Designing Digital Phenomenaria: The Bee Dance

Tom Moher*, David Haas, Janet Kim, Andrew Johnson
University of Illinois at Chicago

Abstract

Third- and sixth-grade students used a graphical simulation of the honeybee dance presented on a plasma panel deployed for several weeks in the corner of their classrooms. Among third graders, acceptance was hindered by discrepancies between the representation of phenomena in the simulation and students' prior knowledge of those phenomena. Sixth graders were forgiving of fidelity limitations, but experienced delays in learning due to their imposition of a "video game" interpretation of the activity.

1 Introduction

Perkins [1992] defines *phenomenaria* as classroom areas where phenomena are made available for children to observe and manipulate. Common elementary school phenomenaria—such as ant farms, aquaria, and gerbil cages—provide access to phenomena that do not naturally occur in the classroom, are continuously available over extended time periods, serve as a locus for small group discourse, and afford discovery through observation. Like physical phenomenaria, computer simulations and microworlds extend the potential range of accessible phenomena, but are typically available only at scheduled times, are used by individuals rather than groups, and focus on experimental manipulation [de Jong *et al.* 1999].

In this project, we designed a first-person simulation of the *waggle* dance that honeybees use to communicate the location of food sources to their hive mates [von Frisch, 1967], and deployed it much the same fashion as conventional phenomenaria (Fig. 1). The application presented two bees in a sparse virtual field; one bee danced while another watches, and when the user signals, the watcher bee flew to the flower identified in the dance and gathered simulated pollen. Upon return, a new dance (with a new destination) commenced. Like the bees, users could also "fly" about the virtual space using a 3-D joystick. The simulation was presented on a 54" plasma display situated in the corner of the classroom, ran continuously for several weeks, and required close observation rather than manipulation [Moher *et al.* 2000]. Our goal was not to study student learning, *per se*, but rather to uncover patterns in the way that students interpreted and interacted with the system.

2 Experience

The bee dance was deployed in third and sixth grade elementary school classrooms for periods of 4-8 weeks. In order to more closely approximate natural phenomenaria, the system was installed without drawing students' attention to the nominal task of decoding the dance; the children were simply told to observe carefully and to see if they could uncover a mystery contained within the simulation. In order to trace the process of interpretation, we continuously videotaped student interaction using a ceiling-mounted camera, and asked students to write frequently about their questions, observations, and degree of interest in the activity. These artifacts were then reviewed for evidence of usage and interpretation patterns.

Figure 1. Students interacting with the Bee Dance system.

In the case of the sixth graders, prior experience with computer games delayed acceptance of the simulation as a representation of natural phenomena, and caused students to adopt strategies designed to uncover arbitrary game-like rule sets. At the same time, the Bee Dance's surface resemblance to a computer game had the positive effect of sustaining interest in spite of the sparse set of affordances in the environment. This provided other students, less interested in games, needed time to reflect on the activity and construct an interpretation that brought it into their domain of interest and knowledge. Social interaction among these groups led in the end to a shared understanding of the waggle dance syntax and semantics across the class, as well as a positive view of the experience. (On the Likert scale, enjoyment rose from 2.6/7 to 6/7 over the course of the unit.)

Third graders lacked both the domain knowledge and game experience that might have given them the patience to work through the interpretive process. They were more inclined to accept the simulation as nature from the outset, but their highly literal interpretations worked to orient their inquiry toward the identification of discrepancies in fidelity. Intervention by the teacher, even to the extent of explicitly articulating the task of decoding the dance and strongly encouraging investigation, could not overcome developmental limitations.

References

VON FRISCH, KARL. 1967. *The Dance Language and Orientation of Bees*, Harvard University Press.

DE JONG, T. DE, VAN JOOLINGEN, W.R., SWAAK, J., VEERMANS, K., LIMBACH, R., KING, S., AND GUREGHIAN, D. 1999. Self-directed learning in simulation-based discovery environments, *Journal of Computer Assisted Learning 14*, 235-246.

MOHER, T., JOHNSON, A., CHO, Y., AND LIN, Y. 2000. Observation-based Inquiry in a Virtual Ambient Environment, *Proceedings ICLS 2000*, Erlbaum, 238-245.

PERKINS, D. 1991. Technology meets constructivism: Do they make a marriage? *Educational Technology 31*(5), 18-23.

* e-mail: moher@uic.edu