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Evolving Concept Maps as Instructional and Assessment Tools  
in Graduate Educational Psychology Courses

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## Abstract

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*. Using a self-study perspective, we frame our findings as a descriptive, intrinsic case study wherein the phenomenon observed is the authors' utilization of concept mapping. 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 as teachers engaged in this process. Using examples of student maps, we describe the value of evolving concept maps in facilitating the development of complex understanding of the material by graduate level students. Finally, we use our critical analysis of the data gathered to evaluate the pros and cons of implementing evolving concept maps into teaching practice.

## Evolving Concept Maps as Instructional and Assessment Tools in Graduate Educational Psychology Courses

Similar to K-12 teachers, college level instructors benefit from examples and discussions of teaching strategies to address the challenges of teaching. In particular, 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 as they share the field with their students. 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.” This is a concern addressed by Woolfolk (2007) in the introductory chapter of her much used undergraduate educational psychology text. Woolfolk (2007) addresses the “everyone knows that” aspect of common sense that seems to permeate many students' impressions of educational psychology findings. We suggest that in addition to this aspect of common sense, graduate students also demonstrate a common sense attitude toward educational psychology that is based on their perceived ability to reason things through – albeit from their own perspective – and a tendency to “own” the understanding of others as their own. For example, many a graduate student espouse the faults of Piagetian Theory based on their reading of others' critiques but do not conduct their own review and analysis of the original work. This approach to educational psychology on the part of graduate students leads to a potential lack of understanding the foundational theories and findings in the field. Further, this approach leads 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 view the need to defend

or support one's beliefs or assertions about theorists like Piaget, Vygotsky, Kohlberg, and Gardner as unnecessary.

The complexity of educational psychology is a second core challenge when teaching graduate level students. Topics within the field of educational psychology are not discrete. For example, cognition, emotion, beliefs, development, and perception occur in tandem in individuals. In order to use any aspect of educational psychology, a teacher or researcher must recognize the other factors that are at play in any learning situation. However, in order to competently and coherently teach about the field of educational psychology, we separate it into segments that to the novice may appear discrete. The challenge then is to provide students with the opportunity to understand both the specific aspects of our field as well as how those different components are interrelated.

In response to these challenges we have implemented evolving concept maps in two graduate courses (i.e., Adolescent Development; Learning and Cognition). We refer to these maps "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. Specifically, 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 additional assigned readings for the next assignment. The evolving maps and explanations served 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.

The purpose of this paper is to discuss how we use these evolving maps within our respective classes. First, we will provide a theoretical review of the research on concept mapping to illustrate its effectiveness in various domains of study. Second, we will describe how this technique has been incorporated into two courses – adolescent development and learning theories. Specifically, we will describe the assignment parameters, scoring rubrics, and samples of student work. Third, we will offer our combined reflections on the use of evolving concept maps in educational psychology and highlight what we see as the pros and cons of this method for this population. Finally, we will conclude with a brief listing of 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.

### 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, 1968). Ausubel (1977) considered cognitive

structures to be organized in meaningful and hierarchical relations, such that larger ideas subsumed lesser related concepts.

Novak, Gowin, and Johansen, (1983) started from Ausubel's perspective and 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. For example, concept mapping has been linked to a greater understanding of earth science concepts (Ault, 1985) and biology concepts (Okebukala, 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).

Additionally, Horton, McConney, Gallo, Woods, Senn, and Hamelin (1993) provided a detailed meta-analysis on concept mapping literature, specifically investigating the effectiveness of concept mapping as an instructional tool and as a means to improve student attitudes toward the content area under investigation. Results from this analysis supported the benefits of concept mapping for both student achievement and improved student attitudes.

While much research has focused on the benefits of concept mapping among school age populations little work has explored its use with graduate level students. Moreover, the focus of work on concept-mapping has been to either establish its validity as a pedagogical tool or to

endorse its use as a measurement tool in research. Little work has examined *how* this tool may be used in graduate student populations studying educational psychology topics (e.g., Battle, Fives, Moore, & Dreyer, 2003).

### Purpose and Guiding Questions

Herein we describe the implementation of evolving concept maps as instructional and assessment tools in two graduate level educational psychology courses. Specifically, we discuss the use of evolving concept maps with master's and doctoral students in courses at two separate universities in classes on adolescent development and theories of learning and cognition. We also address how concept mapping can be implemented as both a teaching tool and a form of formative and summative assessment. We describe our struggles implementing this tool and the perceived benefits of using concept mapping with this population. We also share some examples of student work and the types of feedback received in order to illustrate the value of evolving concept maps. Ultimately our goal is to provide our audience with ample information about the use of these maps so that they can incorporate them into their own teaching.

Our reflection, analysis, and subsequent discussion presented here were framed by several research questions. Additionally, as the analysis of the data commenced and continued, we allowed for other research questions to emerge and be considered in light of the goals of this work. The questions that guided this work included:

- How can evolving concept maps be implemented and used in graduate level courses in educational psychology?
  - What are the pedagogical practices and strategies involved in using evolving concept maps?
  - How can evolving concept maps be used as an assessment tool?

- What physical tools and materials were needed for this technique to be effective?
- What lessons have we learned in using and adapting this technique that can be of use to others?
- What are the pros and cons of using evolving concept maps?
  - What are the perceived strengths of using this approach in these particular classes?
  - What struggles emerged as a result of implementing evolving concept maps?

### Mode of Inquiry

We engaged in an extensive process of self- and collaborative reflection throughout the semesters we implemented evolving concept maps into our pedagogy. The work presented here followed 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). Clearly, this is the overarching goal of the work presented here. We began with a desire to develop sound educational experiences for our students that would directly address some of the concerns we held regarding our pedagogy. Through in-depth discussion, peer-mentoring practices, and self-reflection we examined our own practice in light of the needs of our students.

Self-study researchers must rely on methods from other disciplines, remain true to the expectations of trustworthiness and credibility demanded by those methods and, yet, adapt them to the current phenomenon under examination. In this work, we borrow from case study methodology as a methodological frame for our investigation. In particular, we seek provide a



descriptive (Yin, 1993) intrinsic (Stake, 1995) case study of our teaching experiences using evolving concept maps. Yin's (1993, 1994) descriptive case study approach provided a framework for the description of the pedagogical phenomenon. At the same time, we recognize this as an *intrinsic* case. As described by Stake (1995), "...we need[ed] to learn about that particular case..."(p. 3), not for theoretical reasons but because "[w]e have intrinsic interest in the case..." (p. 3). That is, the work presented here evolved out our desire to understand the processes, challenges, and potential of using evolving concept maps in advanced educational psychology courses.

### *Context of the Study*

We bounded the case by examining the data available from our respective courses which included evolving concept maps from 2004-2005. Helenrose taught a graduate level course entitled "The Adolescent Learner" that was required for students in the middle-level certification masters program but was also taken by a few doctoral students in the spring of 2004 (n=16) and 2005 (n=15). Michelle taught a graduate level course titled "Learning and Cognition" for both master's level and doctoral students in the summer (n=8) and fall of 2004 (n=11) and the fall of 2005 (n=23) in which she utilized evolving concept maps. 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 gone to graduate school together, worked under the same advisor, and written numerous research papers 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 was the first to attempt to use the evolving concept maps. Through

phone calls and face-to-face visits with Michelle, the experience of using the concept maps was shared. In the summer of 2004, Michelle decided to see if the strategy worked for her content area and student population.

### *Data Sources and Collection*

We have several sources of evidence to demonstrate the use of evolving concept maps. These materials were gathered as part of the ongoing process of course instruction and primarily represent the naturally occurring documents that evolved through course implementation. These sources include:

#### *Course materials*

These materials include: course syllabi, assignment details, scoring rubrics, discussion notes (used to facilitate class discussions), Power Point presentations (when used), and feedback messages to the class that were discussed following the return of the first concept mapping assignments. With these data we can examine changes in our expectations, instructions, and scoring.

