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Concept mapping: evaluating the Language Arts Methods course

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Abstract: In this inquiry, I examine the evidence of student learning in an elementary education language arts methods course. Students completed concepts maps that represented their understanding of effective writing instruction at the beginning end of the course. Eighty-one pairs of concepts maps were scored according to established methods. Students included 122% more concepts on their post-course concepts maps; links between concepts increased by 134%. I also analyze a typical student's beginning- and end-of-course maps, which shows that the student's knowledge base increased both in terms of number and specificity of concepts.

Keywords: teacher education, language arts methods, writing pedagogy, elementary methods courses.

Recent criticism of teacher education (Kirby, McCombs, Barney, and Naftel, 2006) has prompted teacher educators to take a closer look at the effectiveness of their programs (Jones and Vesilind, 1996), and researchers have begun to focus on how to measure preservice and inservice teacher knowledge (Moats and Foorman, 2003; Reutzel, Dole, Sudweeks, Fawson, Read, Smith, Donaldson, Jones, Herman, 2007; Phelps and Schilling, 2004).

In the area of knowledge of language and literacy concepts and methods, we know that teachers have gaps in their understanding (Moats and Foorman, 2003). Specifically, in the area of writing instruction pedagogy, teachers themselves acknowledge that they are uncomfortable with teaching writing largely because they lack confidence as writers themselves, which they often attribute to the writing instruction (or lack of) they received during their own K-12 education (Graves, 2002; Murphy, 2003; Napoli, 2001).

Since my goal as a teacher educator is to send teachers out into the public school with the pedagogical content knowledge to teach language arts, I need a way to evaluate the effectiveness of my language arts methods course for pre-service teachers. I need to know, at the end of my course, what, and how well, my students have learned. To determine this, I need to match assessment to course goals.

For about three years, I've been adjusting my course content, but I always felt the pull to add goals. After reading about the "inverted pyramid" decision progress (Bass, 1999), I have been able to narrow the focus of the course. Briefly, Bass describes this inverted pyramid decision process as a series of questions he asked himself:

- What were the four or five learning goals that I had for students in a particular course?
- What did I really believe (and what did I know) about what percentage of students were achieving all of the goals, some of the goals, one or two of them?
- If I had to pick one of these learning goals or outcomes as the one thing that students would retain from this course after leaving it, what would it be?

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- Thinking about that one goal, then could I honestly say that I spent the most amount of time in the course teaching to the goal I valued most? (pp. 4-5)

For my course, I decided that I would spent the most amount of time teaching about and demonstrating effective methods of spelling and writing instruction. The next logical step was to determine a method for measuring whether or not my students reached those goals. Traditional forms of assessment do not capture well the growth in their knowledge of pedagogical content that I hoped to measure.

Some teacher educators use multiple choice tests because they are considered "objective." Some use performance assessments, such as asking students to apply their learning by producing, teaching, and reflecting upon lessons taught during practicum experiences. Because instructional methods courses in teacher education aim to teach content pedagogy, methods teachers need ways to measure students' pedagogical content knowledge. Multiple choice tests are a way to measure content knowledge, whereas assessing students' lesson plans are a way to evaluative their pedagogical content knowledge. Through a short answer, multiple choice test I can efficiently measure some content knowledge, but knowledge of content pedagogy (Shulman, 1987) is embedded in cognitive structures that are difficult to see or describe. Moreover, some students may come with more or less well-developed ideas about effective writing instruction based on their own experiences with writing instruction (good, bad, and indifferent) that have occurred throughout their educational careers. These experiences powerfully influence their ideas about writing and teaching writing. I needed a way to assess their understanding before the class began and at the end of the course. Concept maps provide another way to measure both content knowledge and pedagogical content knowledge in one integrated artifact. For a multiple choice examination, students may perform well if they have memorized facts, but in order to construct a concept map, they need to have an integrated sense of how concepts relate to each other, which requires deeper understanding than mere memorization.

I. Review of the Literature.

In terms of writing instruction, the kind of information that students need is both content knowledge and pedagogical content knowledge, which is largely procedural in nature (Shulman, 1987). Concept mapping allows a student to represent both their semantic long-term memory (Jacobs-Lawson and Hershey, 2002) and their procedural knowledge (Sims-Knight, Upchurch, Pendergrass, Meressi, Fortier, Tchimev, VonderHeide, and Page, 2004).

