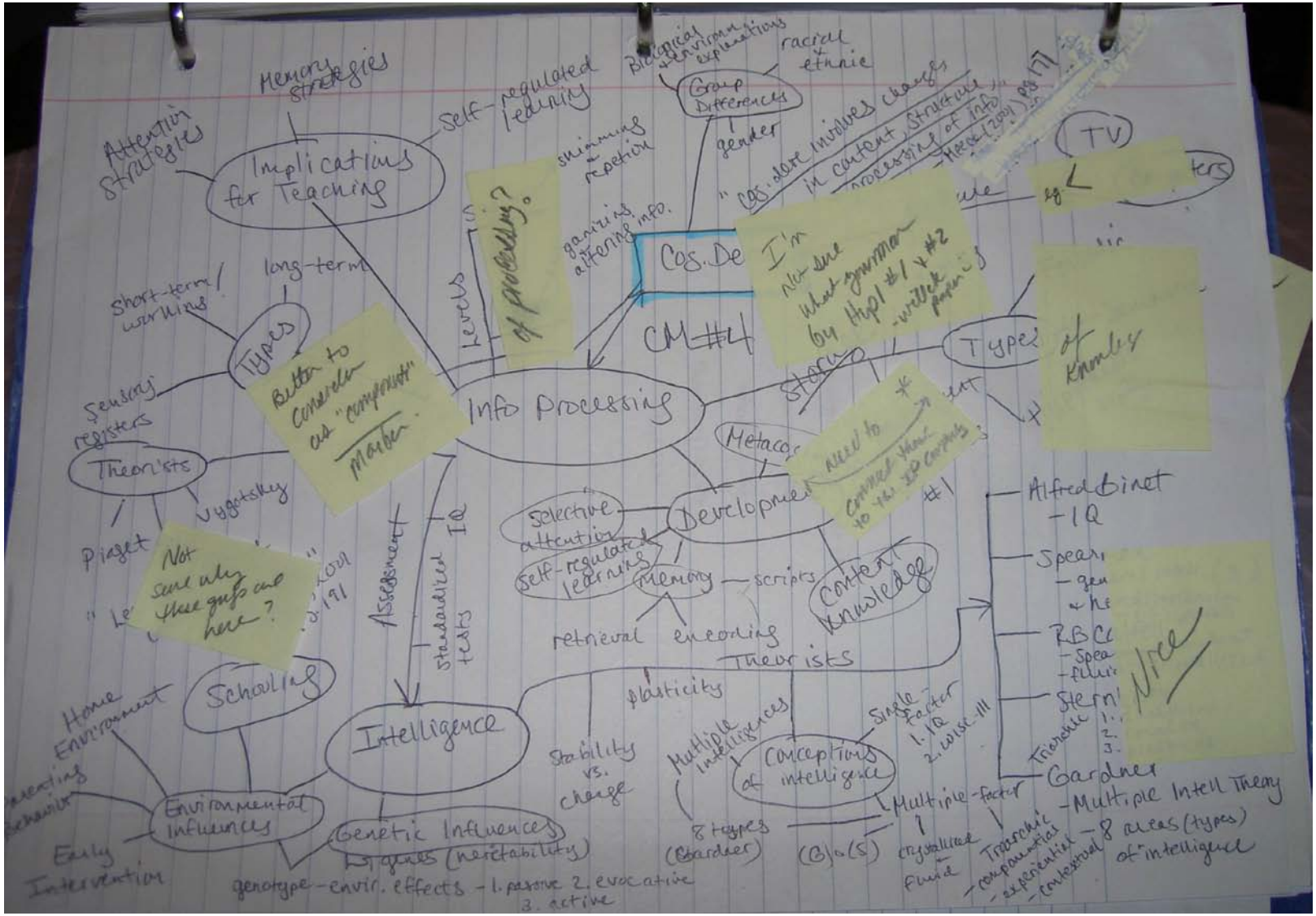


Figure 3. *Large Student Map with Instructor Feedback*



Appendix I. *Helenrose's Weekly Concept Map Evaluation Rubric (2004-2005)*

Criterions	Points					
Map Construction	5	4	3	2	1	0
o All key constructs from the assigned reading are included. o Constructs are placed in theoretically meaningful locations. o Logical and correct links made among constructs.	Map demonstrates all criterions.	Map is limited with respect to **one** criterion.	Map is limited with respect to **two** criterions.	Map fails to meet one criterion **OR** is limited with respect to all three criterions.	Map fails to meet one criterion.	None of the criterions are met.
Written Explanation	5	4	3	2	1	0
o Correctly identifies and describes the key constructs included in the map. o Clearly articulates why constructs were placed as they were on the map and the relations that are demonstrated. o Explanation demonstrates logical and appropriate interpretations of constructs described.	Explanation demonstrates all criterions.	Explanation is limited with respect to **one** criterion.	Explanation is limited with respect to **two** criterions.	Explanation fails to meet one criterion **OR** is limited with respect to all three criterions.	Explanation fails to meet one criterion.	None of the criterions are met.
Quality of Work	3	2.5	2	1	0	
o Professional appearance of map demonstrates care and effort went into creation. o Explanation is typed according to paper format guidelines. o Map and explanation are free of spelling, punctuation, and citation errors.	All criterions are met.	Minor infractions exist on one criterion.	Minor infractions exist on two criterions. **OR** Major infractions exist on one criterion.	Minor infractions exist on two criterions. **AND** Major infractions exist on one criterion.	Major infractions exist on all criterions.	

Appendix II. *Helenrose's Final Concept Map Evaluation Rubric (2004-2005)*

