Kim Miller, Barbara Morgan STEM Academy, Meridian, Idaho

Summary

Topics: Science, Complex Systems, Early Elementary

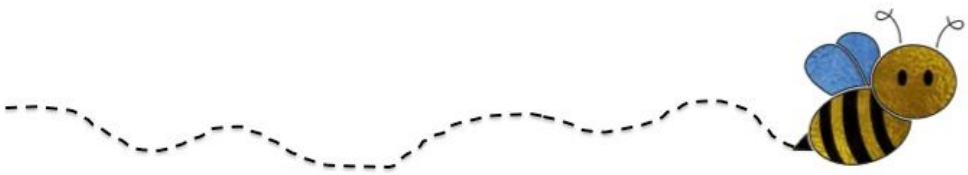
Foundational knowledge for many Science concepts is understanding how systems work. This paper shows how young children can learn about systems in the context of honeybees collecting nectar by combining resources, drawings, simulations, and skits.

Background

Researchers sought to study the effects on learning the structures, behaviors and functions within a system when using drawings, simulations and active play (Danish, 2014, p.3). Students in a Kindergarten and First grade classroom explored a unit of study on honeybees. In addition to books, videos and other classroom resources, students were asked to participate in individual and group drawings. The drawings helped students to focus on the structures and behaviors of honeybees. Through writing skits and participating in group play games they were able to actively demonstrate their level of understanding of structures, behavior, and function for individual bees. A final component was to use a simulation game, BeeSign, to observe bee behavior, make predictions, and design simple experiments from which they could draw conclusions. Using this simulation, the students were able to connect the behaviors to functions for the entire hive.

Research Design

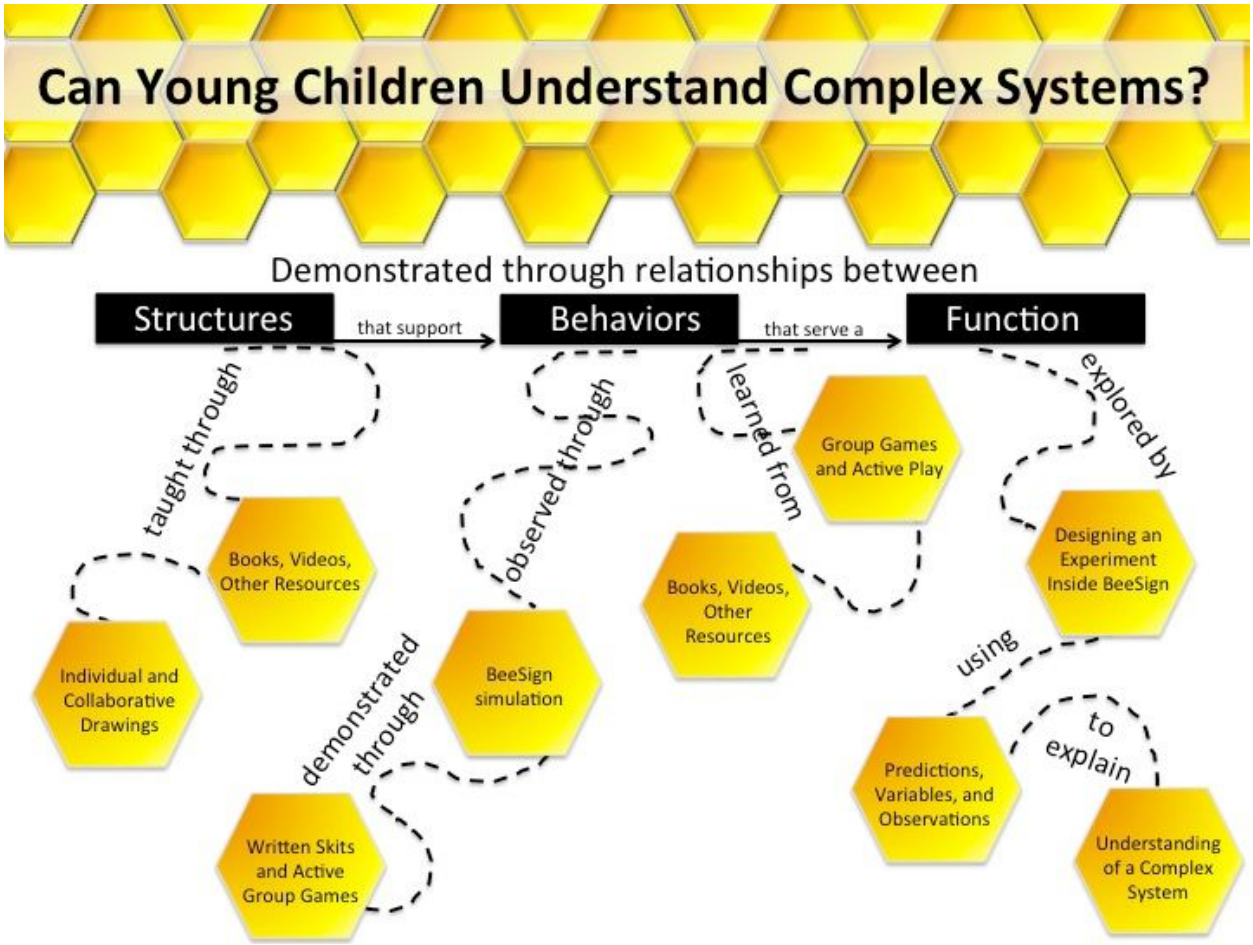
This was a design experiment where all 42 students participated in a 10-session honeybee systems curricula. During the unit students rotated through activities including reading about bees, drawing bees, creating and enacting skits, and engaging in inquiry with the BeeSign software. Students also engaged in a pre- and post-test interview to measure learning gains. The interview results were coded for the presence of structure, behavior, and function concepts so that changes in each could be measured.