#### *Samples of Students' Work and Feedback*

We also gathered examples of student work in these courses. At the end of the semester *after* the posting of final grades, when students came in to collect their projects we individually asked each student if he/she would be willing to allow their concept mapping materials to be used as data for research purposes. Students who provided consent either left their original materials *or* allowed us to photo copy all of the maps and papers for our research purposes. All of the students, in all classes agreed for their work to be included in this research.

Student work examples included copies of evolving maps, final maps, map explanations, and final reflections on the concept mapping process. Further, with the maps and explanation

papers are the written feedback and notes offered by Michelle and Helenrose to the students. For the purpose of this study we looked globally across all the data for trends in feedback, student mapping of ideas, and the evolution of complex conceptual understanding. We use representative artifacts to engage in in-depth analysis of the strengths and weaknesses of this approach and serve as exemplars in our description of this technique.

### *Individual Reflections*

Throughout the process of implementing this pedagogy we made individual reflections on our process and progress. Further, as we mined our course material and student data we each developed a series of reflective and interpretative notes. The reflective notes included basic recollections of what had occurred, why changes were made, and perceptions of the process. Interpretative notes were gathered simultaneously as critical insights, emergent themes, and theoretical explanations became apparent. We later shared these notes with one another as part of the data analysis.

### *Data Analysis*

We conducted a reflective analysis on the data gathered and our experiences with evolving concept maps to develop this case (Kerby, 1991; Merriam, 1998). We employed a four-stage process to analyze the data. In stage one, we independently reviewed and gathered all of the existing data. During this stage, we gathered reflective and interpretative notes and allowed major themes and questions to emerge that were either relevant to our initial research questions or salient enough to warrant the addition of research questions to our investigation. In stage two, we shared our individual findings and engaged in in-depth discussions. Through these discussions and comparisons of individual findings, we identified the major themes and issues from the data that best addressed the questions at hand. In stage three, the general themes

identified were divided, and each author was assigned to conduct an intensive examination of the data, for supporting *and* non-supporting evidence of identified themes.

In the fourth stage, evidence found by individual authors was shared. We then examined each other's findings and interpretations in relation to the existing data. Thus, we attempted to meet the guidelines for self-study research suggested by Bullough and Pinnegar (2001) by ensuring that the data offered in the chapter “demonstrated wholeness” (p. 20), provided “the reader with an inside look at participants’ thinking and feeling” (p. 19), and was presented in “honest, not self-serving ways” (p. 15). Through the shared analysis of the data, we served as interrogators for one another and the information presented. Any disagreement regarding themes and assignment of data to themes as evidence was discussed until agreement was reached.

### *Voices and Organization of Findings*

Throughout this manuscript, we vary voice in the presentation of the data. 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 both 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 us. In these sections, the voice of the author is clearly indicated in the section heading.

### Results

Our results section is comprised of four main themes. First, we describe the actual implementation and evolution of using this technique in our respective classes. Second, we share some of the key lessons we learned as instructors and educational psychologists through our endeavors to improve our practice. Third, we discuss how using evolving concept maps

facilitated our instructional goals, in particular the need to meet the challenge of complexity inherent to understanding educational psychology from our perspective. Finally, we describe the overall pros and cons for implementing evolving concept maps in our classes.

*Description of Mapping Assignments in Adolescent Development and Learning and Cognition*

In this section we will describe how the evolving concept maps worked in our respective classes. We detail our assignment instructions, expectations, and scoring rubrics. We use examples of student work to illustrate the assignments and the types of feedback we provide for students.

*Adolescent Development – Helenrose*

*Mapping assignment.* Students were expected to construct an evolving concept map over the course of the semester. That is, each week as we read textbook chapters and other assigned readings students added constructs and links to their existing maps and made changes when necessary. In addition to the evolving maps, students were also required offer a written explanation of their maps. Much of the framework for this initial assignment was drawn from the work of Battle and colleagues (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 my syllabi in 2004 and 2005:

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 (Fives syllabi 2004 & 2005). Thus, 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.

In addition to the weekly mapping assignments students were expected to complete 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. The details of this assignment were offered on the syllabus:

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 the student’s concept map as well as an exploration of how the content learned this semester will affect his/her 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 (Fives syllabi 2004 & 2005).

*Evaluating the assignment.* Combined, the weekly concept maps and final archive assignment comprised 40% of students overall grade in the course. Other assignments included an observation assignment and case study (20%), student-led class discussion (17.5%), an individual article critique and share (2.5%), and ongoing class participation (20%).

Each concept map and paper was worth 13 points and comprised 32.5% of the students’ overall grade in the course. Students could drop their lowest 2 concept map/paper grades, but a grade of zero (a non-completion) would not be dropped. Each map/paper assignment was assessed using a 13-point rubric (Appendix 1). The map/papers were evaluated with respect to the map construction (5 points), the written explanation (5 points), and the overall quality of the

work offered (3 points). 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; (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, in particular the most salient constructs; (2) explain why constructs were placed as they were on the map (i.e., students needed to provide a rationalization for construct placement within the context of the map); (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, 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. This was not intended to mean that it had to be either 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 worth 7.5% of students overall grade and 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 mid-point 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 for both semesters, I provided students with explicit instruction in concept mapping. That is, following the initial first day of class activities (meeting one another, over viewing the syllabus, explaining course expectations), I explained concept mapping in general and the expectations for our class in particular. Using Power Point and direct instruction, students were provided an overview of the conceptual and empirical uses for concept maps with an emphasis on concept mapping as 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, 1984) 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 the map I actually used when teaching the lesson (Figure 2).

Following the mini-lesson on concept mapping, student pairs or triads were provided with a section of Steinberg & Morris' (2001) review of adolescent development. The article is organized into nine sub-sections that reflect past and future trends in research on adolescent development. Each group was expected to read the assigned section and construct a concept map of the reading together using chart paper and markers I provided. Following the group map construction the class visited one-another's maps "gallery style" to examine both the content



presented as well as the mapping techniques employed. Each group then 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, a discussion was held regarding the mapping processes (e.g., What were good strategies, what didn't work and why?). For the majority of this discussion I attempted to allow the students to identify the strengths and weaknesses of the maps and to articulate strategies used. When necessary I asked pointed question directing students to as yet un-mentioned 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 for me, class met on Thursday afternoons from 4-6 pm. 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. It was crucial that I had the work assessed and feedback provided in order for students to move forward with the maps. The frequency and immediacy of this feedback was a challenge to keep up with as the instructor. However, I feel certain it was one of the major strengths of this as a learning activity.

In 2005, I had one advanced graduate student who commuted 2½ hours to class each week, she occasionally stayed overnight at the university and returned home the next day. It was impossible for her to get the feedback prior to the following class. I maintained that this was a critical component of the assignment and the expectation and that she would have to develop a strategy for dealing with this. We negotiated and developed three strategies. First, I would grade her map and paper first, leaving it in the LRC by 9 am on Friday mornings. This way if the student stayed over night she could pick it up on her way back home in the morning. (I only did this on the nights she was staying in town). The second strategy initiated by the student was to have a friend with a similar commute on Mondays pick up her map and paper. Finally, she made photocopies of her map so that each week she had a copy of her evolving map to work from, and I had a copy to grade.

