REFLECTIVE PEDAGOGY THROUGH ANALOGY CONSTRUCTION

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Abstract

Because thinking and speech are inherently metaphorical processes, teachers across disciplines have traditionally relied on analogies as explanatory tools in introducing new concepts to their students. In this article, I offer theoretical foundations and research findings in support of analogy-enhanced instruction. Since all analogies are faulty in some respects, I discuss limitations on the classroom use of analogical reasoning, along with effective strategies to counter these difficulties. I also present an applied model of analogy co-construction in which students generate a progressive series of more sophisticated analogies in tandem with constructive feedback from classmates and instructor. I conclude with a description of analogy-based classroom activities arranged in ascending levels of complexity.

Thinking and speech are inherently metaphorical processes (Lakoff & Johnson, 1980). Consequently, our conceptual systems are defined and organized in metaphorical terms. In other words, in everyday practice we understand and experience most concepts in relation to other concepts. The metaphorical basis of our conceptual frameworks is precisely why analogies and metaphors exist as linguistic expressions. For example, imagine the thought processes involved when pioneering computer-software designers were searching for an analogous phrase to capture the essence of boxes on a screen as a user interface. After some deliberation, they arrived at the self-descriptive term *windows* as their metaphorical choice (Kopp, 1998). As another illustration of how the use of metaphor pervades all language and communication, consider some of the opportunities for figurative language (shown below in italics) embedded within the context of the analogy, *Theories are like buildings* (adapted from Lakoff & Johnson, 1980, p. 46):

- What is the *foundation* for your theory?
- Your theory is *constructed* on *shaky* grounds.
- These ideas represent the *framework* for your theory.
- A *supporting* rationale will *buttress* your theory.
- Your theory *collapsed* in the face of contradictory evidence.

Since thinking and speech are interwoven with analogies and metaphors, it should not be surprising that teachers across disciplines have long relied on these language tools to introduce new concepts to their students (Heese, 1966; Thagard, 1992). Sometimes even unwittingly, educators preface their explanations with *Likewise*, *Comparably*, *Just as*, and other such analogous expressions (Glynn, Law, & Doster, 1998). A considerable body of theory, research, and practice has shown that analogy construction holds favorable pedagogical implications (e.g., Glynn, 1991; Mayo, 2001b, 2004b, 2006a; Pittman, 1999; Stadler, 1998; Thorley & Stofflett, 1996; Wong, 1993a, 1993b)

Theoretical Bases for the Pedagogical Use of Analogy Construction

What factors underlie the success of analogical reasoning in the classroom? In the following paragraphs, I outline the theoretical bases for using analogy construction for instructional purposes.

1. Comparing familiar and unfamiliar concepts: Analogies allow students to compare, or *map*, familiar (*analog*) and unfamiliar (*target*) concepts (Kaufman, Patel, & Madger, 1996; Pittman, 1999). In doing so,

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analogies provide an interpretive bridge between pre-existing knowledge and new information (Cyrs, 1994; Glynn, 1995). In a sense, analogies serve a conduit function (Reddy, 1993) in facilitating transfer of learning between old and new conceptualizations. In analogical reasoning, learners first search for similarities between the new information and what is already known, and then formulate a hybrid conceptualization that blends these shared similarities (Wittrock & Alesandrini, 1990).

2. Stimulating creativity and critical thinking: Analogy construction encourages the generative process of knowledge creation and integration (Mayo, 2001b, 2004a, 2006a). It also hones comparison-contrast skills as part of an evaluative process of uncovering the similarities and differences between the analog and target concepts (Mayo, 2001b, 2004a, 2006a).

3. Promoting abstract reasoning: Since all analogies break down somewhere, the cognitive processes inherent in analogy construction promote abstract reasoning more as a means than an end. In generating a steady stream of refined analogies, students act as problem *finders* more so than problem *solvers* (Wong, 1993a). Learners search continuously for ways to improve their abstract conceptualizations, but never achieve the ever-elusive perfect analogy. As an indicator of abstract reasoning, it is important for students to comprehend and articulate the pitfalls of even well-conceived analogies.

4. Enlivening and varying content delivery: Teacher-generated analogies can serve as attention-grabbers. If teachers adeptly incorporate interesting and thought-provoking analogies throughout their classroom presentations, this instructional strategy can go a long way in combating the functional limits of student attention span in lecture-heavy classes (Cyrs, 1994).

5. Simplifying the complex: Analogies are a parsimonious means of communication (Kopp, 1998). In a modicum of words, analogies can express complex ideas and help students more readily conceptualize abstract models.

6. Functioning as advance organizers: Advance organizers provide students with a theoretical foundation upon which to build conceptual understanding (Ausebel, 1977). As an exploratory vehicle, analogies can serve an invaluable function for students who must first visualize a concept before comprehending and internalizing it (Mayo, 2006b).

