Using Visual Metaphors as an Application of Constructivist Theory

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Abstract

This article reviews the natural alignment between constructivist theory and using metaphors to represent complex concepts. The process used for this instructional technique is discussed as it is applied in several higher education classrooms. Varied applications on multiple levels and in multiple content areas are discussed. This strategy requires the use of higher order thinking skills on the part of the student.

Introduction

The constructivist theory of learning is not new. The literature provides more and more discussion of this theory of learning. There has been a parallel proliferation of instructional strategies, activities and instructional guidelines for using constructivist practices in teaching at all levels. What is most critical for teachers or professors is to examine the instructional practices used in the classroom and use a critical eye for evaluating their importance and effect on the successful achievement for all students. The following paper describes such a process for two colleagues at a university in the process of reflection on teaching and learning.

As office mates at Niagara University, we often shared our teaching practice and reflections about classrooms, teaching and learning. As faculty members of the College of Education, we were charged with implementing the college's Conceptual Framework in our teaching practice. The conceptual framework developed for the College in 2007 consisted of three major components, outlined in Figure 1, below:

Figure 1
Conceptual Framework, College of Education, Niagara University

Student-Centering through Constructivist Practice

This orientation is based on the belief that knowledge is created and developed by learners and is influenced by the experiences, values, and multiple identities (e.g., race, class, culture, gender, nationality, exceptionality, language of individuals.) This perspective drives us to place the prior knowledge and experiences of students at the core of our instructional practice and facilitate their development through meaningful exploration. Constructivist practice invites candidates to be active participants in their own development and to view knowledge--in theory and in practice--as fluid social constructions that are made and re-made through reflective interactions with social, cultural, and natural phenomena.

Process-Product

Throughout our programs, we also emphasize that education and counseling are most effective when they acknowledge the interdependence of process and product. These are not opposites; rather they are part of each other as seen, for example, when candidates use a process of critical and creative thought to produce and implement pedagogical approaches or counseling strategies. These outcomes or "products" are themselves parts of processes since they represent points on each candidate's developmental continuum. With this individualized framework for growth, there are multiple paths to effective practice and we encourage educators and counselors to continuously examine and implement a wide range of research-based best practices.

Reflective Practice

Self-assessment, peer-assessment, and critical examination of the efficacy of one's own practice are essential dispositions for all professionals. We believe that reflective practice can be taught in the context of courses that view students as knowledge producers in search of meaning. Pedagogy that poses problems rather than transmits content encourages reflective thinking and doing. Educators and mental health professionals must be reflective and metacognitive themselves in order to encourage these practices in those they serve. We also believe that interaction with current and future practitioners both extends and promotes such reflection.

In our informal discussions of improvement of teaching and learning, we began constructing our own ideas about the use of metaphors in teaching conceptual frameworks in our graduate and undergraduate classes. We were both teaching a similar curriculum course and sharing resources. Through a trial-and-error exchange of ideas we began to formulate a process for providing students the opportunity to be involved with constructivist learning and more specifically the use of visual metaphors through a shared instructional strategy.

This article will provide a brief research foundation in support of the visual metaphors teaching strategy. Student learning benefits will be highlighted as well as the procedural steps for introducing this strategy in the classroom.

Related Research on Constructivism and the Use of Metaphors

Visual metaphors, unlike graphic organizers, are focused on aligning two unrelated processes. Through the alignment students can grasp a greater understanding of newer complex concepts. For example, understanding constructivist learning might be compared to a tree. The earth and roots represent prior knowledge; the sun and rain might be the learning environment including resources, classmates and the instructor. This system working together creates growth or the additional rings in the tree. These rings can then represent brain growth of the learner.

In terms of relating visual metaphors to constructivist theory, the four principles or constructivism listed by Catherine Twomey Fosnot (1989) provide a starting place:

1. Knowledge consists of past constructions.
2. Constructions come about through assimilation and accommodation.
3. Learning is an organic process of invention, rather than a mechanical process of accumulation.
4. Meaningful learning occurs through reflection and resolution of cognitive conflict and, thus, serves to negate earlier, incomplete levels of understanding. (p. 40).

The use of visual metaphors for learning new concepts is supported by Twomey Fosnet's principles. Students use their background knowledge of past constructions of the metaphor and through the processes of assimilation and accommodation connect the metaphor (known, concrete) to the new concept (unknown, abstract). The activity naturally creates a cognitive conflict by pairing seemingly two unrelated systems. In general, the use of visual tools supports students in connecting information as well as discovering the interrelated contents and processes. Visual tools link content and thinking processes. (Hyerle, 1996, p15)

The metaphor process we developed and adapted involved not only the application and exchange of ideas regarding curriculum process among professor, classmates, textbooks and research, but also the integration of students' background knowledge. When groups were in the process of designing their metaphor for curriculum, they used the collective background knowledge of the group consisting of knowledge and

experiences. These ideas were then juxtaposed with the conceptual framework of the curriculum course. By aligning these two arenas, students were involved in constructivist learning.

