How graphic organizers, dish detergent, water, electric beaters, bowls, soap foam and a Professor… helped prospective teachers learn Constructivism

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Abstract

Graphic organizers and inquiry-based instruction provide increased opportunities for student engagement and promote increased student achievement. They help teachers to move from being transmitters of knowledge to designers and facilitators of activities and assignments that foster the constriction of knowledge.

Introduction

Because learning happens best when learners acquire new concepts and information, while engaged in authentic tasks which require the application of using problem-solving and critical thinking (Flynn, Mesibov, Vermette, & Smith, 2004), constructivism can and should be applied to the development of the learning environments of our teacher education students. Constructivist educators present real-world environments that employ the context in which learning is relevant. It helps to give students a better understanding of the material they are learning and allows teachers to add experience into the curriculum (Cowden, DeMartin, & Lutey, 2006). They then focus on realistic approaches to solving real-world problems.

If, as constructivists, we believe that learning happens when learners construct knowledge by integrating prior knowledge with new information (Flynn, Mesibov, Vermette, & Smith, 2004), then constructivist-based practices such as those described in this article (i.e., graphic organizers AND inquiry-based activities) can help prepare prospective educators to provide constructivist-based instruction in their own classrooms in the future.

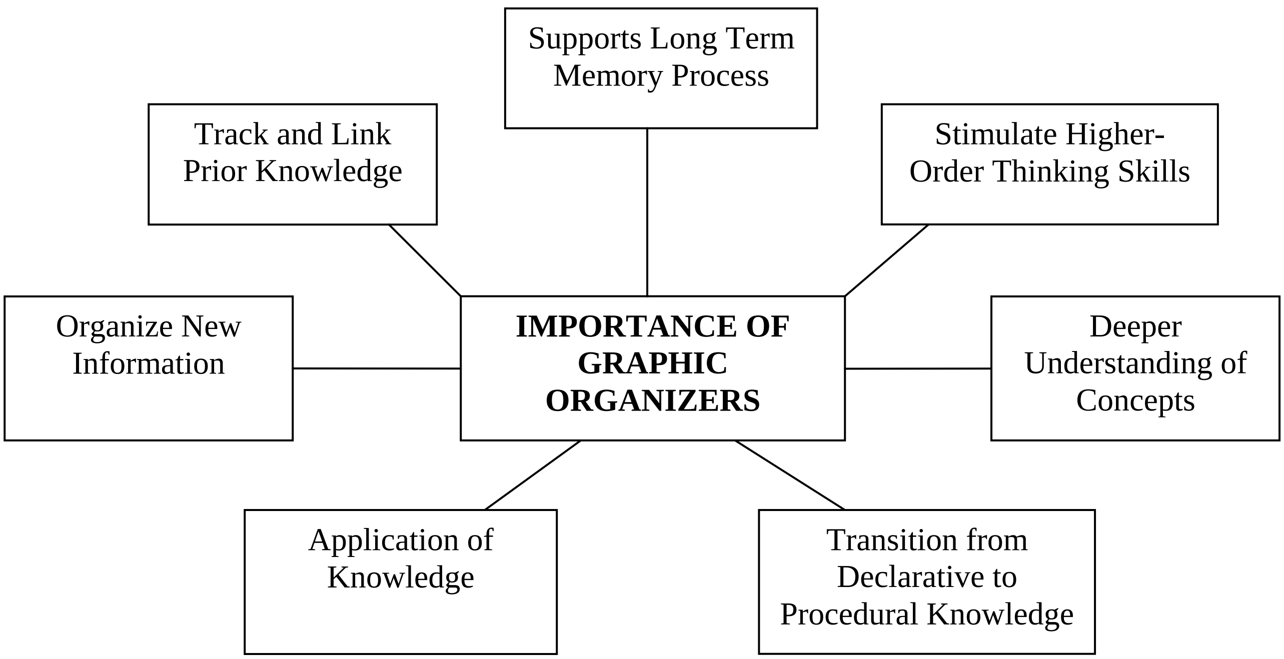
While professors need to lecture on the merits of constructivism, they also need to model constructivist practices in their classes. Because the authors have 'bought into' the constructivist philosophy, it is essential that we conduct our own teaching using strategies aligned with it. Our lessons need to reflect and be part of the real world of the constructivist classroom.

Teaching includes the activities carefully selected by the teacher that help students learn. Curriculum developers must be aware of the kinds of teaching that will help facilitate the achievement of the program goals and objectives (Brown, 1995). A variety of teaching strategies such as graphic organizers and inquiry based learning are needed to ensure that all students have an equal opportunity for learning despite learner differences such as learning styles and strategies.

