EcoMOD – Now Funded!
Computational Modeling Immerse Environments Elementary School Contexts

Design-Based Research (DBR)
EcoMOBILE as a Case Study

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It’s all about the EXPERIENCE
As the economy evolves, you pay more for the ’intangible component’ than the tangible component of a product and feel good about it.

(Prabhakar Jampa)
How does this analogy map on to our education system?
What role does technology play in reimagining spaces for learning?

What is Augmented Reality?
- QR code-based
- Location-based

EcoMOBILE
Mobile Broadband Devices
Augmented Reality
Environmental Probes
ARIS
A situated perspective:
Learning happens in the interstitial spaces among interacting agents and learning resources

(Classroom, 2001; Lave and Wenger, 1991)

Field:
• Draws on personal experience
• Dynamic social interactions
• Many "distractions"
• Single visit to learning space

Classroom:
• Focus on collective experience
• Structured social interactions
• "Easy" direction of attention
• Many visits to learning space

Design-based research focuses on the CONTEXT

As the economy evolves, you pay more for the "intangible component" than the tangible component of a product and feel good about it.

(Prabhaal Jampa)
EcoMOBILE is about BLENDING EcoMUVE and outdoor field trip experiences supported by mobile tech.

EcoMUVE Experience = Take on the role of a scientist and investigate why the fish died.

Changes over time

Perceptual Clues

Data and Graphs

Similairities in surface and deep features of a learning environment should promote transfer to new situations.

(Goldstone and Sakamoto 2003)
Inquiry in EcoMUVE is scaffolded:
• Question is pre-defined
• Data collection is simulated
• Graphing is structured
• Explanations are constrained

DRIVING QUESTION for EcoMOBILE:
What happens when we bring this experience into the real world, and support with mobile tech?

Design intentions for EcoMOBILE experience:
• Give students agency in collecting and analyzing data in realistic scenarios
• Show that what they learned in the classroom holds relevance when they step outside
• Offer the ability to see and notice things they may not have known were there
• Support opportunities to work together to solve a problem

A tension in education research

The cognitive perspective
• Focus on individual cognition and memory
• Context for learning is tightly controlled

The situated perspective
• Focus on material and representational resources available
• Context for learning is inherently social

Controlled randomized trials

Mixed methods research (and DBR plays a role)

Design intentions ~ Reality?

Design-Based Research

(Greeno 1997; Anderson et al. 1996, 1997; Cobb & brown 1998)
Prototype Analysis Design Development Implementation Evaluation

Rapid Prototyping

Rapid Prototyping

Design-based Education Research

Traditional Education Research


DESIGNER(S)

What they know about...

...technology

...subject

...learning and instructional design

Design-Based Research

DESIGNER(S)

What they know about...

...technology

...subject

...learning and instructional design

Anticipated learning context

THE DESIGN

Specific learning goals

Design-Based Research
Design-Based Research

**DESIGNER(S)**

What they know about...
- technology
- subject
- learning and instructional design

Anticipated learning context

Specific learning goals

**THE DESIGN**

**DESIGN PROCESS**

**THE STUDENT EXPERIENCE**

- engagement?
- learning?

DATA SOURCES
- pre-post surveys
- observation/video
- log-file data

**EcoMOBILE – Round 1**
Students were given their own phones and roles. They observed pond features in EcoMUVE and were given the roles of Naturalists, Microscopic Specialists, Water Chemists, and Private Investigators. Students worked together to create a video that summarized the health of the pond based on whole team's observations.
Design-Based Research

THE STUDENT EXPERIENCE

...engagement...learning

DATA SOURCES
...pre-post surveys
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Student Opinions

Naturalist

Observe pond for similarities to EcoMUVE
Observe virtual fish
Calculate fish population size
Collect macroinvertebrates
ID macroinvertebrates and calculate tolerance index

Naturalist

Observe pond for similarities to EcoMUVE
Observe virtual fish
Calculate fish population size
Collect macroinvertebrates
ID macroinvertebrates and calculate tolerance index
Work together to create video that summarizes the health of the pond based on whole team's observations

Microscopic Specialist

Observe pond for similarities to EcoMUVE
Observe duckweed
Observe 3D model of duck
Observe how starch decomposition by bacteria
Video of how oxygen dissolves in water

Collect macroinvertebrates
Measure pH
Measure phosphates
Measure turbidity

Work together to create video that summarizes the health of the pond based on whole team's observations
Take Home Messages:
- Activities that involved measurement, collection, exploration.
- The intersection of virtual and real elements.
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AR support for data collection and interpretation

Post-survey results:

- increase in understanding of water quality variables
- self-report opinion and affective survey increase in:
  - understanding scientific practices,
  - causes of ecological change,
  - self-efficacy related to using tables and graphs
The TEACHERS’ experience

“It felt like 90% of the time they were at the pond environment, they were working on interacting with the pond and their partner, whereas previous times it felt like it was maybe 60 or 50% of their time they were independently interacting.”

“They’re getting to see parts of the world that they don’t see, like the microscopic creatures, what the pH level is, they’re getting to see things that they didn’t know existed”

“I was able to work a little more one-on-one and with small groups, I just traveled around and checked in with kids, I wasn’t directing things, that felt really different to me, and I really liked it... It felt more like what I like to think of teaching as being - not just directing top-down.”
Quantitative Results from Pre-Post Survey

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<th>Mean (Pre) SD</th>
<th>Mean (Post) SD</th>
<th>Effect Size</th>
<th>T-test, p-value</th>
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<tr>
<td>Describing Data</td>
<td>10.5 (±0.41)</td>
<td>10.8 (±0.32)</td>
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<td>Understanding Variability</td>
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<td>22.4 (±0.37)</td>
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<td>Supporting Claims with Evidence</td>
<td>15.9 (±0.49)</td>
<td>17.4 (±0.47)</td>
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<td>Context (near)</td>
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<td>0.77 (±0.66)</td>
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<tr>
<td>Context (far)</td>
<td>0.88 (±0.43)</td>
<td>0.5 (±0.44)</td>
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</table>

(Cooke, Kamarainen, Brezler, Metzolf, Grotzer & Dede, NARST 2016)

Qualitative Coding of Student Explanations
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Design-Based Research

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Specific learning goals

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THE STUDENT EXPERIENCE

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DATA SOURCES

...pre-post surveys
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Log-file data

Log File Data

For Researchers
For Teachers
For Students
Log files for researchers and designers

Free-choice hotspots

Log files for teachers

GoPro data from EcoMOBILE

NEWTON 2014 – Meredith Thompson - Started with Log Files for Students

Integrated Evernote with FreshAIR Log Files
Design intentions ~ Reality?
How do the design and technology -> experience -> learning?
Design-Based Research = Iterative design, triangulation of many sources of data and evidence

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