Using visual metaphors supports and exemplifies the constructivist theory in learning. Constructivist practice transfers responsibility of the learning process to the learner. The learner uses prior knowledge and new information or skills to build new knowledge frameworks, thus "constructing" new knowledge using his or her own blueprints. No two learners construct the same knowledge framework thus making the learning personalized as well as embedded. Using visual metaphors for conceptual frameworks does exactly this. Students use their own background knowledge of a visual system and pair the component parts and processes with the new concept. Again, it is personalized and connected for the individual learner. (Foote, 2001)

Hyerle also states "On a deeper level, the more visual tools are used to express ideas, the more there also may be a shift in how we actually define things. Traditionally, we isolate knowledge to define 'things.' Given visual tools, learners are motivated to seek definitions that are relational, patterned, and context-driven." (Hyerle, 1996, p. 20).

Marzano, Pickering & Pollock (2001) discuss the importance of using dual-coding theory of information by pairing the linguistic form with the imagery form. "The more we use both systems of representation the better able we are to think about and recall knowledge" (p. 73)

Constructivist theory easily applies to the use of visual metaphors as an instructional strategy. The following set of descriptors of constructivist teaching behaviors underscore the use of best practices in teaching in classrooms.

1. Constructivist teachers encourage and accept student autonomy and initiative.
2. Constructivist teachers use raw data and primary sources along with manipulative, interactive, and physical materials

3. When framing tasks, constructivist teachers use cognitive terminology such as “classify,” “analyze,” “predict,” and “create.”
4. Constructivist teachers allow student responses to drive lessons, shift instructional strategies, and alter content.
5. Constructivist teachers inquire about students’ understandings of concepts before sharing their own understandings of those concepts.
6. Constructivist teachers encourage students to engage in dialogue, both with the teacher and with one another.
7. Constructivist teachers encourage student inquiry by asking thoughtful, open-ended questions and encouraging students to ask questions of each other.
8. Constructivist teachers seek elaboration of students’ initial responses.
9. Constructivist teachers engage students in experiences that might engender contradictions to their initial hypotheses and then encourage discussion.
10. Constructivist teachers allow wait time after posing questions.
11. Constructivist teachers provide time for students to construct relationships and create metaphors.
12. Constructivist teachers nurture students’ natural curiosity through frequent use of the learning cycle model.

(Brooks, J. & Brooks, M., 1993, pp. 103-118).

While the above list is applicable to generally strong teaching practices, number 11 is noteworthy to a discussion of visual metaphors. Applying the above principles transfers the learning power from instructor to learner and significantly changes the role of the instructor/teacher.

The teacher becomes a facilitator of learning and actively monitors and adjusts throughout the learning process based on interaction and feedback from learners. Providing learning opportunities for students to construct relationships and create metaphors is key to the strategy described here. The organization of learning opportunities is a fluid process that should be revised and adapted as learners interact with knowledge from the teacher, resources and classmates and create new knowledge frameworks for their learning.

Correlation of Metaphor Strategies with Bloom’s Taxonomy

In addition to the integration of the use of visual metaphors for constructivist theory of teaching and learning students are actively engaged in using all levels of Bloom’s

Taxonomy. (Bloom, et. as., 1956) The taxonomy is a commonly accepted system for understanding the various levels of educators' objectives in teaching, and it continues to be taught routinely in teacher education courses. Table 1 presents an alignment of the ways in which the visual metaphor process aligns with the taxonomy.

Table 1
Correlation of Metaphor Strategies with Bloom's Taxonomy

6 **EVALUATION**: determining the alignment between the metaphor and the new concept (what works, what doesn't); evaluating the success of the alignment; incorporating feedback from classmates for additional labels of parts or processes
5 **SYNTHESIS**: compiling information in a new pattern; understanding of the alignment of the new concept with the metaphor and the transfer of understanding from the known (metaphor) to the unknown (new concept)
4 **ANALYSIS**: aligning the conceptual framework of the new concept with the metaphor; breaking down the parts and processes in both the new concept and the metaphor
3 **APPLICATION**: applying knowledge, facts, techniques and rules in a different setting; taking an unfamiliar or new concept (abstract) and applying to a familiar metaphor (concrete); applying labels from the metaphor to the new concept
2 **COMPREHENSION**: translating information regarding new concept and metaphor; comparing parts and processes of the new concept with the metaphor
1 **KNOWLEDGE**: bringing background and course information together; collecting and acquiring information regarding new concept (including what the student already knows); collecting and acquiring information regarding metaphor (including what the student already knows)

Recent authors (Flynn, et. al., 2010) have suggested that constructivist practices can be viewed as inverting Bloom's Taxonomy, so that the "beginning" levels of analysis and synthesis involve constructivist practices while knowledge and comprehension define the "by-products" of the learning process. Using the shared background knowledge of the learning community and the new concepts introduced by the instructor, learning (or Knowledge) is created through this powerful connection of making visual metaphors.