Concept maps are graphic representations of concepts linked and arranged according to the students' understanding of the relationship of the concepts and thus are a window into students' cognitive structures or schema (Novak, 1998). Based on research on the structure of knowledge, terms like "network" and "web" are metaphors we use to talk about how concepts are connected to other concepts in simple linear chains or in vertical hierarchical relationships. Concept maps are visual representations of those networks of ideas. Concepts are written in nodes (bubbles) and relationships between them are shown with lines that can be explained further using linking words written on the lines. Concept maps can be useful for identifying students' misconceptions, for developing their understanding, and for assessing their understanding summatively (Bolte, 1999). They are also useful as tools for deep learning because they help students connect new ideas to prior knowledge (Williams, 2004). Concepts maps are a valid and reliable measure of what students understand (Shavelson and Ruiz-Primo,

2000) and have been used in many subject areas, including biology (Mintzes, Wandersee, and Novak, 2001), science education (Markham and Mintzes, and Jones, 1994), math (Bolte, 1999), political science (Parkes, Zimmaro, Zappe, and Suen, 2000), nursing education (Williams, 2004), psychology (Jacobs-Lawson and Hershey, 2002), statistics (Lavigne, 2005), and medical education (West, Park, Pomeroy, and Sandoval, 2002). Most significantly, for my purposes, concept mapping has been used in teacher education (Artiles and McClafferty, 1998; Beyerbach, 1988), but not to assess preservice students' understanding of subject area teaching methods.

II. Theoretical Framework.

Kegan's constructive-developmental theory of adult development (2000) is the larger theory that informs this research. In Kegan's terms, we want preservice teachers to be making progressive development toward more complex constructions of their knowledge about effective teaching. In order to be able to do that, we must know what preconceived notions our students bring with them into the classroom. What are their current constructions of knowledge about teaching, about effective teaching, about the effective teaching of writing? Then, the form of that knowledge must undergo a change in form, a transformation, if we are to say that transformational learning has occurred. If students only add to their set of knowledge, then the learning is informational, which is worthwhile, but it is not transformational. The learning that we expect preservice teachers to experience in methods courses is a meaning-constructing task; they cannot merely be the recipients of knowledge by transmission.

The theoretical framework for this research assumes the validity of Shulman's notion of pedagogical content knowledge (1987). Content knowledge is subject matter knowledge that teachers possess. Pedagogical content knowledge is the unique blend of content knowledge and pedagogy that results when teachers organize, represent, and adapt topics, problems and issues for diverse students and when they present those topics, problems, and issues during instruction.

The current study is an example of practitioner research (Borko, Liston, Whitcomb, 2007), which attempts to examine practice from the inside by the teacher educator, who embodies a dual role of both teacher and researcher. Practitioner research is intentional because it is planned and deliberate, rather than spontaneous. It is also systematic because the researcher gathers information in an organized manner, keeps records, and analyzes the data collected in multiple ways. Practitioner research falls within the tradition of scholarship of teaching, an area of research that opens the classroom door so that teaching becomes "community property" (Shulman, 2004). Practitioner research should be available for public critique and review, which in turn makes it possible for other practioners to make use of it in their contexts.

II. Purpose and Methods.

Though my main intention was to evaluate the effectiveness of the course I teach and the way that I teach it, I hope that the method that I have used to evaluate my teaching will prove useful to others who want to know if their students are truly learning—if their teaching is truly effective. Although the Praxis and other tests of teacher knowledge can be used to measure the outcomes of teacher education, the results of these tests are not specific enough to be used to evaluate students' learning in any particular course. By using concept mapping as a pre- and post-measure of student learning, I sought to determine the degree of growth in the depth and complexity of students' knowledge in terms of the specific curriculum of the course.

I taught the students how to make a concept map by explaining, showing examples, and modeling. I then directed the students to create a map of their initial understanding of what constitutes effective writing instruction. Use of concept maps to assess students' understanding should be embedded in the instructional process, not just added on at the end (Mintzes, Wandersee, Novak, 2001). Accordingly, throughout the course, I used concept maps as part of instruction to explore subtopics of effective writing instruction (e.g., effective spelling instruction).