Final Concept Map, Paper, and Archive (30 points). At the end of the semester, students will turn in their final or completed concept map that evolved over the course of the semester. Students will write a reflective paper which includes a synthesis and evaluation of "Adolescence," relying on the evolution of their concept map as well as an exploration of how the content learned this semester will affect their approach to teaching. Students are also expected to turn in an archive including all of the previous concept maps and explanations. This paper and archive are expected to be presented in a professional format.

Criteria	**POINTS**	
	Available	Earned
Final Map		
Complete, map represents the concepts covered this semester with appropriate changes per instructor comments.	5	
Reflective Paper		
Presents a synthesis of the student's understanding of "adolescence"	5	
Explores relevance of content covered to the student's own experience and/or future goals	5	
Paper is written in APA style and is free of grammatical, spelling, and typographical errors	5	
Archive		
Includes all previous maps	5	
Presented in a professional format	5	
Total Points	**30**	

Appendix III. *Michelle's Concept Map, Explanation Paper, and Application Paper Evaluation Rubrics (Fall 2004)*

Criterions	Points					
Map Construction	5	4	3	2	1	0
▪ All assigned constructs/concepts/theorists from the assigned reading are included. ▪ Constructs/concepts/theorists are placed in theoretically meaningful locations. ▪ Logical and correct links made among constructs/concepts/theorists.	Map demonstrates all criterions.	Map is limited with respect to **one** criterion.	Map is limited with respect to **two** criterions.	Map fails to meet **one** criterion **OR** is limited with respect to all **three** criterions.	Map fails to meet **two** criterions **OR** fails to meet **one** criterion and is limited with respect to **one or more** criterions.	None of the criterions are met.
Quality of Map	2		1		.5	0
▪ Professional appearance of map demonstrates care and effort went into creation. ▪ Map is free of spelling and typographical errors.	All criterions are met.		Minor infractions on **one** criterion.		Minor infractions on **both** criterions **OR** major infractions on **one**.	Major infractions on both criterions.