Using the Metaphor Process in the Classroom

In order to make use of the metaphor-construction process, students must have an understanding of the meaning of metaphors prior to working with the strategy of visual metaphor alignment. Using the example of curriculum design in a course in higher education, an initial activity in the course might involve students using their prior knowledge of curriculum to complete a metaphor comparison statement. An example might be Curriculum is like the sunrise because the more of the sun (curriculum) students see the brighter their knowledge becomes, where the student completes the underlined portion of the statement using his or her own idea. Discussing the various examples from the class allows for more connections and creativity from students. Another student might expand on the previous example by adding that the air gets warmer (increased understanding) as the sun rises.

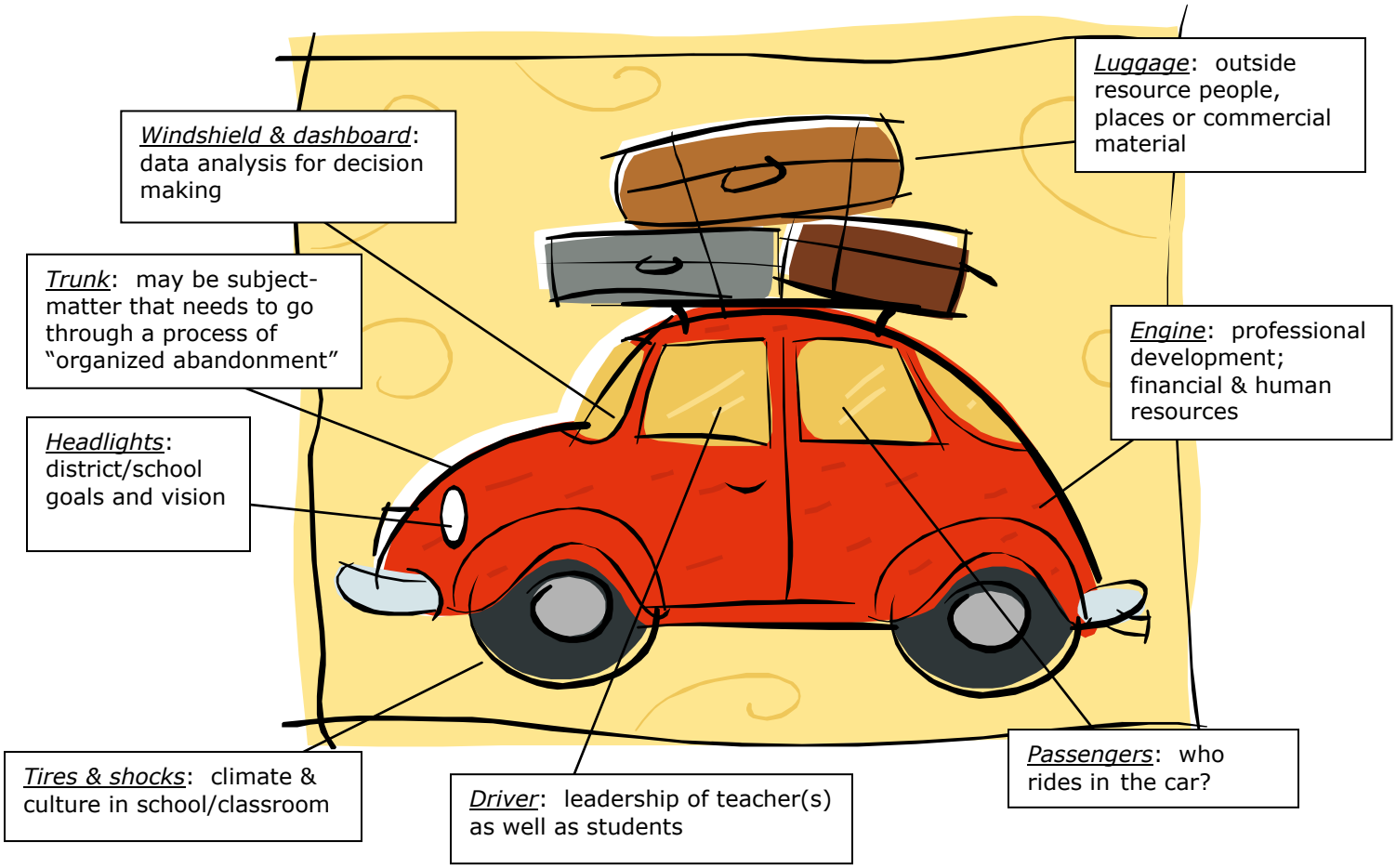
To move into the visual metaphor the instructor shares an example that works with the content of the course. Perhaps a recipe might provide an example where students can identify aspects of the curriculum process with parts of a recipe (i.e. flour and sugar as basic content; mixing and baking parts of the learning environment; etc.). Students would then discuss and list the critical elements of a workable visual metaphor:

- Complex system
- Distinct but related processes within the system
- Features with specific functions

Using a general concept to be taught, instructors should ask students to work individually or in groups to come up with a visual metaphor to represent the concept. The metaphors are then shared and discussed with the entire class. Students are encouraged to ask questions about the various visual representations and make suggestions and predictions on how the representation might incorporate other aspects of the concept.

For example in teaching the complexity of the curriculum process in courses in a college of education, students might select a car for their metaphor. The car would be labeled as in Figure 2, below:

Figure 2
Visual Metaphor for the Curriculum Process



Additional information would include the analysis of subsystems, i.e. engine (role of carburetor, sparkplugs, radiator, etc). The engine could easily represent systems thinking in terms of the curriculum process in the district.

Adaptations of the Metaphor Activity

The authors have experimented with a variety of adaptations for the metaphor strategy:

- Have students create the visual after introduction of concept framework
- Have students revisit the visual metaphor after the course is over and add, edit, subtract, replace the visual to better represent the concept
- Use icebreaker for individuals to complete the sentence "(The concept) is like ____ because _____.") to generate ideas

- Use student visual metaphors to teach new aspects or elaborations of the general concepts demonstrating connections to the main idea
- Have other students find applications of the visual metaphor to the concept

Evaluation of Metaphor Projects

Visual Metaphors can also be used to assess and/or evaluate student learning. The rubric in Table 2 has been used by the authors for evaluating the student/group's final project. The key components focus on the alignments in terms of labels and processes.

Table 2
Rubric for Evaluation of Metaphor Projects

	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
VOCABULARY/DETAILS	Metaphor lacks labels or parallel of parts and functions	Metaphor has parts labeled (<7) and/or not all parts are parallel in function	Metaphor has parts labeled 7-10 that parallel the parts of the concept in function	Metaphor has parts labeled (10+) that parallel the parts of the concept in function
PROCESSES	Metaphor does not represent any processes of the new concept	Metaphor represents processes (<3) at a basic level	Metaphor represents processes (3+) at an advanced level	Metaphor represents processes (3+) at advanced level using systems & subsystems
REPRESENTATION	Metaphor is disorganized and incomplete	Metaphor is somewhat organized but not fully developed	Metaphor is organized and complete	Metaphor is well organized and demonstrates parts and processes clearly

Benefits of the Metaphor Process

The authors believe that there are many reasons why this activity works so well for students in understanding a new complex concept or system. Some of the possible benefits include that the process:

- Uses all levels of Bloom's Taxonomy
- Respects diversity
- Provides choice with unlimited visuals; equalizes the playing field
- Promotes constructivist process

- Engages prior knowledge
- Connects the new to old
- Moves from concrete to abstract
- Connects linguistics and imagery
- Personalizes learning
- Connects concepts with visuals
- Provides easy access to new conceptual frameworks
- Demonstrates relationships within conceptual
- Differentiates for learners' strengths
- Models a teaching strategy for students in education fields
- Integrates creativity

Student Feedback on the Metaphor Process

Students have used a variety of concrete examples to create metaphors for more complex, abstract concepts or systems. Just a few examples include a maze, the story of the three little pigs, an aquarium, white water rafting, a garden, and an art pallet. These are just a few of the visuals used by students.

Students stated that visual metaphors like the car (and its many intricate systems) really can be a metaphor for many systems. It can be helpful as reference point for even the most complicated concept. People use metaphors in conversation but the visuals, when viewed during the study of new material, can be the graphic organizers that help place new information into a familiar framework, i.e., a useful tool for any classroom.

Students commented that by visualizing a familiar concept, they can make parallels and connections to help them organize new information. By making connections between familiar and unfamiliar, or new material, it becomes clearer and easier to understand.

Summary

The use of metaphors helps in comparing familiar aspects of something tangible with a more complex and unfamiliar concept. Using metaphors can personalize learning and understanding as well as stimulate creative thinking. A visual metaphor can help represent conceptual systems and the intricate relationships among subsystems of the concept.

Instructors should be aware of the learning curve as it applies to this strategy. Students may not be able to identify complex examples at first. However, when provided an example and an opportunity to share and discuss the examples from classmates, students can begin to expand their analysis from basic labeling of parts to a higher level of understanding.

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