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 students' 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 for me 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[otesis] 1 and hyp[otesis] 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 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 tended to be more traditional in nature and was aimed at helping students develop an academic writing voice. Such a voice in my course meant

that students offered sufficient scholarly arguments, used 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 map/paper assignment each semester I also provided students with a general feedback memo in which I highlighted common errors or concerns with their work. This feedback was offered around three main themes: maps, explanations, 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 choose to include certain constructs on the map and why you put them where you did. This will need to include in some cases and 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 5 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. (Fives, 2004: 1<sup>st</sup> concept mapping endeavor)

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.* During the Spring of 2004, I was aware of the concept mapping assignment Helen had implemented with her adolescent development class and

intrigued by the thought of using the assignment with my graduate level course in learning and cognition. In Fall 2003, I first taught the course to masters and doctoral level 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 come to a deeper level of 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.

Although I had some reservations, I decided to implement concept maps with my learning and cognition class starting in the Summer of 2004. I viewed the concept mapping assignment as a way to meet the needs of all students with regard to their content knowledge and writing by providing them a self-constructed visual representation of the course content as well as regular feedback on their writing and APA style. I chose to first attempt the assignment in a summer semester because, I reasoned, the class would be smaller (i.e., few papers and maps, fewer student complaints) and the semester was only five weeks long (i.e., if it did not work out well, at least it would be over quickly).

*First concept mapping endeavor: Summer 2004.* In the Summer of 2004, I implemented the assignment in my course Learning and Cognition course. The course met twice a week (i.e., Tuesdays and Thursdays) for four hours each day over a five week semester. There were eight students in this course. Three students were in masters programs and five students were in doctoral (i.e., PhD and EdD) programs in the College of Education.

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 the slides Helenrose developed. Class time was provided for students, working in groups, to develop concept maps based on their current understanding of learning and cognition. Students then shared the maps with the class and discussed 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. Further, 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 their errors were similar to one's Helenrose noted, whereas others were unique to my class. Thus, I borrowed text from her feedback memo when appropriate.

The changes I made to the assignment at the outset of the semester were due to the shortened summer semester. Specifically, I decided that students would turn 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. Combined the weekly concept maps and archive were worth 55% of students final grade in the course (i.e., 35% for the weekly maps and papers, 20% for the final map and synthesis paper). In addition to the concept map assignment students were also required to work in pairs to prepare a presentation and lead a

discussion on a topic relevant to the course (17%), to identify an article related to the course content to be shared with the class (14%), and participate in on-going discussion (14%).

Additional changes to the assignment in summer 2004 pertained to the return of feedback and the rubric for the weekly concept maps and explanations papers. 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., over an hour and a half each way) that prevented them from coming to campus on non-class days. Thus, some students did not receive their graded maps and papers until Tuesday, with the next additions to the maps due by Thursday.

I also made a small change to the map and paper rubric in response to patterns I saw after grading the first week's maps and papers. That is, the rubric indicated that students would be assessed on their inclusion, placement, and links made to "constructs." My students appropriately included the names of theorists as well as general concepts and organizing nodes in their maps. However, in their papers, they referred to each of these items as "constructs." To address this misunderstanding about the meaning of the term "construct," I discussed the issue in class, included this point in the written feedback notes given to the class after the first assignment, and changed the rubric to address "constructs/concepts/theorists" instead of just "constructs" (Appendix III).

*Second concept mapping endeavor: Fall 2004.* In the Fall of 2004, the learning and cognition course met once a week on Thursday evening for three hours over the course of 13 weeks, not counting Thanksgiving week. At the outset of the semester, there were 18 students enrolled in the course (i.e., 14 masters students, three doctoral students, and one graduate specialist student). Seven masters students dropped the course before the end of the semester.

Several of these students indicated they dropped due to the workload and time required for the course. In response to student feedback and my experience with the assignment in Summer 2004, as well as my desire to make the assignment more manageable with the expected larger class size, I made several changes.

The first change I made pertained to the selection of terms to include in the map. The required texts for the course (i.e., Schunk, 2004 and additional supplemental readings) contain a lot of information. In Summer 2004, I noted that students often included terms and topics from the text that I saw as less central. In oral and written comments, students also expressed feeling overwhelmed by the amount of reading and information to include in the maps and papers. Thus, in Fall 2004, I provided students with a list of terms to be included for each version of the map. As stated in the syllabus,

Students will be provided with a list of terms that are required to be included in their maps. Terms will be posted on WebCT at least one week before the respective concept map is due. Students may also add additional terms. (Buehl syllabus, Fall 2004)

By providing students with the terms, I intended to focus their reading and direct them to the content I saw as most important. However, by encouraging them to add more terms as they saw as necessary, their individual understandings and creativity were still supported.

A second change pertained to differentiated assignments for masters level and doctoral level students. Specifically, all students completed weekly maps but only doctoral students were required to write weekly explanation papers. In lieu of the explanation papers, masters students were expected to write two application papers and complete a midterm writing assignment that required the application of specific course content to the analysis of a written case. The guidelines for the application papers were as follows:



Masters level students are required to write two short application papers (i.e., 2-4 pages) throughout the course of the semester. These papers are to be based on the readings and concept map due for a particular day. Application papers are more than a summary of the reading assignments. Specifically, students are to discuss the implications and application of the assigned reading material to their field. Through the application papers students should address how the terms for that week's concept map are related to one another. ***Application papers are due the day the material is discussed.*** Because students may choose to write their application paper at any point in the semester NO LATE papers will be accepted. Instead students should write an application for another day.

Two application papers are required. However, students may choose to write an additional application paper to improve their grade. The lowest of the three application paper grades will be dropped from the student's overall point accumulation. The rubric for scoring the Application Papers are provided in Appendix D. (Buehl syllabus, Fall 2004)

Given the changes in requirements, adjustments were also made to the rubrics. Specifically, the 13 point rubric for maps and papers was changed. All maps were scored using a 7-point rubric (i.e., 5 points for map construction and 2 points for map quality in terms of appearance; Appendix IV). For the doctoral students, weekly explanation papers were worth 9 points each (i.e., 5 points for the content of the explanation and 4 points for the quality in terms of writing and APA formatting, Appendix IV). Master students' application papers were scored using a similar 9 point rubric and their score was multiplied by two in order to total 18 points (Appendix IV).

All other assignments, including individual article critique and share, a group presentation and discussion, and participation, were required of both masters and doctoral level students, as seen in the following table from the syllabus documenting the grade distribution:

Assignment	Due Date(s)	Masters Level		Doctoral Level	
		Points	%	Points	%
Weekly Concept Maps	On going: see class schedule	70	23%	70	23%
Weekly Explanation Papers	On going: see class schedule			90	29%
Application Papers (2@ 18 pts each)	Flexible	36	12%		
Midterm Assignment	October 21 <sup>st</sup>	54	17%		
Final Concept Map, Archive, and Statement	December 10 <sup>th</sup>	50	16%	50	16%
Article Critique & Share	Flexible	20	6%	20	6%
Presentation & Discussion	See class schedule	40	13%	40	13%
Participation	On going	40	13%	40	13%
	Total Points	310		310	

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 V). Students in non-teaching fields were encouraged to speak with me to identify how alternative applications.

A final change in the Fall 2004 semester related to the students receiving and incorporating feedback into their maps. That is, although I made efforts to have all maps graded by Monday, some students again had schedules and commutes that prevented them from picking up the maps until the following class period, Thursday, the same day the next map was due. Thus, I could not expect the changes I suggested to be incorporated until the following week. Consequently, as I graded each weekly map, I had to keep in mind what feedback the students had or had not received when the map was created.

*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., 8 doctoral students and 15 masters students). This semester, I again presented students with the terms to include in their maps but made some modifications with regard to the initial presentation of concept mapping as well as changes to the assignments.

