Redeveloping A Signature Pedagogy For Engineering: Responding To New Spaces And New Technologies

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Signature Pedagogies

“the characteristic forms of teaching and learning” associated with particular professions

Signature pedagogies in the professions
Lee S. Shulman  
Daedalus Summer 2005
Signature Pedagogies

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….. implicitly define what counts as knowledge in a field and how things become known.

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Signature Pedagogies

“… even determine the architectural design of educational institutions..”

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“... even determine the architectural design of educational institutions.”

http://www.physics.gla.ac.uk/theDepartment/lectureTheatre.html

Martin Wood Lecture Theatre, University of Oxford

http://www.physics.ox.ac.uk/physics/images/dscf1110.jpg

“... which in turn serves to perpetuate these approaches.”

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Lord Kelvin’s lecture theatre, University of Glasgow

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Chalk Talk

a characteristic genre in mathematics based disciplines

Figure 2 from:

The cinematic art of teaching university mathematics: chalk talk as embodied practice
Fox, J & Artemeva, N
In our view, the chalk talk genre is not only central to the teaching of mathematics but can also be **pedagogically interactive, meaningful, and engaging** as a way into disciplinary doing and being.” (Cobb, 2000, p. 30).

*in The cinematic art of teaching university mathematics: chalk talk as embodied practice
Fox, J & Artemeva, N
from: Multimodal Communication 1(1), pp. 83-103 December 2011*
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Sketching Thinking

Dynamic diagrammatic reasoning processes

Fig 1. The evolution of a battery scenario—novel protocol time of 9 hours and 34 minutes.
Sketching Thinking

Dynamic diagrammatic Reasoning processes

The Digital Interface
Using the Tablet PC in Class

Tablet PC Use - In Class

Sarat Singamneni
AUT School of Engineering
The importance of sketching

Notes in Numerical Analysis:
James O. Wilkes, ~1985
Octave Levenspiel
Chemical Reaction Engineering, "1985
Suppose we use Newton-Rhapson, and we have found a tentative root at \( x = -2 \).
- To find the others, (and avoiding finding the same root again), we form a new polynomial

\[
p_4(x) = x^4 + 0x^3 - 27x^2 + 14x + 120
\]

• Now we
  - Repeat the process
  - Do the division
  - We expect the division to work out exactly, we will get some small remainder polynomial
  - Will have increasing round-off problems if the polynomial is ill-conditioned
  - Could “flip” the polynomial to avoid some problems
General 1D parabolic PDE

- Our general 1-space D parabolic PDE is

\[ c(x, t, u, \frac{\partial u}{\partial x}) \frac{\partial u}{\partial t} = x^{-m} \frac{\partial}{\partial x} \left( x^m f \left( x, t, u, \frac{\partial u}{\partial x} \right) \right) + q \left( x, t, u, \frac{\partial u}{\partial x} \right) \]

- With initial condition

\[ u(x, y_0) = u_0(x) \]

- And boundary conditions (at either end)

\[ p(x, t, u) + q(x, t) f \left( x, t, u, \frac{\partial u}{\partial x} \right) = 0 \]
Adding a dead-zone to the bang-bang controller prevents the continuous oscillation in control input.

A bang-bang controller with a deadzone

\[ R(s) \rightarrow \frac{E(s)}{K} \rightarrow \frac{1}{s(s+1)} \]

\[ \frac{de}{dt} \]

\[ \text{start} \]

\[ \text{stop} \]

\[ \text{switching} \]

\[ \text{surface} \quad \#1 \]

\[ \text{surface} \quad \#2 \]

In this case once the \( \dot{e}(t) \) axis is reached, the system comes to rest (at \( \circ \)), with a steady-state error of
The Digital Chalk - Wacom Digitizer and Stylus

Uses Electro-Magnetic Resonance
- Precise
- Pressure sensitive
- Separate Digitizer from touch

Handwriting on the iPad

Uses Capacitive Digitiser
- Relatively imprecise
- Not Pressure sensitive
- ‘Palm rejection’ issues
Pilot Survey of Students

96% rated the Tablet PC presentation method as an improvement

Functional Improvements
- easier to read – from anywhere in room

Student Engagement and Learning
- feel more involved
- student and lecturer working together
- much more interactive and relatable
- it makes the class more interesting and lively.

This method is more effective in a way since we get to see all the steps required/executed in order to attain the final answer.
Digital Marking

Flipped Classroom

Simulations and Polls

Podcasts

SAMR – Transformative Approaches

Redefinition
Tech allows for the creation of new tasks, previously inconceivable

Modification
Tech allows for significant task redesign

Augmentation
Tech acts as a direct tool substitute, with functional improvement

Substitution
Tech acts as a direct tool substitute, with no functional change

Dr Rueben Puentedura
www.hippasus.com
Signature Pedagogies

The Simpsons:
From: MoneyBART
Season 22, Episode 3
http://bartsblackboard.com/

Questions?

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