Findings

Researchers found that primary aged students are able to understand complex systems (Danish, 2014, p.24). Students were taught structures through books, videos, resources and drawings. The students participated in both individual and collaborative drawing times. They were able to modify their drawings based upon new learning, and show evidence of learning. Students were taught behaviors within the system through information provided from books, videos and resources. In addition, they observed a simulation of bee activity collecting pollen and returning to the hive to make honey. Following the simulation, students wrote skits supported with storyboards to reflect the observed behaviors of the bees. Students then participated in group games using active play, and acted out bee behaviors.

The simulation game, BeeSign, also allowed students to design simple experiments where they could experience inquiry learning by predicting bee behavior, and then observing and explaining observed effects in the simulation. Through modifying and observing bee behaviors in the simulation game, students were able to learn and understand how behaviors serve a function within a system.



Learning was measured using coded rating scales. Student responses were assessed for understanding at the beginning of the unit and again at the completion. Results showed that measurable learning occurred with student understanding of structures, behaviors, and functions within a system. (Danish, 2014, p.24). Learning at the function level was particularly valuable as this is often elusive for students. The research also indicates that a focus on those structures that support specific behaviors was noted by students, and valuable for them connecting across levels. Students were able to identify the behavior of bees dancing and the influence on the success of the hive to find more nectar. For example:

> "It (the dance) makes them get more nectar. Because if they don't dance, all the bees would still be looking for it. And when one of them finds it, it won't dance so it will just go back. And that one [point at the dancing side of the board] tells [bees] so that more [bees] will go." (Danish, 2014, p.40).

The verbal explanation from the student demonstrates an understanding of how structures and behaviors serve a function within a system.

Implications

Implications from this research are that young students can be taught and understand foundational knowledge of systems. Understanding the relationship between structure, behavior and function in a beehive may also assist students in drawing generalizations about systems in other areas of Science. Understanding how behavior of an individual bee affects the function of the beehive could have implications for helping young students understand the effects their individual behavior may have on the function of a classroom community. Using simulations and active play in addition to traditional resources of books, videos and other materials creates a deeper understanding for students. Each form of representation (drawings, skits, the simulation) helped the students to focus on different dimensions of the system, suggesting that the combination is quite powerful.

Source

Danish, J. A. (2014). Applying an Activity Theory Lens to Designing Instruction for Learning About the Structure, Behavior, and Function of a Honeybee System. Journal of the Learning Sciences, 23(2), 1-49. doi:10.1080/10508406.2013.856793

Additional Resources

- The BeeSign simulation: http://www.joshuadanish.com/beesign/
- Embodied play with bees: http://stemforall2016.videohall.com/presentations/726
- NetLogo: https://ccl.northwestern.edu/netlogo/
- Bee Dance (Waggle Dance): https://www.youtube.com/watch?v=-7ijI-g4jHg