Graphic Organizers

Scholars such as Jean Piaget (1954) and John Dewey (1944) emphasized the importance of active learning on the part of the students. Research at different academic levels and with different types of populations has consistently shown that graphic organizers encourage students to become actively engaged during the discussion of key concepts, help them evaluate and organize new knowledge, encourage divergent thinking, and stimulate higher-order thinking skills. As an example, Figure 1 presents a graphic organizer demonstrating the importance of graphic organizers to the teaching/learning environment.

Figure 1.
Importance of Graphic Organizers



Used, properly, graphic organizers can be included within a constructivist perspective that places responsibility on students to take charge of their learning experiences. In this approach, teachers are not viewed as transmitters of knowledge, but rather as designers of activities and assignments that foster the construction of knowledge (Fosnot, 1996; Glaserfeld, 1996). Graphic organizers are among the activities that research has shown help students link newly acquired information to prior knowledge forming complex, organized networks of conceptual understanding (Baker & Piburn, 1997; Jonassen et at., 1999).

For over a decade, the authors have been using graphic organizers with elementary, high school, and college students as tools to help them connect newly acquired information to previous knowledge using verbal and visual language. We have found that it helps students to incorporate knowledge into existing schemata, which provides them with a useful transition from declarative knowledge – i.e., things we know – to procedural knowledge – i.e., things we know how to do. (Anderson, 1976; Marzano, 1998) A number of researchers (e.g., Ritchie & Gimenez, 1995) have found that the webbing of ideas created by structural knowledge (i.e., well-organized schemata) supports the development of procedural knowledge. It allows students to understand the relationship between ideas in a visual way (Sze, 2004). And, since graphic organizers require that students elaborate, classify, organize, connect, and own the information, they can more easily retrieve the newly acquired knowledge at a later point. In other words, because information stays in working memory for a longer period of time as students make connections among concepts, the use of graphic organizers supports the long-term memory process. Graphic organizers require students to make connections and the making of connecting requires the information to stay in the working memory for long periods of time. When information is kept in the working memory for long periods of time it supports long-term memory.

At the college level, we have been using hierarchical, conceptual, sequential, evaluative, relational, and cyclical graphic organizers to teach different theoretical contents. When a faculty member selects a graphic organizer, she bases her selection on the curriculum content to be taught, the learning objectives associated with it, and the kind of knowledge that she wants her students to develop (i.e., declarative and/or procedural). After analyzing the type of curriculum content to be taught vis-à-vis the learning objectives, the professor determines whether the development of schemata entails finding hierarchical relationships among concepts, sequencing steps to reach a final point, identifying similarities and differences between two or more concepts, recognizing cause-and-effect relationships, etc. If the learning objectives further suggest a passage from declarative to procedural knowledge, specific instructions are developed to help the students use the graphic organizers to develop mental structures that are transferred to procedural knowledge. It is important to assure that students have opportunity to work with others to develop graphic organizers. That way, if some students have difficulty with spatial relations, others can help them to understand a "graphic organizer" more easily. Students create graphic organizers in small groups, which allows misconceptions to become exposed and, therefore, easier to incorporate into an interactive effort to co-construct knowledge.