Since the purpose of this study was to evaluate the effectiveness of this course, the students created a concept map at end of the course. Although I scored the maps, the scores were not part of their course grade. I compared the scores on this final concept map with the students' scores for their initial maps in order to measure the growth of their understanding over the course of the semester.

Scoring procedures vary, but I used a simplified form of the method recommended by Novak and Gowin (1984) in which nodes and lines are counted. Walker and King's study (2003) of concept mapping as a form of student assessment also employed this scoring method. Two scorers scored a subset of the maps and had an interrater reliability of .98. See Figure 1, which shows the scoring guide.

Nodes (Concepts) 1 pt. each _____

- Don't count redundancies
- Don't count irrelevant issues

Labeled Lines/Links _____

Validity Link Score _____

- invalid or misconceived link label = 0 pts.
- partially valid, general or imprecise link = 1 pt.
- valid, precise, clearly stated link = 2 pts.

Line/Node ratio____ Validity ratio____

Figure 1: Concept map scoring guide.

III. Results and Discussion.

Eighty-one pre-course concept maps and 81 post-course concept maps were scored. A paired-samples *t* test was conducted to evaluate whether the post-course concept map scores were statistically significantly higher than the pre-course concept map scores. The number of concepts that students included in their concept maps increased significantly ($t(80) = 15.04$, $p < 0.01$). The number of labeled connections that students made among concepts increased significantly ($t(80) = 8.42$, $p < 0.01$). The validity of the connections was assessed as well. Connections that were not labeled received one point, but connections that were labeled received two points. This validity of connections score also increased significantly ($t(80) = 12.34$, $p < 0.01$).

From these gain scores, I could conclude that students' knowledge of effective writing instruction increased, but this would be misleading and insufficient. A closer examination of the nature of students' pre-course concept maps shows that their initial understandings of effective writing instruction were vague. Some of the concepts they listed in their pre-course concept

maps were related to general ideas about effective instruction and learning, but not specific to effective writing instruction (e.g. instruction should be varied, allow for growth, build upon past instruction). However, their post-course concept maps included specific concepts that they encountered during the course.

Specific concepts addressed in the course were:

- word study that incorporates word sorting and differentiated instruction based upon spelling assessments
- genre-based writing instruction
- elements of writing workshop: daily lessons, independent writing time, and sharing
- writing process
- gradual release of responsibility model (called IMSCI, explained below)
- writing assessment and instruction based upon analytical scoring (6 traits)

As I examined the students' post-course maps, I looked for evidence that these major concepts were included.

Let's look at an example of a pre-course concept map (see figure 2). I chose this particular map because it typified a middle range of performance on the concept mapping task. This student's map indicates that she conceives of effective writing instruction as something that requires thought and interest, should emphasize creativity, and address conventions of grammar, spelling and proper format. These are concepts that she probably has acquired largely through personal experience. Her map approximates an understanding of effective writing instruction that matches her development as a preservice teacher. No part of her map is "incorrect," but other than her inclusion of specifics about conventions, the rest is nonspecific. Typically, students who possess general knowledge about a topic produce concepts maps that are wide, but not deep. One would expect that after students have developed a more complex, sophisticated knowledge base, their maps would reflect both the breadth and depth of that knowledge.

