Hmelo-Silver, C., Sinha, S., Gray, S., Jordan, R., Honwad, S., Rugaber, S., Vattam, S., Goel, A., Ford, W., & Schmidt, C. (2010) Appropriating Conceptual Representations: A Case of Transfer of in Middle School Science Teacher. Presented to the Annual Conference of the National Association for Research in Science Teaching, Philadelphia, March 2010.

APPROPRIATING CONCEPTUAL REPRESENTATIONS: A CASE OF TRANSFER IN A MIDDLE SCHOOL SCIENCE TEACHER

Cindy E. Hmelo Silver, Suparna Sinha, Steven Gray, Rebecca Jordan, Sameer Honwad, *Rutgers University*
Spencer Rugaber, Swaroop Vattam, Ashok Goel, *Georgia Institute of Technology*
Wendy Ford, Casey Schmidt, *Linwood Middle School*

Abstract

This paper presents a case study in which a middle school science teacher modifies her classroom instruction and teaching materials using the Structure, Behavior, and Function (SBF) representational framework to transfer her reasoning about one natural system (an aquarium ecosystem) to another natural system (human cells and body systems).

Background

❖Understanding complex systems is a difficult but important component of scientific literacy (Sabelli, 2006).

❖SBF is a conceptual representation for reasoning about multiple complex systems.
- What: structure
- How: behavior
- Why: function.

❖Two lenses for studying transfer
-Actor-oriented approach: traces trajectories adopted by the learner to see similarities between two situations (Lobato, 2006).

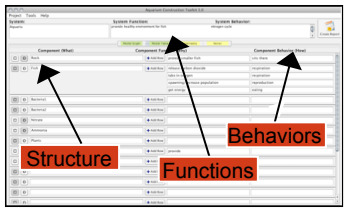
-Preparation for Future Learning (PFL; Bransford & Schwartz, 1999) identifies experiences that prompt learner to transfer understanding.

❖Research questions:
- Why did the teacher, Ms. Y. transfer her understanding of SBF to new instructional domains?
-How did she transfer these understandings?

Instructional Context

Middle school science teacher in technology enhanced aquarium ecosystem unit
❖Reptools toolkit
-Function-oriented hypermedia
-NetLogo computer simulations
(Wilensky & Reisman, 2006)

❖Aquarium Creation Tool (ACT) (Goel et al, 2009)
Modeling tool that makes SBF representation salient.



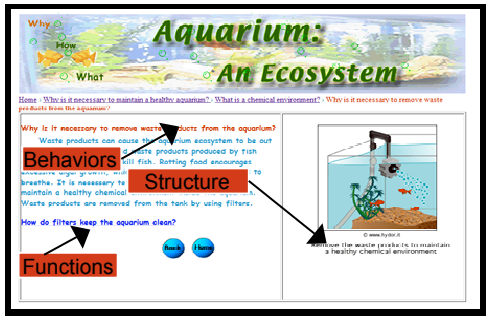
ACT Table View

Methodology

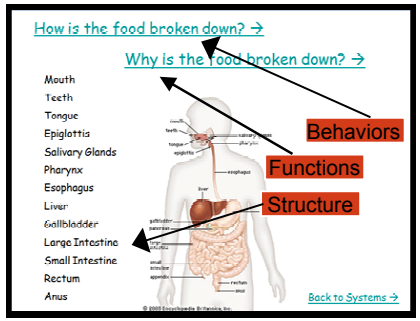
❖Participants
Middle school teacher, Ms. Y and Ms. T.

❖Data Sources:
-Teacher interviews
-Video recording of classroom instruction

❖Interaction Analysis (Jordan & Henderson, 1995) of video clips of Ms. Y introducing the SBF concept within the aquarium unit and cellular systems within the human body.



Researcher created hypermedia



Teacher created hypermedia

Findings

❖TEACHER CREATED HYPERMEDIA
Ms. Y's hypermedia on the digestive system outlines the different structures in the system along with leading 'why' and 'how' questions.

❖ INTERVIEW DATA
Identifying similarities through SBF lens
Interview highlights instances of Ms Y's understanding that structures in the digestive system may have multiple behaviors and functions.

Ms. Y: So, what we were thinking about is … they don't get that the food has to go to the cells and the cell actually …creates energy from this food and then there's a waste and it sends that back to the body for it to be excreted. So we're trying to give them not only the names of the parts and what each…does …but how it needs to work-
Ms. T: I would say we're trying to bring in the behavior into it. They get the structure, we teach part the function, but there was never that behavior why does it need to do what it does…

❖ INTERACTION ANALYSIS
Introduction of SBF begins as discrete components, progresses to acknowledging complexity, finally providing a systems perspective with the cell/body unit.

Conclusions

❖SBF was useful construct for teachers to organize their ideas about complex systems

❖They were able to link nested subsystems (cells) to larger order body
system (body functions).

❖Teachers transferred knowledge by:
- Creating SBF oriented hypermedia
- Applying SBF to unit teaching the unit on body systems

❖Teaching aquarium unit prepared teacher to refine their own thinking.

❖Recognizing themselves as learners allowed teachers to be objective about their knowledge.

❖Important issue for future research is understanding conditions that facilitate teacher appropriation of conceptual tools

Acknowledgments

This research was funded by IESgrant # R305A090210. Conclusions or recommendations expressed in this paper are those of the authors and do not necessarily reflect the views of IES.