Ubiquitous Computing, Representations of Knowledge, and Deep Understanding

Annette Kratcoski, Karen Swan,
Jason Schenker & Mark van 't Hooft

AT&T Classroom

Objective

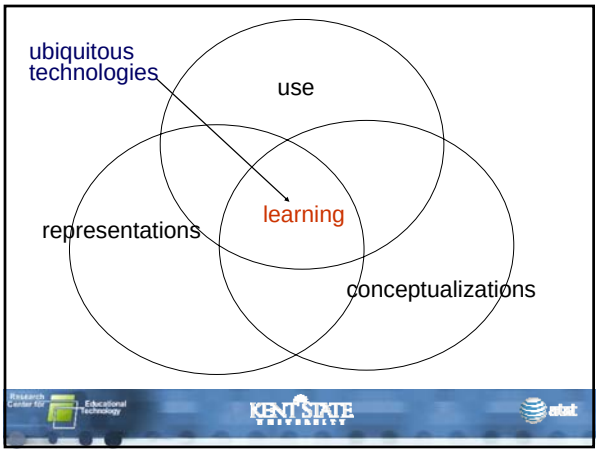
to explore the effects of ubiquitous computing at the classroom level

- effects on the kinds of representations used
- effects on students' deep understanding

theoretical framework

"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."

-- Mark Weiser



Research Questions

What kinds of external representations of knowledge do teachers and students employ to support learning when they have ubiquitous access to a variety of digital devices?

(How) does such ubiquitous access affect student learning and students' attitude/motivation toward learning?

Subjects

Classroom 1: third grade class suburban	19 students 11 boys/8 girls 2 special needs
Classroom 2: fourth grade class suburban	19 students 10 boys/9 girls 3 special needs
Classroom 3: 2 first grade classes rural	23 students each Class A: 11 boys/12 girls 3 special needs Class B: 12 boys/11 girls 4 special needs

Data Sources

- Teacher artifacts—
  - lesson plans, journal prompts, rubrics
- Student artifacts —
  - student work, digital stories, PowerPoints
- Interviews —
  - teachers and students
- Field notes from classroom observations

Findings: Teacher Interviews

- Ubiquitous computing impacts student engagement and motivation to learn.
- Ubiquitous computing impacts the quality of student work.
- Ubiquitous computing impacts the communications and problem solving skills students use and acquire.
- Increased technology access facilitates in-context learning.
- Increased technology access enhances students' representations of knowledge

Findings: Student Interviews

- Students articulated detailed reasons for choosing particular representations.
- Students were able to describe in detail key concepts represented in the projects they were working on.

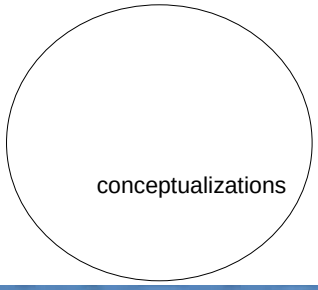
ASSESSMENT OF CONCEPTUAL UNDERSTANDING
(Newmann & Wehlage, 1995)

standard	criteria
analysis (1-4)	measures the extent to which the student demonstrates higher order thinking -- student performance demonstrates thinking about the subject matter by organizing, synthesizing, interpreting, hypothesizing, describing patterns, making models or simulations, constructing arguments, inventing procedures.
disciplinary concepts (1-4)	measures the extent to which the student demonstrates use and understanding of specific concepts -- student performance demonstrates an understanding of important ideas related to the subject matter that go beyond application of basic concepts by elaborating on definitions, making connections to other concepts within the subject, or to other content areas
elaborated communication (1-4)	student performance demonstrates a concise, logical, and well-articulated explanation or argument that justifies the student's answer/work -- could include diagrams, drawings, or other visual representations -- must communicate an accurate, complete and convincing explanation or argument.