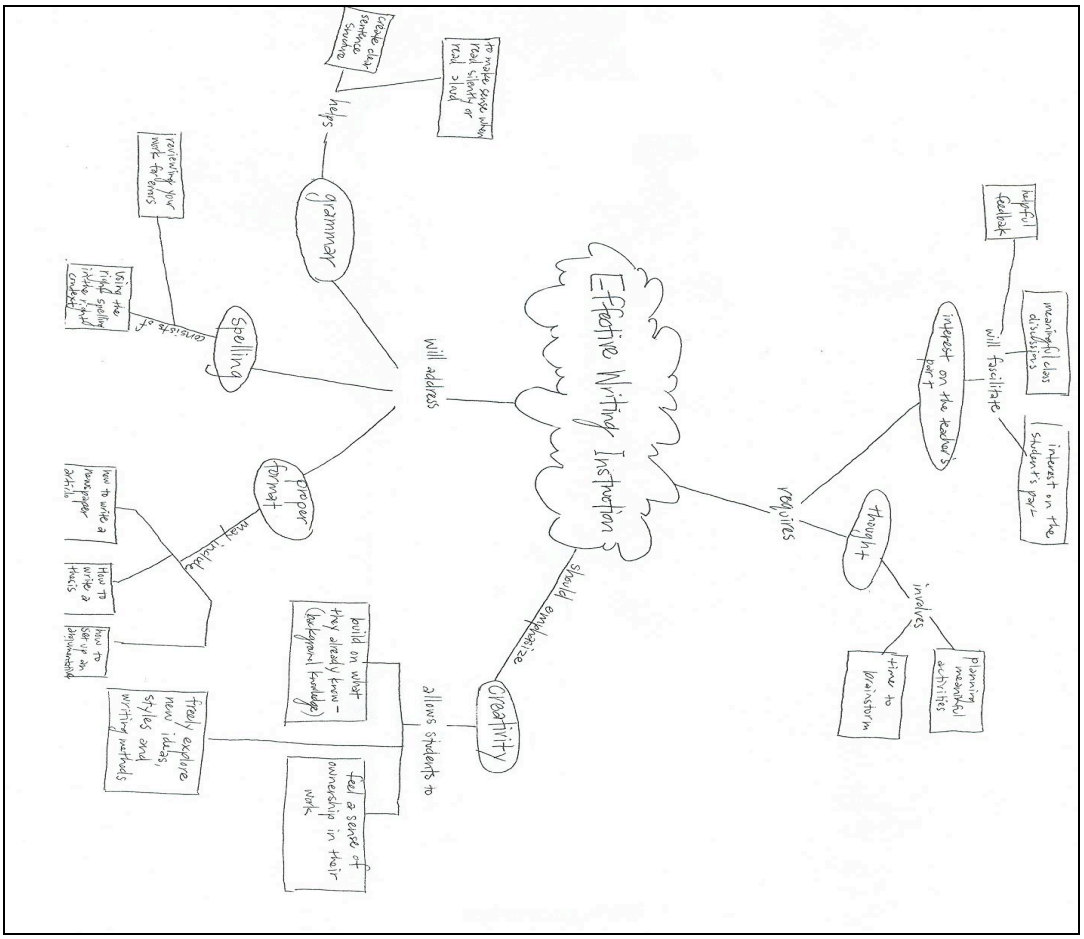

Figure 2: Student's pre-course concept map.

When we examine her end-of-course concept map (see figure 3), the level of specificity is much greater, reflecting an increase in the breadth and depth of her knowledge base. Her map now indicates that she understands effective writing instruction as an enterprise that should match instruction to assessment. She connects this to how feedback can be correlated with a specific standard, such as her new knowledge of the stages of spelling development. Her map also indicates that she understands how to differentiate instruction through the application of a scaffolding model (IMSCI). Each element of the scaffolding model has examples with detail, enumerating specific instructional practices. For example, she explains that modeling should focus students' attention on the goal of the activity and that modeling should help eliminate students' fear of failure because they've seen it done at least once. Her map doesn't provide detail about how to teach the traits of writing, but she does enumerate them correctly. Finally, her map indicates an understanding of the affective dimensions of writing instruction, which we had discussed in class. Specifically her map indicates that effective writing instruction should provide students with the tools to write on their own successfully, the confidence that they can write, and opportunities to learn from their mistakes without feeling dumb.