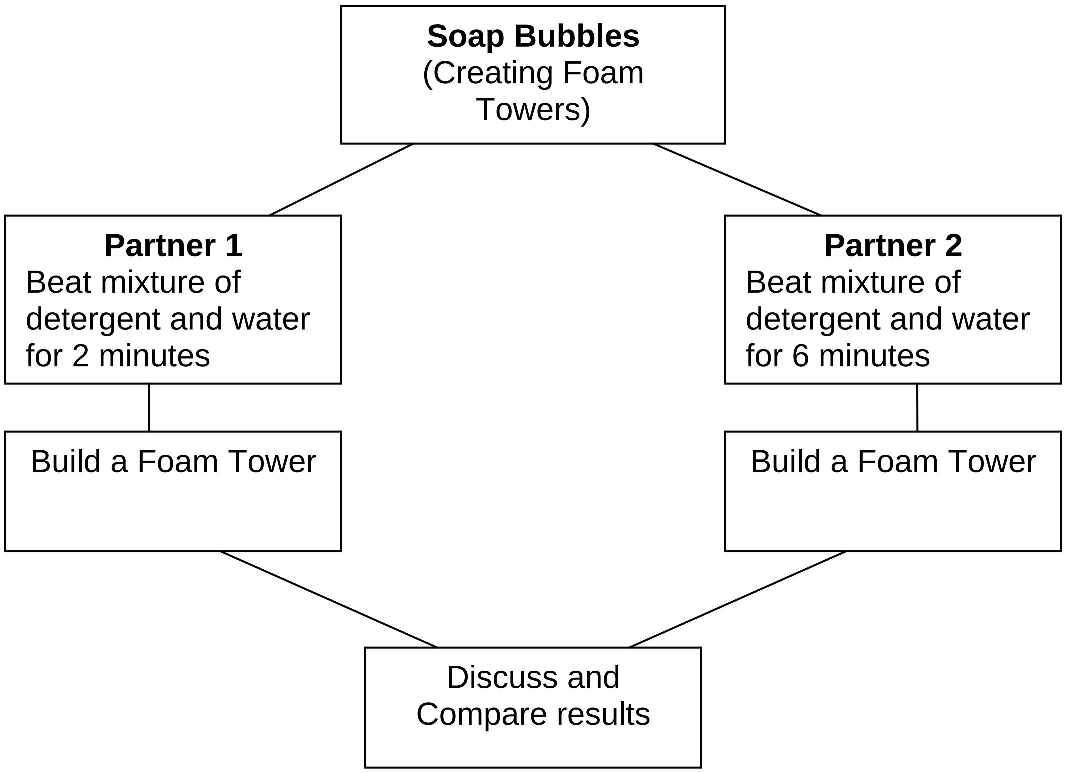
As students build these visual representations of their mental schemata, conceptual misconceptions become explicit and, therefore, easier to incorporate into an interactive effort to co-construct knowledge. In this process, assumptions are challenged and students are forced to explain and support their mental webbing of ideas, which leads to a deeper understanding of how concepts are interrelated. When students externalize their ideas to other students in this manner, a simple assimilation of isolated components in a static scheme is no longer possible. Students see the need to accommodate their existing structures in order to develop meaningful knowledge that can be efficiently applied to the solution of relevant problems.

Inquiry-Based Activities

Do students in a learning community co-construct knowledge? Do students engaged in inquiry-based activities co-construct knowledge? Socio-cognitive theory assumes they do. Research suggests that through inquiry-based learning, dialogue, and active participation, learning communities provide rich environments for individuals' construction of knowledge (Cole, 1996; Cole, et.al., 1997; Herrenkohl, et. al., 1999; Mercer, 2000; Rogoff 2003; Rogoff, Turkanis & Bartlett, 2001; Wells, 1999).

Most teacher candidates lack experience in inquiry-based learning (Rankin, 1999). Because they lack this experience, we introduce prospective teachers to inquiry-based learning in three laboratory activities, moving from the more familiar "directed exploration" (soap foam), to "challenging exploration" (birdhouses), and finally to "open-ended exploration" (discovery box). Figure 2 presents a graphic organizer for the first of these three activities.

Figure 2.
Soap Bubble Activity



Directed Exploration

First, teacher candidates work together in a directed exploration. Given dish detergent, water, electric beaters, bowls, and a set of instructions, pairs make soap foam. One person beats the detergent and water mixture for two minutes; the other for six minutes. Each student builds a foam tower, and then they compare the size of the bubbles, as well as the strength and height of the tower. Students discuss the topic twice: once when they set up the exploration, and again at the end when they compare results. Between times, as they beat their mixtures, they chat about unrelated topics. Throughout the process, the professor acts as a facilitator to guide them in their discussion of the multiple variables that may have made the difference between the two directed explorations. The goal is to use active problem-solving and critical thinking skills to understand that there can be many factors that affect an outcome, thus demonstrating the importance of this active learning concept.

Challenging Exploration

Following the directed activity, teacher candidates take part in a more challenging exploration: the design and construction of birdhouses. Students are given an information handout that includes the dimensions of various birdhouses. Located in small groups, each student in the group chooses a different birdhouse. To complete the first part of the task, students use measurements from the handout to draw a design of a birdhouse on graph paper. The design must show different views of the birdhouse, e.g., front view, back, sides, top, etc. Some students jump right in, glancing back and forth between the handout and the paper. These students pore over their designs, engrossed in drawing the diagram and in writing directions on how to construct the birdhouse. Other students begin to draw, stop, look around at what others are doing, start again, look again, etc. Yet others look to the teacher imploringly, turn to their neighbors for help, or give up. Mini “teaching” stations pop up around the room as students from one group go to another table for help, for reassurance, or to take part in topic-related discussions.