CONCEPTUAL UNDERSTANDING

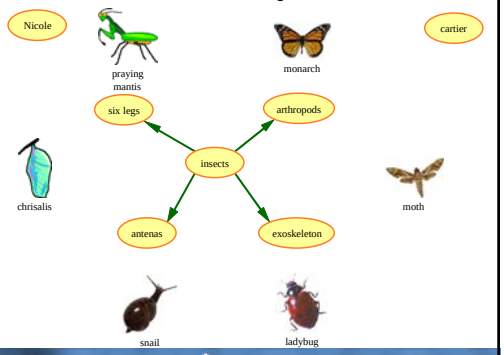
	average rating across classes
high ability	11.43
medium ability	11.03
low ability	10.20
special needs	10.83

theme: deep understanding

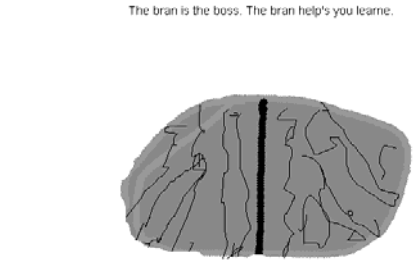


- Students used a variety of digital technologies as thinking and learning tools to support subject area and conceptual learning at high levels.
- Students demonstrated deep understanding of key concepts by elaborating on specific concepts & making connections between concepts.
- Teachers reported positive impact on the quality of student work.

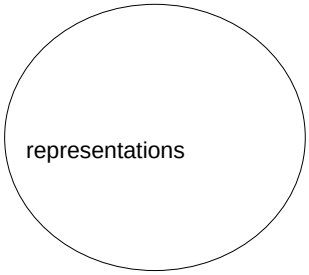
Nicole & Cartier's Insect Venn Diagram



Faith's drawing of the brain



theme: multiple paths to knowledge representation



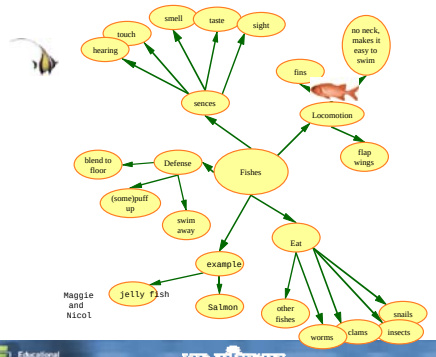
- Ubiquitous access to digital devices resulted in a remarkable variety of opportunities through which students could represent their learning.
- Teachers and students could access, explore, create, and share ideas in a much greater variety of formats and in far more integrated ways than possible before.

Multiple Representations: Examples

Case Study I (suburban 3rd grade):

- Students used digital microscopes to compare plant and animal cells and recorded observation notes on their handhelds.
- Student groups worked collaboratively to research animal traits online, record notes on their handhelds & create Venn diagrams that organized their findings.
- Students researched endangered animals, prepared multimedia presentations to summarize their findings, & created digital claymation movies to represent the life cycles of their animals.

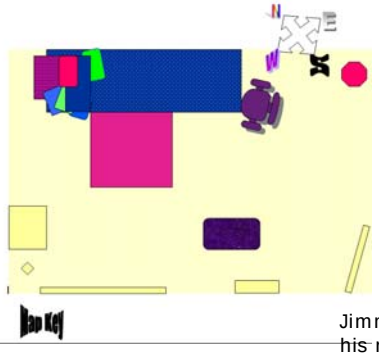
Maggie & Nicol's fish Venn diagram



Multiple Representations: Examples

Case Study II (suburban 4th grade):

- Students used online resources, handhelds, whiteboards, digital cameras, & multimedia authoring software to create detailed map and geography representations.



Jimmie's map of his room

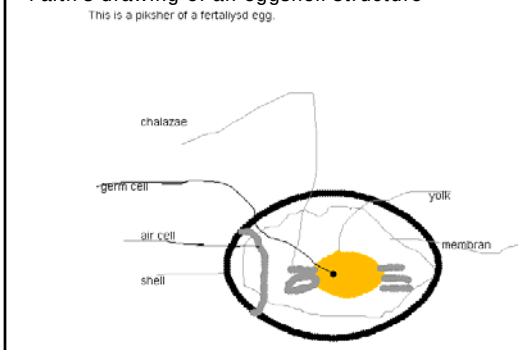
Multiple Representations: Examples

Case Study III (2 rural 1st grade classes):

- Students used digital cameras, time-lapse photography, & graphing software to study the development of chick embryos & fertilized eggs in an incubator.
- Students used digital microscopes to examine skin cells, studied x-rays using the document camera, & measured changes in their heart rate using digital heart monitors.
- As a culminating project, students created digital stories of their own superstructures (bodies) that included each structure & organ they studied.

Ms. Viers' class' photo journal of chick hatching

Faith's drawing of an eggshell structure



Blaine's Kidpix drawing of the effects of smoke on your lungs

use

theme: changes in pedagogy

conducting vs. instructing

use

theme: changes in classroom dynamics

increased collaboration

meaningful participation of all students

students as experts

Research Center for Educational Technology

http://www.rcet.org