With respect to the initial presentation of concept mapping, on the first day of class, I used Helenrose's materials explaining the uses of concept mapping. However, for in-class practice, students worked in groups to map concepts from a specific text. Specifically, each group was given a passage about a different educational philosophy. In groups, students mapped the information they saw as most central to their understanding of the educational philosophy and shared the maps and their process of construction with the class. I made this change to better reflect the nature of the work students would be expected to do each week. Also, the plotting of terms from a provided text was in line with Helenrose's initial design.

Changes to the concept mapping assignment were made 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 based the reading that was assigned and discussed during the class that week. These maps were scored using a 2-point rubric (i.e., 2=good, 1 = Fair; 0 = Inadequate/Missing; Appendix VI) 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 VI). Because unit maps were not due until after students had received all relevant feedback and discussed the content in class, I expected students to present high quality maps that included any necessary changes. Students completed four unit maps throughout the semester and I did *not* drop any unit map grades.

Explanation papers, once again, were only a requirement for the doctoral students and they were only submitted for 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 grade was dropped). These papers were graded using a 15-point rubric (Appendix VI) to provide more specific feedback.

In Fall 2005, masters students did not write application papers related to their maps. Instead, working in groups they gave a presentation and lead a discussion related to a specific instructional application based on the theories from the course. As part of the preparation for their presentation, students were required to identify an appropriate reading for the course and assign the terms students were to map. The various course requirements and point distributions for the masters and doctoral students in Fall 2005 were as follows:

Assignment	Due Date(s)	Masters Level		Doctoral Level	
		Points	%	Points	%
Weekly Concept Maps	On going: see schedule	20	7%	20	7%
Unit Concept Maps	On going: see schedule	48	18%	48	18%
Unit Explanation Papers	On going: see schedule			45	16%
Midterm Assignment	November 10 <sup>th</sup>	60	22%	60	22%
Instructional Application Presentations	November 17 <sup>th</sup>	45	16%		
Final Concept Map, Archive, & Statement	December 9 <sup>th</sup>	60	22%	60	22%
Participation	On going	40	15%	40	15%
	Total Points	273		273	

### *Lessons Learned*

In addition to the structural aspects of using evolving concept maps, we learned several important procedural lessons during the time we used this technique. These are practical issues that are pertinent to instructors who may use this technique in the future.

*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 to make it ones' own. This is clearly evident in Michelle's multi-semester re-framing 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 used Helenrose's initial format and materials as a starting point from which to work.

Additionally, student comments were useful in providing insight into what students' perceived the as useful and beneficial aspects of the assignment as well as aspects that could be changes or improved upon. In both of our classes, particularly in our first attempt with concept

mapping (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' comments and feedback. Students' were more than forthcoming in their feedback throughout the semester. Further, 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. Michelle considered students' feedback carefully and some of the subsequent changes in Fall 2004 and 2005 were based, in part, on their suggestions. Thus, obtaining student feedback can provide useful information for making changes.

Despite the benefits of student feedback and suggestions for change, we found that it was also important for us as instructors to remain committed to the assignment throughout the semester. For example, although we were open to student feedback we both remained firm in our commitment to the assignment. 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 own classes when a graduate student, Mary, 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 evolving nature of the map as we used the assignment in our courses required that be a centerpiece within the course. Substantial changes midsemester could be too disruptive to the course structure and perhaps indicate the instructor was not committed to the assignment. 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 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. Helenrose had all maps graded by Monday afternoon and was able to leave them in the LRC for students to pick up. Michelle also tried to have all maps graded by Monday. However, some of her students could not pick papers up during business hours. Consequently, other arrangements were made (e.g., graded maps and papers were posted on the door to her suite if she was not in her office).

*Maps as formative and summative assessment.* Another lesson we learned from our experiences pertained to how the concept mapping assignment could be used as both a formative and summative assessment. That is, we view the assignment as formative in that students had the opportunity to develop their skills without penalty (i.e., we both dropped lowest grades) and the opportunity to change and revise their maps throughout the semester based on instructor feedback and their deepening understanding. However, the weekly maps were also summative in the sense 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 address this issue and emphasized 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 before turning them in. Finally, we both had students submit a final map at the end of the semester that served as a summative assessment of what students had learned. Additionally, the synthesis paper associated with the final map provided students to reflect on all that they 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. 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. These students typically used a master-map to detail the map organization scheme (See figure 6, Cindy's maps). Occasionally, as with Cindy's maps, students combined the technology piece with hand written aspects. Because Cindy had difficulty getting lines drawn in Word as she liked, she did these by hand. She also colored in or highlighted the circles with colored markers because she did not have access to a colored printer. In general, the students who used word processors to draw their maps went through the same processes as those who constructed their maps by hand. That is, they decided exactly where to place concepts and they developed their own schemes for meaning with respect to color coding and the meaning of different kinds of lines. In addition, students who used work processors had the added advantage of being able to make relatively minor changes to their maps with little mess or fuss. In contrast, students who were hand drawing their maps were occasionally frustrated when they needed to make substantial changes.

The other program some students used was 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-early 50s who were pursuing doctoral degrees in Educational Psychology.

In 2004, Alina used Inspiration to complete her evolving map. In comparison to the other maps created by students that semester and later, this was one of the simplest and linear maps constructed in the Adolescent Learner course, despite its confusing appearance. Early in the semester, Alina remarked in passing 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 is an accurate reflection of how Inspiration works is beyond our ken. However, this perspective from the student suggested to Helenrose that the cognitive work of concept mapping may not have been happening for Alina early on in the semester.

In contrast, in 2005, Heather started the semester using Inspiration and after the 4<sup>th</sup> week abandoned it, 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 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 to generate the maps. In the cases that used word processing as a drawing tool, the maps were similar in quality to those drawing by hand (albeit a little neater). However, unless they had previous experience, students who used a concept-mapping program seemed to have limited maps or gave up on the program early on.

### *Meeting the Challenges of Teaching Educational Psychology*

Here we use examples from students' maps and papers to demonstrate how this approach addresses the challenge of teaching educational psychology. We discuss how this process served to assist the students in developing more personal and integrated understandings of the material as well as how these maps served to inform our teaching throughout the semester.

### *Complexity*

Figures 4 and 5 are images of two students', Ann and Sue (pseudonyms), final maps from the 2005 semester of the adolescent learner. For the purposes of representation here, the maps have been slightly altered with numbers, circles, and arrows to direct the reader to the specific area of the map under consideration.

One of the reasons we chose to use concept mapping in our classes was to help learners understand and visualize the complex nature of the content studied in our respective courses. In the adolescent learner course, students needed to see not only how individual concepts influence adolescent learning but also how hosts of concepts interact and provide simultaneous, sometimes competing influences on learning experiences. An initial glance at the maps created by Ann and Sue may suggest that Sue's map (Figure 5) is substantially more complex. However, a more fine tuned analysis and understanding is needed before such an assumption is garnered. Here we first describe the overall mapping strategies used by each student and then we make comparisons across the two maps.

*Ann's map.* Ann's map and themes tended to follow the order and organization of the course. Each of the main themes she indicated on her map were either reflective of the chapter title or the syllabus discussion topic (7 of these themes are highlighted on her map). In general, Ann constructed her map by focusing one section of the map on the topics to be covered each week.

An examination of Figure 4 illustrates that she did not use lines to show connections across major headings or subheadings. Instead, Ann used color to show relations among topics on her map. That is, within each main theme the subtopics surrounding it were color coded such that similar subtopics related to other themes could be identified. The white ovals on Ann's map

indicate areas that were coded in pink. Pink was described in her explanation papers as representing social relations or interactions among learners. Thus, most of the nodes/topics in the Socio-emotional development theme (#6) were coded pink. However, in Constructivism (#3) Vygotsky and ZPD (zone of proximal development) were also coded pink, as were aspects of Physical Development (#1), Peer/Social Relations (#7), Teenagers (unmarked), and Survivability of Gifted Students (unmarked lower left corner). Thus, through the use of color and her explanation papers Ann was able to articulate her conceptual understanding of adolescence.