Weekly Explanation Paper Rubric (only for doctoral students)

Explanation	5	4	3	2	1	0
▪ Addresses the constructs/concepts/theorists included in the map. ▪ Clearly articulates why constructs/concepts/theorists were placed as they were on the map and the relations that are demonstrated. Explanation demonstrates logical and appropriate interpretations of constructs/concepts/theorists described.	Explanation demonstrates all criterions.	Explanation is limited with respect to **one** criterion.	Explanation is limited with respect to **two** criterions.	Explanation fails to meet **one** criterion **OR** is limited with respect to all **three** criterions.	Explanation fails to meet **two** criterions **OR** fails to meet **one** criterion and is limited with respect to **one or more** criterions.	None of the criterions are met.
Quality of Explanation	4	3	2	1	0	
▪ Explanation is free of spelling, punctuation, grammatical, or typographical errors. ▪ Explanation is written with appropriate citation of sources. ▪ Explanation is written in accordance with paper guidelines and APA style (e.g., references, levels of heading, margins).	All criterions are met.	Minor infractions exist on **one** criterion.	Minor infractions exist on **two** criterions **OR** major infractions exist on **one** criterion.	(Minor infractions exist on **two** criterions **AND** major infractions exist on **one** criterion) **OR** (Minor infractions on all **three** criterions)	Major infractions exist on all criterions.	

Application Paper Rubric (only for masters students)

Written Application Paper	5	4	3	2	1	0
▪ Correctly identifies appropriate applications of constructs/concepts included in the map. ▪ Applications demonstrate logical and appropriate interpretations of constructs/concepts described. ▪ Specific examples of how constructs/concepts can be applied are provided	Explanation demonstrates all criterions.	Explanation is limited with respect to **one** criterion.	Explanation is limited with respect to **two** criterions.	Explanation fails to meet **one** criterion **OR** is limited with respect to all **three** criterions.	Explanation fails to meet **two** criterions **OR** fails to meet **one** criterion and is limited with respect to **one or more** criterions.	None of the criterions are met.
Quality of Application Paper	4	3	2	1	0	
▪ Application paper is free of spelling, punctuation, grammatical, or typographical errors. ▪ Application paper is written with appropriate citation of sources. ▪ Application paper is written in accordance with paper guidelines and APA style (e.g., references, levels of heading, margins).	All criterions are met.	Minor infractions exist on **one** criterion.	Minor infractions exist on **two** criterions **OR** major infractions exist on **one** criterion.	(Minor infractions exist on **two** criterions **AND** major infractions exist on **one** criterion) **OR** (Minor infractions on all **three** criterions)	Major infractions exist on all criterions.	

Appendix IV. *Michelle's Final Concept Map, Archive, and Philosophy of Learning and Teaching Rubric (Fall 2004 & 2005)*

At the end of the semester, students will turn in their final or completed concept map that evolved throughout the course as well as an archive of all previous papers (i.e., map explanations for doctoral students and application papers for master's students) and maps. Additionally, students will write a reflective synthesis paper, no longer than 10 pages, in which they present their philosophy of learning and teaching supported by the course content. Specifically, students should present their views of how learning occurs and the implications this has for their teaching practices.* Be specific in how the course content has influenced your thinking as well as in how you think it will influence your actions.

To conceptualize their statements, students should reflect on the evolution of concept maps and consider how the content learned this semester influenced their views of learning and teaching. Students may also wish to consider the following questions:

- How do you define learning?
- How have your views of learning changed?
- What are the best ways to learn in your area?
- What kinds of experiences best facilitate learning?
- Given your views of learning, how will you teach?
- What is your role in the learning process?
- What methods do you intend to use to help others learn?
- What is effective teaching?

All statements MUST be well-supported by the material discussed in class and refer to the appropriate constructs, concepts, and theorists with appropriate citations. That is, students should explain the theories that are foundational to their views on learning and teaching using the terms and concepts discussed in class.

The final concept map, archive of previous papers, and statement of learning and teaching philosophy should be presented in a professional format.

*If a student is not in a teaching field, an alternative application can be made. For example, students could discuss how the course content will apply to their research paradigms or current/future careers. Alternative applications for this assignment must be discussed with the professor by the middle of the semester, Thursday, October 14.