7. Personalizing course concepts: Consistent with a constructivist educational philosophy, analogy construction permits students to generate new insights on the basis of their life experiences, learning histories, and predilection for discovery (Mayo, 2001b). Introducing personal relevance and meaningfulness into students' learning processes is a robust tool for stimulating conceptual understanding and growth (Clinchy, 1995).

8. Tailoring teaching to fit the needs of the learning environment: Analogies and metaphors exist in diverse forms, just as the needs of learning environments differ widely. Finding an appropriate match between analogy and learning context is vital to the success of analogical reasoning in the classroom (Mayo, 2006b).

Understanding the differences between *literal* and *metaphorical analogies* (Holyoak, 1984) is useful in yoking analogy to learning environment. Literal analogies involve close similarities between the features of the analog and target concepts (e.g., *A wasp's nest is like a mosquito's nest*). These *tightly mapped* analogies require less reflective thinking on the part of students. In contrast, metaphorical analogies invoke comparisons between distinctly different types of information (e.g., *A wasp's nest is like a medieval fortress*). These *loosely mapped* analogies push students to reason more abstractly.

The distinction between *frozen* and *novel metaphors* (Littlemore, 2001) is also an important consideration in the effort to connect figurative language to the learning situation. Frozen metaphors are clichés, such as *sharp as a tack* or *looking like a million bucks*, which are used commonly as part of ordinary language. In contrast, novel metaphors combine ideas in new or unusual ways. From the annals of famous musical lyrics, examples of novel metaphors include Paul Simon's *like a bridge over troubled waters* or Jim Croce's *meaner than a junkyard dog*. Interestingly, although both of these metaphors were unique at the time of their original inception, they have entered the realm of frozen metaphors over time.

9. Serving as diagnostic assessment tools: As a snapshot measure of conceptual understanding at a given moment in time, students may experience a *breakthrough analogy* (Mayo, 2006b) as the sudden coming together of the elements of a problem where no insight into a viable solution had existed previously. Through pre-post analysis, students may also demonstrate dynamically evolving conceptions across time, beginning with a *baseline analogy* (Mayo, 2006b) and moving through a series of revised analogies that move progressively closer to clearer conceptual understanding.

Limitations on the Classroom Use of Analogical Reasoning

Though analogies are generally effective heuristic tools, all analogies are faulty in some respects. As described by Glynn, Law, & Doster (1998), "analogies are like double-edged swords, with the potential of facilitating comprehension and, at the same time, creating misconceptions" (p. 205). If pushed too far, analogies can actually mislead learners. Consequently, instructors must take proactive measures to guard against such confusion. Using the illustrative analogy, *The human eye is like a camera* (Glynn, Russell, & Noah, 1997), when the instructional process turns to the dissimilarities between the analog and target concepts, it should become clear that the human eye and a camera focus is very different ways. Whereas the human eye focuses by using the cornea and the muscles surrounding the lens, a camera is focused by altering the distance between the lens and film. Rather than try to sweep this analogical inconsistency under the carpet, teachers should make their students aware of the point at which this analogy breaks down (Mayo, 2001b; Thagard, 1992).

Another problem associated with the use of analogical reasoning is that poor analogical transfer may occur when students enter the learning situation with a weak knowledge base with respect to the target problem domain. In these instances, learners become *functionally fixed* on the surface details of the analog that are not present in the target problem content (Duncker, 1935/1972). This conclusion has been supported in subsequent educational research and practice (e.g., Gick & Holyoak, 1980).

Brown (1994) and Clement (1993, 1998) demonstrated the effectiveness of *bridging analogies* in countering a learner's limited background knowledge. Bridging analogies are intermediate metaphorical conceptions that form when you divide an analogy into smaller parts that can be more readily mastered. In line with the view of successful *midwife teachers* (Belenky, Clinchy, Goldberger, & Tarule, 1986) who assist students in reflecting on knowledge, classroom educators can employ bridging analogies to clarify comparisons between problem situations that students originally encounter trouble perceiving as analogous.

To remedy some of the problems associated with students' insufficient knowledge structures, Spiro, Feltovich, Coulson, and Anderson (1989) recommended the introduction of *multiple analogies* during instruction. Initially requiring learners to generate an unproductive analogy, and then to evaluate its deficiencies, pushes them in the direction of clarifying and identifying components of more productive analogies (Mayo, 2001a, 2001b, 2004b, 2006a; Wong, 1993a, 1993b). From this perspective, analogy-enhanced instruction can be considered a generative process "where conceptual growth emerges from a continual refinement and synthesis of fragmented, incomplete knowledge" (Wong, 1993b, pp. 1259-1260).