*Sue's map.* Sue's representation of her understanding of adolescence utilized several mediums to show connections across ideas. Thick green lines were used to connect the 6 major themes to her organizing construct "Adolescence." On her map these themes are numbered 1-6 and include: (1) Theories of Development, (2) History of Childhood, (3) Puberty, (4) "Teenagers," (5) Impacts of School, (6) Peer Relations. While these are not necessarily the organizing constructs Helenrose would have used to frame a conceptual map of adolescence these themes were of value and importance to Sue.

Next, Sue used moderately thick red lines to demonstrate connections among the major themes (e.g., the line connecting Peer Relations #6 to Puberty #3). She also used this level of connection to draw in themes that were initially considered minor in the course but that later needed greater representation on the map. For example, Peers (#9) was a central theme in Sue's map early on, even though peer relations were not explicitly examined until later in the semester. Thus, when the theme, Peer Relations (#6) was added to the map, she made a strong connection to her previous theme Peers, using the solid red line. In this way, she was able to adapt her map to the changing content over the semester.

Sue used light pink colored straight lines to add subtopics to the map. Some examples of subtopics highlighted on the map are Peers (#9), Physical Changes (#7), and Parenting (#8). Details related to each subtopic were added in consistent rings of color: blue, yellow, and light green. She used these same colors to show interrelations within the subtopics presented.

Sue graphically represented connections across subtopics, using a dotted thin red line. These dotted red lines demonstrate her understanding of the integration of these constructs, concepts, and names, and their overall influence on adolescence. Peers (#9) has several links to other topics on the map. According to Sue's map, Peers are related to Physical Changes (#9), Group Differences, and Parenting (#8) to note a few. She also provided a complex connection between Peers and Impacts on School through a connection to Vygotsky (see white arrows indicating connections). Thus, she demonstrated graphically, how she thinks Peers influence schooling – through Vygotsky's Sociocultural Theory.

*Comparisons.* Both Ann and Sue were able to demonstrate the complex nature of their conceptualizations of Adolescence. Ann went through several mapping strategies before settling on her color coding scheme. In contrast, Sue, who had done concept mapping in a curriculum development course the prior semester, had only one major overhaul of her map and then developed adaptive strategies for working with the existing information. Although, both maps provide evidence of complex understanding, Sue's map offers a decidedly more detailed, visible, and interrelated interpretation of the work. Ann was often bound to having to decide if a given construct was reflective of one or another of her color codes (e.g., social or cognitive). Thus, the relations within her color coding scheme were limited to general themes. Sue's map allowed for connections to be made not only among main concepts but through connections to others (e.g.

Peers to Vygotsky to impact on school) reflecting an understanding of how psychological constructs can serve as mediators between concepts, behaviors, and outcomes.

### *Pros and Cons*

Based on our experiences with using the maps in our classes, course evaluations, and student reflections, we outline what we see as the pros and cons of using evolving concept maps.

#### *Pros*

*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. One 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 the constructs and concepts examined in the course and representing these connections on their maps. Consequently, the students had to actively engage with the content to create a map that provided physical documentation of what they knew the topic (i.e., adolescent development or learning and cognition). The written explanation papers also highlighted the individual construction of knowledge in that students had to provide a reason or rationale for the connections they made.

Additionally, students were encouraged to be creative and adopt a mapping style that was best for them. As seen in Helenrose's examples, some students used color and different types of

lines. In both classes, other students used different shapes, icons, and font sizes. 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 what they knew and the connections they were making with 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 and valued. As seen in Helenrose’s examples, all feedback was provided on sticky notes, often in the form of questions or open recommendations (e.g., “You may want to consider...”), and it was the student’s choice as to how concepts were ultimately incorporated into the maps.

Based on students’ comments and feedback, it was apparent that most recognized their role in the learning process and that they gained from the experience. They were clearly proud of their maps and the work they represented. Students indicated that they intended to save their maps and use them for future reference (e.g., for comprehensive exams). Further, 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” (Buehl, Summer 2004 course evaluation).

*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. Further, 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 throughout the semester. That is, we had regular glimpses into their understanding of the content, not just on an exam or the occasional comments in class. Thus, we were better able to address misunderstandings and target instruction to the students' needs. Additionally, in both classes, the concept maps lead to more interactive discussion in class in which students were more willing to discuss 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 such extensive experience using them before our respective courses. The expertise in concept mapping that students developed over the semester could be transferred to their experience in other classes or in their own teaching. That is, 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 with them in class, she was considering ways they could be used more seriously.

### *Cons*

*Time.* Despite the observed benefits of concept mapping, there were also very specific drawbacks that should be taken into consideration. Perhaps the biggest of these pertains to the issue of time. The concept mapping assignment is time consuming, both for the students and 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. Further, 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 classes and work 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 unless they are compelled to explain the maps to others.

### Conclusions

We hope this paper 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 this technique 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: Fives' Lesson Planning Map