Criteria		**POINTS**	
		Available	Earned
Final Map			
	Complete, map represents all concepts examined this semester with appropriate changes per instructor comments.	5	
Archive			
	Includes all previous maps	3	
	Presented in a professional format	2	
Philosophy of Learning and Teaching Statement			
	Articulates a coherent learning and teaching philosophy.	10	
	Correctly incorporates content and terminology from course.	10	
	Provides specific examples of how views of learning and teaching will influence practice.	10	
	Paper is written in APA style with appropriate citation and is free of grammatical, spelling, and typographical errors.	10	
Total Points		**50**	

Appendix V. *Michelle's Weekly Concept Map and Unit Map (Fall 2005)*

Weekly Map Rubric

2 (Good)	1 (Fair)	0 (Inadequate/Missing)
•All terms included •Good effort in placing & linking terms •Neat and professional appearance •No spelling or typographical errors	•Few missing terms •Poor placement of several terms •Lack of appropriate links •Relatively neat and professional appearance •Few spelling and/or typographical errors	•Numerous missing terms •Inappropriate placement of terms •No links •Unprofessional or "messy" appearance •Numerous spelling and/or typographical errors

Unit Map Rubric

Criterions	**3**	**2**	**1**	**0**
Inclusion of assigned constructs/concepts/theorists	All constructs/concepts/ theorists are included in the map.	Most constructs/concepts/ theorists are included with only a few (i.e., 1-2) missing from the map.	Several (i.e., 3-4) constructs/concepts/ theorists are missing from the map.	Numerous (i.e., 5+) constructs/concepts/ theorists are missing from the map.
Placement of constructs/concepts/theorists	Constructs/concepts/ theorists are placed in meaningful locations.	Most constructs/concepts/ theorists are placed in meaningful locations.	Several constructs/ concepts/theorists are poorly placed.	Numerous constructs/ concepts/theorists are poorly placed; lack of understanding.
Links among constructs/concepts/theorists	Logical and correct links are made among constructs/ concepts/theorists.	Most links are logical and correct with only a few missing or incorrect.	Several links are incorrect or missing.	Numerous links are incorrect or missing.
Quality of Map				
Professional appearance; Care and Effort; Errors	Map is professional and error-free.	Map is relatively professional with only a few minor spelling or typographical errors.	Map is messy and hard to understand and/or has several spelling or typographical errors.	Map is illegible. There are numerous spelling or typographical errors.

Appendix VI. *Michelle's Unit Explanation Paper Rubrics (Fall 2005)*

Unit Explanation Paper Rubric (only for doctoral students)

Criterions				
Explanation	**3**	**2**	**1**	**0**
Discussion of constructs/concepts/ theorists included in the map	All constructs/concepts/ theorists are addressed.	Most constructs/concepts/ theorists are addressed except for a few (i.e., 1-2).	Several (i.e., 3-4) constructs/concepts/ theorists are not addressed in the explanation.	Numerous (i.e., 5+) constructs/concepts/ theorists are not addressed.
Articulation of why constructs/concepts/ theorists were placed as they were on the map and discussion of the demonstrated relations.	Articulate explanation of all constructs/concepts/theorists.	Articulate explanation but limited with respect to a few constructs/concepts/ theorists.	Several constructs/concepts/ theorists are poorly explained.	Numerous constructs/concepts/ theorists are poorly explained; lack of appropriate explanation.
Logical and appropriate interpretation of constructs/concepts/theorists described.	Logical and appropriate interpretation of constructs/concepts/ theorists.	Most interpretations are logical and appropriate with few inappropriate or incorrect interpretations.	Several incorrect or inappropriate interpretations.	Numerous incorrect or inappropriate interpretations; lack of appropriate understanding.
Writing	**2**	**1**	**.5**	**0**
Spelling, punctuation, grammatical, or typographical errors	Error-free	A few minor errors	Several errors or incoherent sentences	Numerous errors
Citation of sources	Appropriate citation of sources	A few missing citations	Several missing citations	Lack of citations
Paper guidelines and APA style (e.g., references, levels of heading, margins)	APA guidelines were followed.	Overall APA guidelines were followed with a few instances of incorrect formatting and style.	APA guidelines were used, but there are several instances of incorrect formatting and style.	APA style was not used.