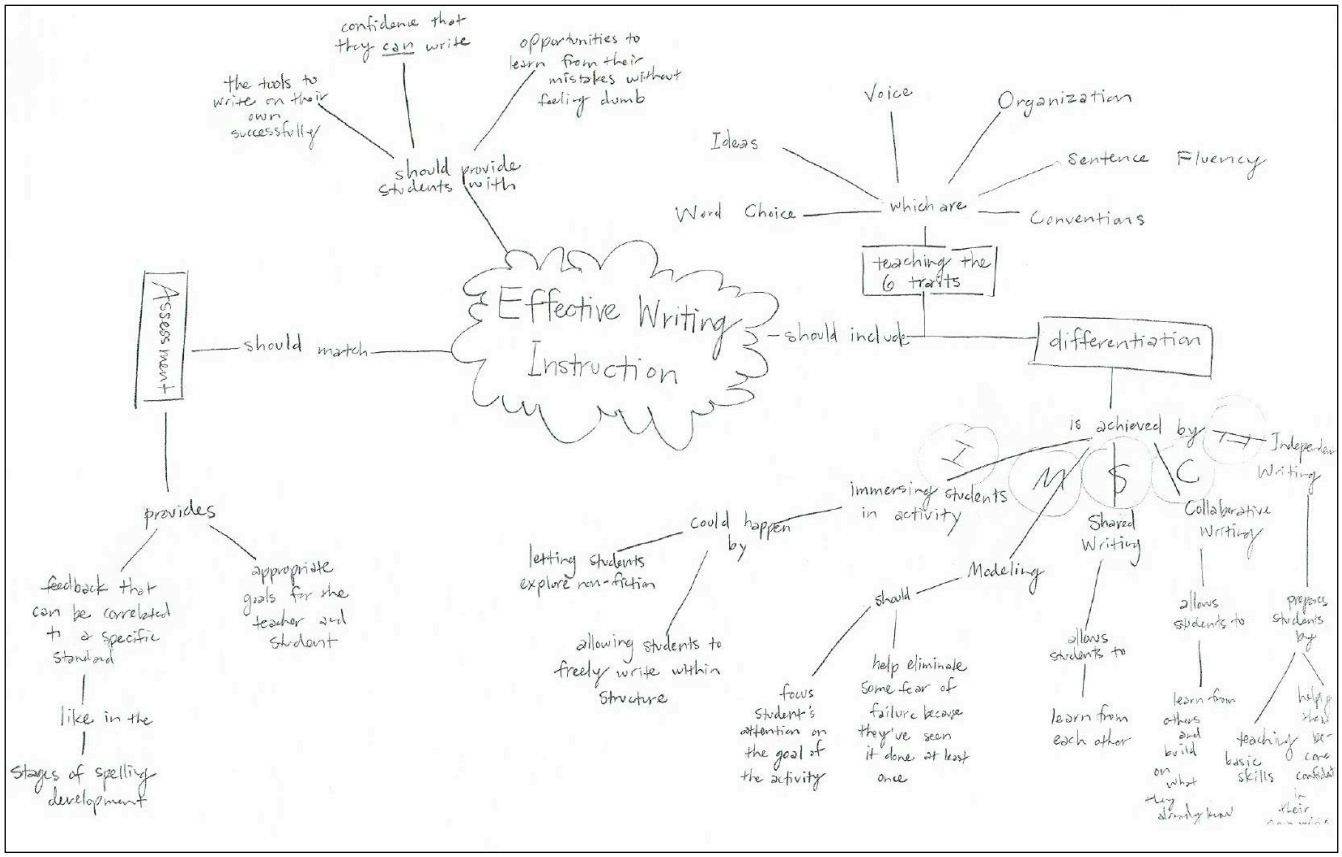

Figure 3: Student's end-of-course concept map.

What happened in this course to bring about changes in students' thinking about effective writing instruction? What learning experiences did the students have? In order to discuss what students experienced in this course, it's necessary to explain the two main foci of my instruction.

The first focus is the theory of the gradual release of responsibility, which I explain to the students using an acronym—IMSCI. "I" stands for immersion; by immersing students in text types or genres and analyzing the features of those genres, students gain the familiarity they need to imagine the goal of a writing task. "M" stands for modeling; the teacher actively models writing the text type or genre and models skills and strategies that are relevant to writing the genre. "S" stands for shared writing; teacher and students co-construct an example of the text type or genre, while incorporating relevant skills and strategies. "C" stands for collaborative; before asking students to try out the text type on their own, an intermediate step is to allow students to try writing the genre with a partner (this step is optional for some genres, such as autobiography). The final "I" stands for independent; once students have had the genre modeled and have participated in shared and/or collaborative writing of the genre, they are more likely to be ready to write in the genre independently. I emphasize, when teaching this model, that even when students are writing collaboratively or independently, they are never left entirely to their own devices. The teacher should be conferencing, offering guidance, answering questions, asking questions, and doing one-on-one or small group reteaching of relevant skills and

strategies. The IMSCI model is a way of conceptualizing gradual release of responsibility (Pearson and Gallagher, 1983) that is specific to writing instruction.