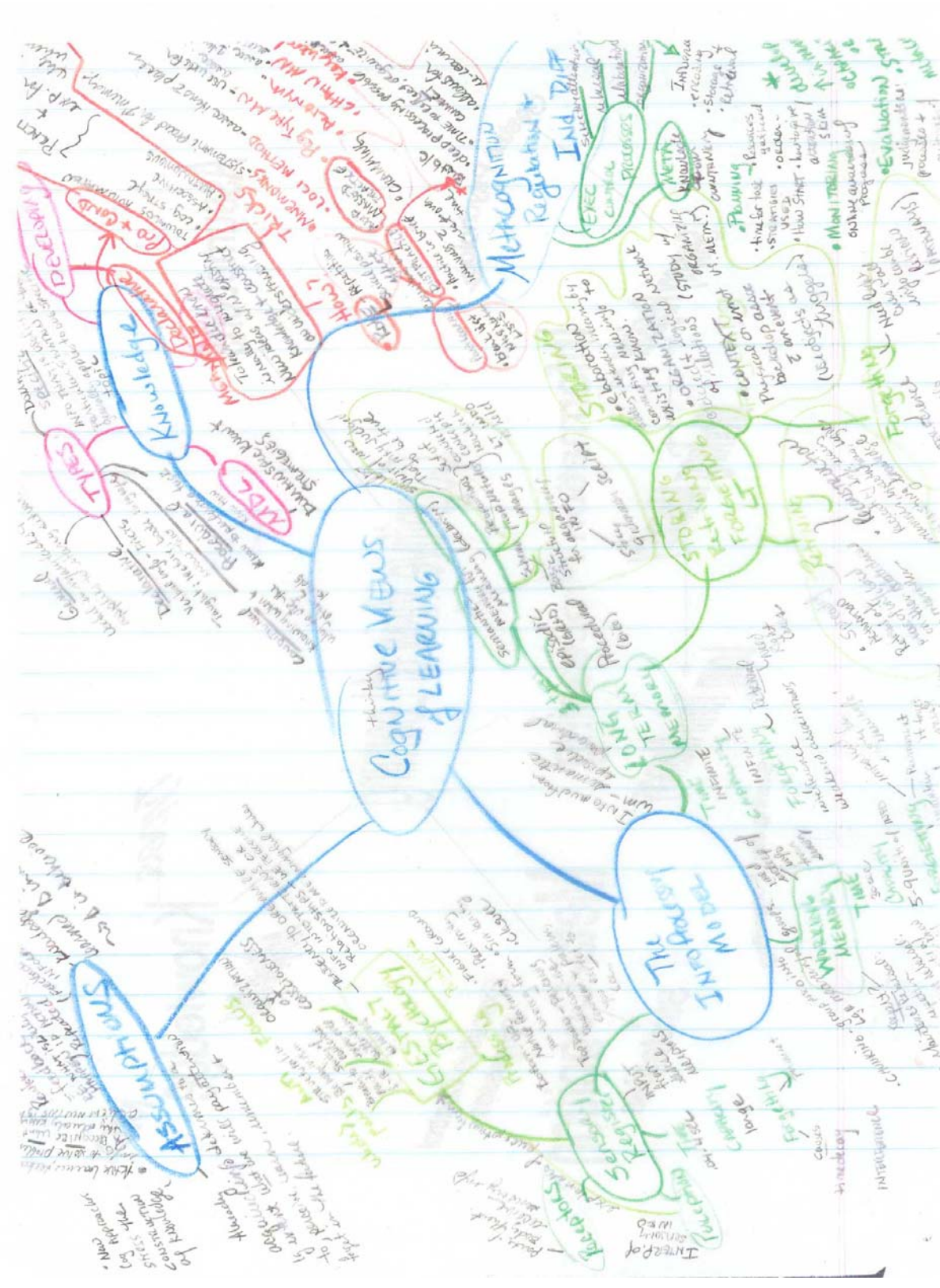


Figure 2: Fives' Teaching Map

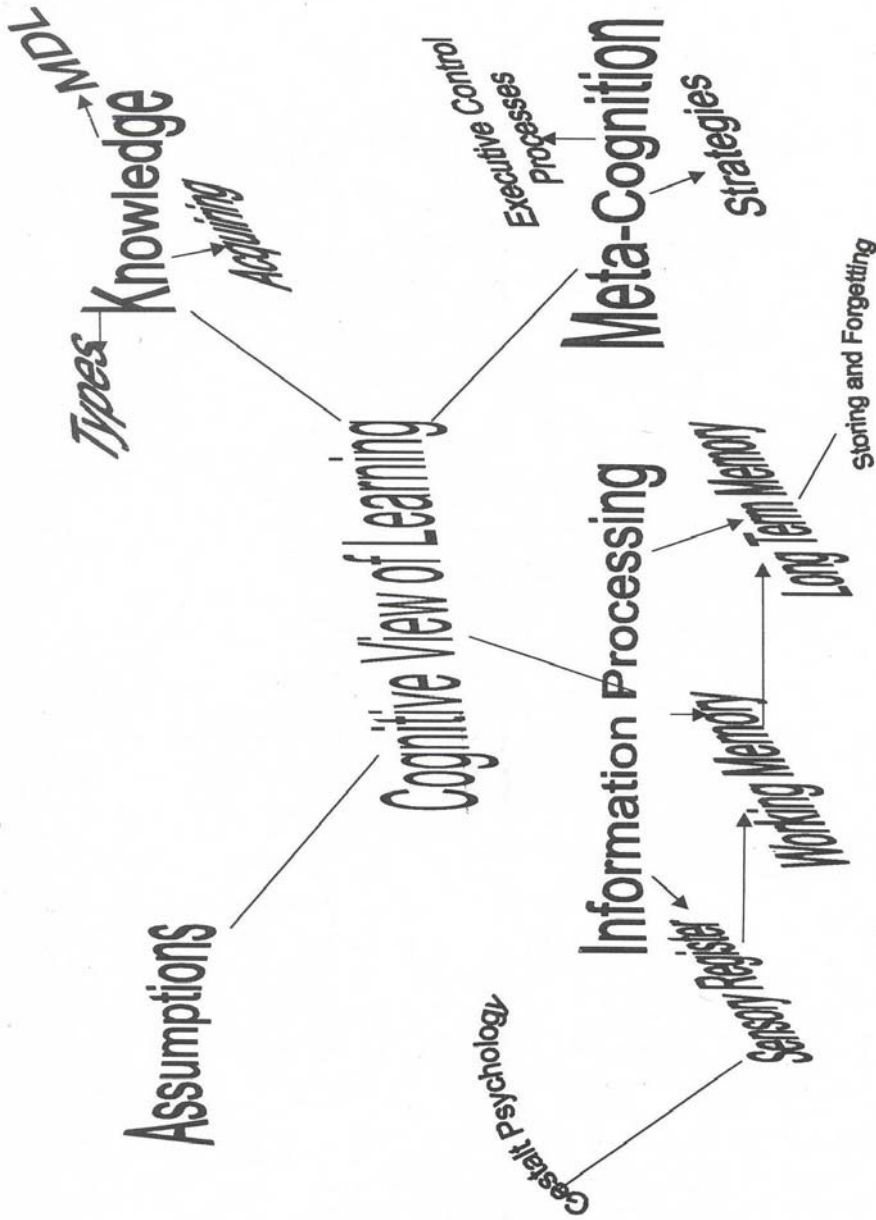


Figure 3: Large student map with instructor feedback

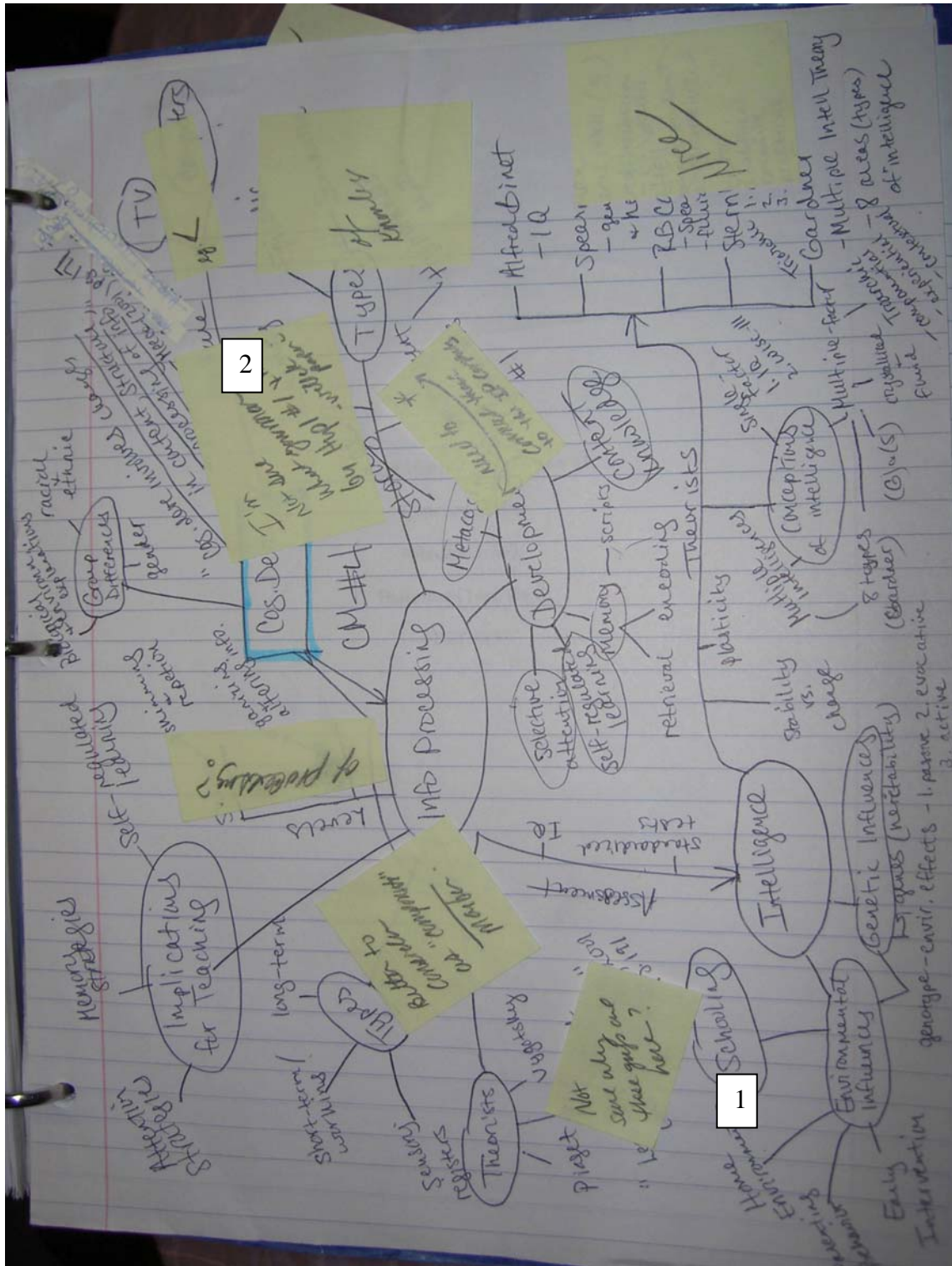


Figure 4: Ann's map a less complex map from adolescent learner

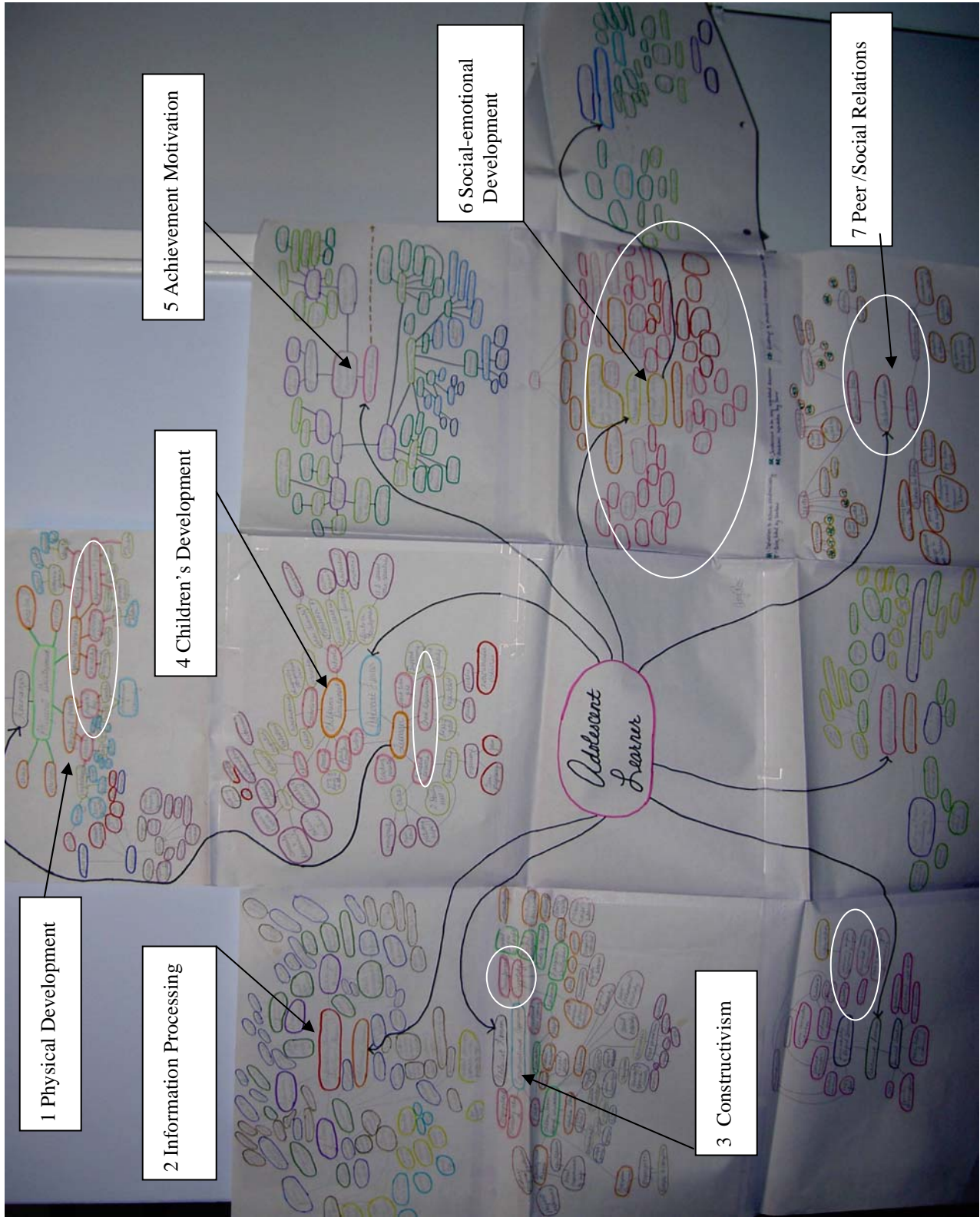


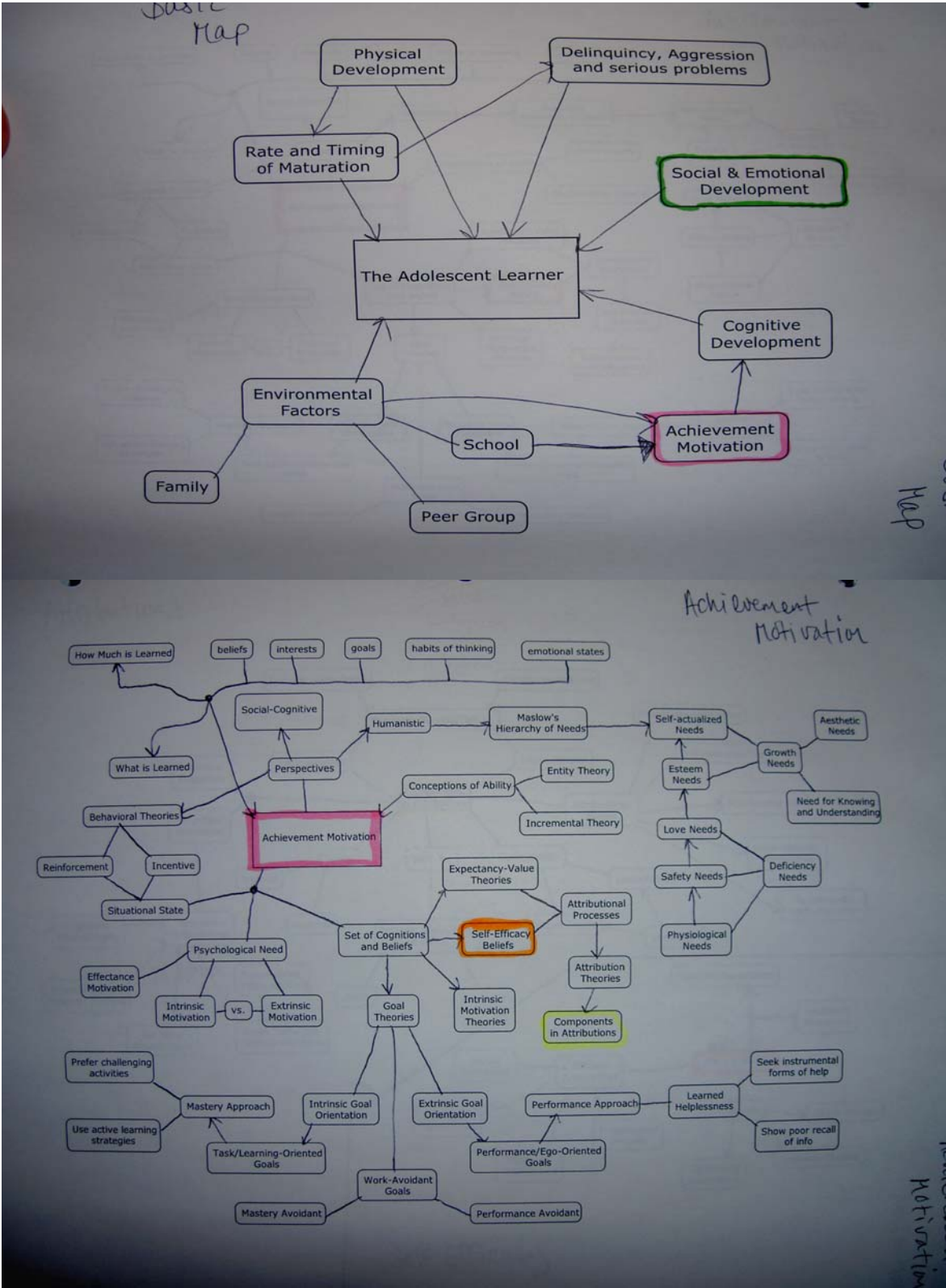


Figure 5: Sue's final map, a more complex map from adolescent learner



Selected Main Ideas			
Item	Heading	Item	Heading
1	Theories of Development	6	Peer Relations
2	History of Childhood	7	Physical Changes
3	Puberty	8	Parenting
4	"Teenagers"	9	Peers
5	Impacts of School	10	Vygotsky (left) & Piaget (right)

Figure 6: Cindy's Basic Map 7 And Detailed Map 7



Appendix I  
 Fives' Weekly Concept Map Evaluation Rubric (2004-2005)

**Weekly Concept Map Rubric**

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

## Appendix II

## Fives' Final Concept Map Evaluation Rubric (2004-2005)

Final Concept Map, Paper & 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 the student's concept map as well as an exploration of how the content learned this semester will affect his/her 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, is free of grammatical, spelling, and typographical errors	5	
Archive		
Includes all previous maps	5	
Presented in a Professional Format	5	
<b>Total Points</b>	<b>30</b>	

## Appendix III

Buehl’s Concept Map Evaluation Rubric (Summer 2004)

Criteria	Points					
	5	4	3	2	1	0
<b>Map Construction</b> <ul style="list-style-type: none"> <li>○ All key constructs/concepts/theorists from the assigned reading are included.</li> <li>○ Constructs/concepts/theorists are placed in theoretically meaningful locations</li> <li>○ Logical and correct links made among constructs/concepts/theorists.</li> </ul>	Map demonstrates all criterions.	Map is limited with respect to <b>one</b> criterion.	Map is limited with respect to <b>two</b> criterions.	Map fails to meet one criterion <b>OR</b> is limited with respect to all three criterions.	Map fails to meet two criterions <b>OR</b> fails to meet one criterion and is limited with respect to one or more criterion.	None of the criterions are met.