Open-Ended Exploration

A number of class periods later, the students move to the final type of exploration: an open-ended task. In open-ended tasks, they are given neither the final product nor the process. For the first exploratory activity, each student brings in a discovery box he or she assembled for one science topic: that is, a box with many materials on one topic, but no instructions. One student, for example, may bring in a box on pulleys and gears. It could be filled with children's non-fiction books on pulleys and gears, different sized rulers, pencils, weights, string, hooks, buckets, pulleys, clamps, and ropes.

In small groups, students take turns "playing" with one another's discovery box. Some students may appear to love the freedom, while others look around the room asking, "What are we supposed to do?" The teacher facilitates those few students who have not yet started. The usual cry is one of anxiety over the lack of instructions. To get them started, the teacher may choose something out of the box and ask a leading question such as, "What might you do with this?" The teacher continues to pull things out of the box until students have a few ideas they are eager to pursue. Before long, the room becomes very lively with exchanges like, "Look at this! It makes little hexagons." "That's funny. Why was that one stronger?" "It tasted bitter on the sides of my tongue. Where did you taste it?" When the teacher tells students it's time to put the boxes away, they almost always groan and ask if they can continue just a little longer.

Outcomes of Inquiry Based Activities

As suggested, directed, challenging, and open-ended explorations can generate progressively higher levels of cooperation and inquiry, helping prospective teachers to understand the importance of inquiry-based activities in their own teaching. During the directed exploration, the room remains relatively quiet except for the hum of beaters or the occasional discussion centered either on how to do the task or on some unrelated topic. When the assigned task is completed, students lose interest. This type of activity helps students deal with early feelings of apprehension and brings them to a higher level of engagement and discussion than would have otherwise been afforded by other more traditional means. The directed exploration, though low on cooperation and inquiry, gives students a measure of confidence in dealing with slightly unstructured environments, and these experiences enable them to move from an area of low discomfort to one of more challenging exploration.

During challenging exploration, students work both alone and in the midst of a group. The intergroup and intragroup talk may deal with such things as explaining mathematical concepts and procedures, encouraging one another, or giving positive feedback. Challenging exploration demands that concepts be discussed in the context of needing those concepts to complete the task. In the midst of dialogue and active exploration, both those students needing help and those giving help appear to increase in subject matter knowledge. Feelings of enthusiasm and of overcoming initial difficulties appear to give students the dispositions, knowledge, and skills needed to handle more Ill-defined, open-ended exploration.

After some initial confusion during open-ended exploration, the classroom can buzz with lively activity and keen interest. One experiment leads to other inquiries, and students' conversations focus on authentic questions, on comparing results, and on engaging in further exploration.

Directed activities focus on specific expectations, and as a result they often limit students' discussions and learning. Challenging activities leave the process undefined, which inspires students to raise questions and generate dialogue to meet the need for clarification. The highest level of inquiry, open-ended explorations, may initially raise feelings of anxiety. However, if supported with prior, less demanding explorations, these activities free students to follow more demanding, personally significant avenues of inquiry. In the process from directed to challenging to open-ended inquiry, students develop the supportive environment they need to co-construct knowledge.

The overall goal of the activities is to helped the prospective teachers to see the connection between these inquiry-based activities and how students learn. This active learning process gives them a hands-on perspective regarding the importance of creating dynamic classroom teaching environments within in a milieu of constructivist learning. The secondary goal is that prospective teachers observe a professor modeling the constructivist perspective rather than "preaching" about strategies.

Conclusion

All of the activities described in this article (i.e., graphic organizers and inquiry-based activities) help prepare prospective educators to provide constructivist-based instruction in their own classrooms in the future. Graphic organizers encourage students to become actively engaged during the discussion of key concepts, help them evaluate and organize new knowledge, encourage divergent thinking, and stimulate higher-order thinking skills. They can be included within a constructivist perspective as they help students link newly acquired information to prior knowledge forming complex, organized networks of conceptual understanding. Inquiry-based learning helps to create active learning communities where dialogue and active participation occurs in the rich constructivist perspective. The outcomes of activities based on both of these concepts are rich environments for individuals' construction of knowledge. Professors need to create learning environments such as these for their teacher candidates, emphasizing constructivist approaches both through the use of graphic organizers and through active-learning explorations.

It is essential that the candidates are not lectured about the importance of these concepts but instead actually experience them in constructivist learning environments created by professors who actively model their belief in this learning theory. We need to have prospective teachers experience the differences among directed exploration, challenging exploration, and open-ended exploration to have them reflect on the effectiveness of the open-ended, inquiry–based constructivist learning. The dilemma for the classroom teacher is to ensure they have an impact on their students and still be standards-directed and standards-based.

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