Educational Applications of Generative Analogies

In terms of encouraging analytical thinking about underlying learning principles, I have found analogies to be powerful heuristic tools in my own undergraduate psychology classes. In comparing parallel course sections (analogy-enhanced instruction versus no-analogy control) of life-span developmental psychology, I examined the impact of analogies in teaching conceptual applications of prominent developmental theories (Mayo, 2001b). Although I discovered that those class sections exposed to both teacher- and student-generated analogies outperformed the no-analogy control sections on both quantitative and qualitative measures of comprehension and application of course content, learning gains were more striking when I allowed students to create their own analogies. Based on these findings, I have undertaken investigation into the instructional efficacy of the *co-construction* of analogies involving opportunities for student-student critique and facilitating instructor feedback (Mayo, 2004b, 2006a). From the results of my examination of analogy co-construction in the classroom, I have developed the three-stage *GEM Model of Analogy Co-construction* (Mayo, 2004b, 2006a) that asks students to: (1) *G*enerate original analogies for course principles; (2) *E*valuate these analogies in accordance with constructive feedback from their classmates and instructor; and (3) *M*odify their initial self-generated analogies in light of others' appraisals. This tripartite model mirrors a cyclical process of outgrowing earlier analogies in favor of adopting increasingly more sophisticated conceptualizations. As recorded in a cumulative journal called an *Analogies Log* (Mayo, 2004b, 2006a), students demonstrate ongoing evidence of conceptual growth from an initial self-generated analogy to one or more refined analogies. Appendix A describes the guidelines for completing an Analogies Log as cast in light of the stages of the GEM model.

Realizing that analogy-enhanced instruction engenders its most favorable learning outcomes in cases where students are actively involved in the process of analogy co-construction, I often attempt to draw my students into the dynamics of learning through analogy-based classroom activities. For consideration in the material that follows, I have numerically arranged a series of five activities in general accordance with ascending level of complexity.

Activity #1:

1. Offer a partial analogy to the class (e.g., *Human personality development is like… because….*).
2. Allow students the chance to fill in the blanks.

Activity #2:

1. Hold up an object in class (e.g., *etch-a-sketch*).
2. Ask students to brainstorm about the ways in which the object is similar and dissimilar to the concept being covered (e.g., *tabula rasa*).

Activity #3:

1. Using the name of a well-known scientist, theorist, philosopher, or other person relevant to course content, ask students to personalize an analogy by imagining that they actually are that person in the conduct of his or her work.
2. Probe students on how they might feel being that person relative to contributions to his or her field of study (e.g., *If I was Sigmund Freud, I would feel like… because….*).

Activity #4:

1. Submit a word or term (e.g., *stream of consciousness*) to the class.
2. Ask students to come up with other words that they associate with this target expression.
3. Require students to provide supporting justifications for their responses.
4. Encourage other students to critique the responses of their classmates in order to clarify any tenuous connections.

Activity #5:

1. Provide students with a list of 8-10 terms from a given chapter or unit in your course (e.g., *unconscious, modeling, free will, association, heredity, mental activities, reward, social interaction*).
2. Ask students to draw connections between, among, and across these terms.
3. Encourage students to critique each other's offerings, focusing on the similarities and differences afforded within these relationships.

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APPENDIX A: GUIDELINES FOR COMPLETING AN ANALOGIES LOG IN TERMS OF THE THREE-STAGE GEM MODEL OF ANALOGY CO-CONSTRUCTION

Stage 1: Generate

1. In the context of an ongoing recorded journal called an Analogies Log, each student will formulate one or more analogies for each learning principle by identifying:

   a. salient features of the analog and target concepts;

   b. similarities between the analog and target;

   c. differences between the analog and target (i.e., instances where the analogy breaks down);

   d. appropriate conclusions on the basis of the available information.

   Students will use graphic organization to present their analogies, as illustrated below with the analogy, *The human brain is like a computer*.

Features of Brain (Analog Concept)	Features of Computer (Target Concept)	Similarities	Differences
neurons	circuits	storage	processing
cognition	software	retrieval	

Conclusions: The physical brain is capable of memory storage and retrieval in a manner analogous to the way that the computer relies on its hardware and software to perform similar functions. However, the computer undertakes completely logical operations while processing information, whereas the brain combines pure logic with creativity, emotionality, and intuition as it processes information and acquires knowledge and skills.

Stages 2 and 3: Evaluate and Modify

2. Students will exchange their logs with a minimum of three classmates who will constructively critique each analogy.
3. As deemed necessary, students will either modify their original analogies or offer new analogies in line with the peer feedback. Students will include the names and comments submitted by each classmate, along with supporting rationale for any changes in their analogical reasoning.
4. Students will bring their revised logs to class in order to participate in a teacher-led, whole-class discussion wherein they will share their analogies, critique those of their classmates, and be exposed to facilitating comments offered by the instructor.
5. Students will record feedback from the class discussion that led to any changes in their analogical reasoning.
6. Students will undertake a final revision of the applicable analogies in accordance with the aforementioned feedback. Once again, students will provide supporting rationale for any revisions before submitting their completed logs to the instructor for grading purposes.