<b>Written Explanation</b> <ul style="list-style-type: none"> <li>○ Correctly identifies and describes the key constructs/concepts/theorists included in the map.</li> <li>○ Clearly articulates why constructs/concepts/theorists were placed as they were on the map and the relations that are demonstrated.</li> <li>○ Explanation demonstrates logical and appropriate interpretations of constructs/concepts/theorists described.</li> </ul>	Explanation demonstrates all criterions.	Explanation is limited with respect to <b>one</b> criterion.	Explanation is limited with respect to <b>two</b> criterions.	Explanation fails to meet one criterion <b>OR</b> is limited with respect to all three criterions.	Explanation fails to meet two criterions <b>OR</b> fails to meet one criterion and is limited with respect to one or more criterion.	None of the criterions are met.
<b>Quality of Work</b> <ul style="list-style-type: none"> <li>○ Professional appearance of map demonstrates care and effort went into creation.</li> <li>○ Explanation is typed according to paper format guidelines.</li> <li>○ Map and explanation are free of spelling, punctuation, and citation errors.</li> </ul>	3 All criterions are met.	2 Minor infractions exist on one criterion.	1.5 Minor infractions exist on two criterions. <b>OR</b> Major infractions exist on one criterion.	1 Minor infractions exist on two criterions. <b>AND</b> Major infractions exist on one criterion.	0 Major infractions exist on all criterions	

Appendix IV

Buehl's Concept Map, Explanation Paper, and Application Paper Evaluation Rubrics (Fall 2004)

Weekly Concept Map Rubric

Criteria	Points					
	5	4	3	2	1	0
<b>Map Construction</b> <ul style="list-style-type: none"> <li>All assigned constructs/concepts/theorists from the assigned reading are included.</li> <li>Constructs/concepts/theorists are placed in theoretically meaningful locations</li> <li>Logical and correct links made among constructs/concepts/theorists.</li> </ul>	Map demonstrates all criteria.	Map is limited with respect to <b>one</b> criterion.	Map is limited with respect to <b>two</b> criteria.	Map fails to meet <b>one</b> criterion <b>OR</b> is limited with respect to all <b>three</b> criteria.	Map fails to meet <b>two</b> criteria <b>OR</b> fails to meet <b>one</b> criterion and is limited with respect to <b>one or more</b> criteria.	None of the criteria are met.
<b>Quality of Map</b>	2		1		.5	0
<ul style="list-style-type: none"> <li>Professional appearance of map demonstrates care and effort went into creation.</li> <li>Map free of spelling and typographical errors</li> </ul>	All criteria are met.		Minor infractions on one criterion.		Minor infractions on both criteria <b>OR</b> major infractions on one.	Major infractions on both criteria.

Weekly Explanation Paper Rubric (only for doctoral students)

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

