Leveraging Educational Technologies to Capture, Share, and Interact with Students’ Ideas

HGSE T561, Fall 2016
October 17th, 2016
Research Interest

Developing and analyzing educational technologies and environments for supporting STEM learning

http://en.community.dell.com
http://web.uri.edu
http://education.lego.com
Research Area

• Educational Technologies: new hardware, software, interfaces for teaching and learning

• Focus on STEM (science, technology, engineering, and math) subjects, from K to primary to secondary through university

• Special emphasis on **creativity** in engineering, on **documentation** of student work (the process), and on **collaboration**
TEACHING PRACTICES:
• Science, Technology, Engineering, Math (STEM)
• Hands-on activities
• Project Based Learning
• Engineering Design Process
• “Real-World” Applications

RESULTS:
• Increase technological literacy
• Peak curiosity
• Stimulate creativity
• Build self-confidence
• Instill passion for learning
The Education Continuum

Pre-K
Primary
Secondary
University
Industry
Problem: We have a 100,000sf building on a 150,000sf parking area on a 10 acre lot. What is the impervious area lot coverage?

Impervious area = 100,000sf + 50,000sf = 150,000sf

To convert sf to acres:
1. List the numbers you know = \( \frac{3.44\text{ ac}}{10\text{ ac}} \)
2. Find the conversion factor = \( \frac{1\text{ acre}}{43,560\text{ sf}} \)
3. Cancel units and do the arithmetic

\[
\text{Impervious area} = \frac{150,000\text{ sf}}{43,560\text{ sf}} = 3.44\text{ acres}
\]

So, \( \frac{150,000\text{ sf}}{3.44\text{ acres}} = 34.4\% \) = Impervious lot coverage.

Up to 1 ton, Deadman (a we with the hoe) concrete?

To brace forms, that we can move with what size makes a ton of concrete?

So \( \frac{1\text{ yd}^3}{27\text{ cf}} \times \frac{150\text{ lbs}}{\text{ cf}} \times \frac{1\text{ ton}}{2,000\text{ lbs}} \times \frac{2.05\text{ kg/lb}}{1\text{ kg}} \times \frac{0.09\text{ kw/hr}}{1\text{ kw}} \times \frac{10\text{ hr}}{1\text{ ton}} = \frac{5.28\text{ $}}{\text{ kw/hr}} \)

So we guess at a cubic yard (9000 cubic feet) deadman does as 28000 BTU heater cost to operate for 10 hours at 9 cents/kW hr?
Individual Groups Working Independently

Background Research (BR) → Hypothesis (H) → Design (D) → Test (T) → Results (R) → Analysis (A) → Conclusion (C)
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Periodic Cross-Group Sharing Resulting in Collaboration
Individual Groups Working Independently

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Periodic Cross-Group Sharing Resulting in Collaboration
Social Network Analysis (SNA)
SNA Diagrams from Zhang et. al. (2009)

Teacher-centric class with small fixed-groups

Interacting groups

Opportunistic collaboration

SNA: Lecture Style

Mrs. Smith

Trevor

Ashley

Laura

Skyler

Ross

Isaiah

Mike

Katie

Erin

Monica

Justin

Zach

Nichole

Maria

Caitlin

Louis

SNA: Lecture Style + Q&A

- Ashley
- Laura
- Skyler
- Ross
- Isaiah
- Mike
- Katie
- Monica
- Erin
- Justin
- Zach
- Maria
- Nichole
- Louis
- Trevor
- Mrs. Smith
Idealized Small Group Social Network with Individualized Roles within Groups
InterLACE: Interactive Learning and Collaboration Environment

Work supported in part by NSF grant #1119321
Design Principles

• Facilitate student discussion, argumentation, and negotiation to empower students to share, develop, and build ideas, theories, and designs collectively.
• Promote collaboration among individual students, student groups, and the teacher.
• Enable the teacher to act as a facilitator of the above two principles, as well as to allow them to focus on student thinking.
• Flexible environment that can be customized to fit the culture of the classroom.
InterLACE Functionality

Persistent shared workspace for gathering and displaying student contributions

Ability to highlight and compare student work

Real-time progress tracking and formative assessment information

Automated analyses and user interface functions for facilitating summative grading

Commenting feature for enabling discussions and tagging for peer evaluation

Teachers can use existing content and embed third-party simulations

Variety of input devices for capturing student ideas, discussions, and class work

Grouping and saving individual arrangements for expressing spatial orientation of ideas

InterLACE
Visual Classrooms

http://VisualClassrooms.com
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2. Find or list the conversion factor = 10 ac
3. Cancel units & do the arithmetic

\[
\text{Impervious area} = \frac{150,000 \text{ sf}}{1 \text{ acre}} = 3.44 \text{ ac}
\]

So we guess at a cubic yard of deadman does 20,000 BTU heater cost to operate for 10 hours at 9 cents/kW hr?

\[
\frac{1 \text{ yd}^3}{27 \text{ ft}^3} \times \frac{150 \text{ lbs}}{\text{ yd}^3} \times \frac{1 \text{ ton}}{20,000 \text{ lbs}} \times \frac{3.41 \text{ kBtu}}{\text{ kw hr}} \times \frac{0.09 \text{ cents}}{\text{ kw hr}} \times 10 \text{ hr} = \$5.28 \text{ to operate}
\]

So 1 yd³ will weigh about 1 ton, deadman size 3’ x 3’ x 1’.
1990’s: Learn to Build a Robot
1990’s: Learn to Build a Robot

2000’s: Design and Create a Robot
The Education Continuum

Pre-K

Primary

Secondary

University

Industry
S. T. E. A. M.

Science → Technology → Engineering → Arts → Math
What I didn’t show...

Physics Glasses

iPad & mobile devices

Alternative Platforms (URAPI)

Maker Movement

Touch Table Interfaces

I.E.L. Integrating Engineering and Literacy

Teacher Professional Development

Interactive Playground Science (SciGames)

Conferences/Workshops

Education Research

Paper Robots

RoboBooks

and more...