The second focus of my instruction is experiential learning. The students live the experience of writing instruction based on the IMSCI model as I demonstrate how each element of the IMSCI can be used to teach a particular genre of writing and my students actively participate. When I model how to teach a particular prewriting strategy, they try out the strategy for themselves. In this way, my students experience the IMSCI model and reflect on that experience before they teach writing lessons in their practicum at local elementary schools where they teach lessons based on the IMSCI model.

Most of the students' final concept maps included the IMSCI model, though at varying levels of specificity (see Table 1).

Table 1. Inclusion of IMSCI model in final concept maps.

Included IMSCI and elements of IMSCI	Included one or more elements of IMSCI	Mentioned IMSCI, but provided no detail	No mention of IMSCI, no mention of any elements of IMSCI	Total
48	15	5	13	81
59%	19%	6%	16%	

Although I taught the IMSCI model as declarative knowledge, by creating the lived experience for my students, my hope was that they would internalize the IMSCI model. I can see that 84% of the students did internalize the model to some degree, and that 59% of them internalized all elements of the IMSCI model.

Another goal of my class was to ensure that students understood that writing is a non-linear, or recursive, process that involves pre-writing, drafting, revising, editing/proofreading, and publishing. Table 2 shows that 79% of my students included some aspect of the writing process in their final concept map.

Table 2. Inclusion of writing process in final concept maps.

Included all elements of the writing process	Mentions one or more elements of writing process	Mentions writing as a process or "steps"	No mention of writing process or elements of writing process	Total
53	7	4	17	81
65%	9%	5%	21%	

The goal is not, of course, to have students create detailed concepts maps, but rather for students to gain the pedagogical content knowledge they need to be successful teachers of writing. In the future, I plan to use concepts as a learning tool rather than as an assessment of their learning. I plan to have them create maps as a whole-class collaboration, in pairs, and individually. By comparing their maps with those of peers and with mine, students can evaluate their understanding in a low-risk context.

IV. Implications and Recommendations.

Maps are a flexible tool for both learning and assessment. They can be completed in class or as a homework assignment. One can broaden or narrow the scope of the map as needed. For example, I could ask students, while studying the best practices for teaching grammar to improve

writing, to map their knowledge of grammar instruction at the beginning of the unit so that I can assess where students are in their understanding. I could ask them to create another map after they have experienced research-based practices like sentence combining and after reading a position statement on grammar instruction from the National Council of Teachers of English.

Concept mapping can be used in any course or discipline as a way for students to graphically represent their understanding of content. Because concepts are linked with lines and words or short phrases, the cognitive labor is different from writing an essay on the same topic where students must concentrate on organization, sentence structure, and grammatical conventions of writing, as well as on the concepts. A concept map liberates students from the concerns that accompany formal essay writing, allowing them to focus their whole attention on concepts and the relationships between and among those concepts.

While concept maps are used in a variety of disciplines as an assessment device, the configuration of the task varies. In some studies (e.g. Ruiz-Primo, et al., 2001), the researcher provides students with some or all of the concepts, and the students' task is to connect them logically. To examine students' understanding of effective writing instruction, it might be useful to compare a free recall concept map with solicited recall for which certain elements of concept are provided to the students.

It could also be useful to compare the results of concept maps with written essays, both done in response to the same prompt. Research has shown that concept maps aid students' essay writing (Parkes, et al., 2000), but how students use those maps to support their essay writing is unclear. Also, if a student's concept map is complex, will that complexity be reflected in his or her essay? Conversely, can a student write an essay that captures the complexity of the concepts if his or her concept map is not complex?

V. Conclusions.

The potential of concept mapping as a way to measure student learning has been demonstrated in many disciplines. I was able to validate, using concept maps, that students developed more complex constructions of their knowledge (Kegan, 2000) about effective writing instruction. Students' post-course concept maps showed that pedagogical content knowledge (Shulman, 1987) had become integrated into their understanding of effective writing instruction. Practitioner research of this kind allows us to treat teaching as "community property" (Shulman, 2004), opening the doors of our classrooms so that our teaching methods and forms of assessment can be shared with and critiqued by others.

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