Application Paper Rubric (only for masters students)

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

## Appendix V

## Buehl's Final Concept Map, Archive, and Philosophy of Learning and Teaching Rubric (Fall 2004&amp; 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 questions 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<sup>th</sup>.

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 written in APA style with appropriate citation and is free of grammatical, spelling, and typographical errors	10	
<b>Total Points</b>		<b>50</b>	

## Appendix VI

## Buehl's Weekly Concept Map, Unit Map, and Unit Explanation Paper Rubrics (Fall 2005)

## Weekly Map Rubric

2 (Good)	1 (Fair)	0 (Inadequate/Missing)
<ul style="list-style-type: none"> <li>All terms included</li> <li>Good effort in placing &amp; linking terms</li> <li>Neat and professional appearance</li> <li>No spelling or typographical errors</li> </ul>	<ul style="list-style-type: none"> <li>Few missing terms</li> <li>Poor placement of several terms</li> <li>Lack of appropriate links</li> <li>Relatively neat and professional appearance</li> <li>Few spelling and/or typographical errors</li> </ul>	<ul style="list-style-type: none"> <li>Numerous missing terms</li> <li>Inappropriate placement of terms</li> <li>No links</li> <li>Unprofessional or "messy" appearance</li> <li>Numerous spelling and/or typographical errors</li> </ul>

## Unit Map Rubric

Criteria	3	2	1	0
<b>Map Construction</b>				
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.
<b>Quality of Map</b>				
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.



## Unit Explanation Paper Rubric (only for doctoral students)

<b>Criteria</b>				
<b>Explanation</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>0</b>
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/theories.	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.
<b>Writing</b>	<b>2</b>	<b>1</b>	<b>.5</b>	<b>0</b>
<ul style="list-style-type: none"> <li>▪ Spelling, punctuation, grammatical, or typographical errors</li> </ul>	Error free	A few minor errors	Several errors or incoherent sentences	Numerous errors
<ul style="list-style-type: none"> <li>▪ Citation of sources</li> </ul>	Appropriate citation of sources	A few missing citations	Several missing citations	Lack of citations
<ul style="list-style-type: none"> <li>▪ Paper guidelines and APA style (e.g., references, levels of heading, margins)</li> </ul>	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.