Active Learning & Working Memory

Fostering Deep, Sustained, and Flexible Learning

Peter E. Doolittle
Assistant Provost for Teaching and Learning
Executive Director, Center for Instructional Development and Educational Research
Professor, Educational Psychology
Virginia Tech

Agenda

1. Introduction
2. Active Learning
3. Technology
4. Working Memory
5. Active Learning & Working Memory
6. Conclusion

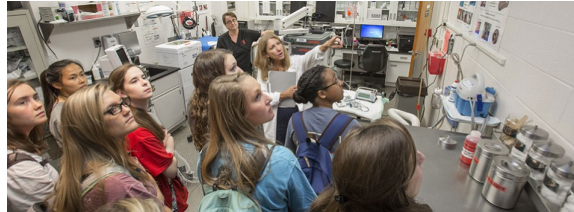# Active Learning

---

Word Activity

Learning & Meaning

1. Knowledge/meaning is constructed during experience and reconstructed during recall.

2. Knowledge is organized.

3. When specifics are lost, meaning remains.

4. Cognitive strategies are used to function more effectively.

5. We can assess the effectiveness of our thinking.

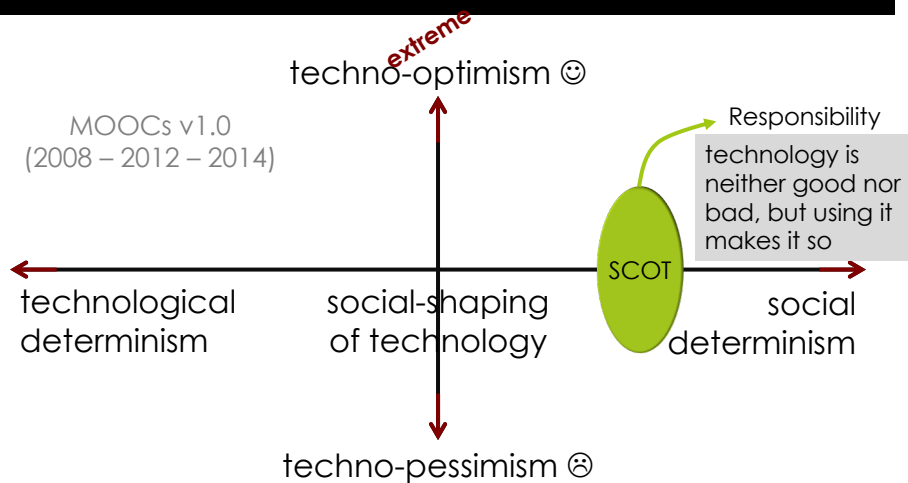(Engle, 2006; Halpern & Hakel, 2003; Mariano, Doolittle, & Hicks, 2009; Wagner, 2006)

motivation

Cognitively   Behaviorally

What we process we learn.

Affectively   Socially

metacognition

Active Learning, Silver Bullets, & Technology

David Stearns, U of Washington
A Map of Typical Positions on Technology & Culture (2012)

Introductory Frame

extreme

techno-optimism ☺

MOOCs v1.0
(2008 – 2012 – 2014)

Responsibility

technology is neither good nor bad, but using it makes it so

technological determinism

social-shaping of technology

SCOT

social determinism

techno-pessimism ☹

David Stearns, U of Washington
A Map of Typical Positions on Technology & Culture (2012)

Introductory Frame

extreme

techno-optimism ☺

bility

In 50 years there will only be 10 institutions in the world delivering education, and Udacity has a shot at being one of them.

- Sebastian Thrun (Udacity)

We found that the majority of MOOCs scored poorly on most [learning] principles…[but] highly on organization and presentation of course material…although most MOOCs are well-packaged, their [learning] quality is low.

- Margaryan, Bianco, Littlejohn (2015)

techno-pessimism ☹

David Stearns, U of Washington
Gartner Hype Cycle

Hype, Hope, Rhetoric & Research

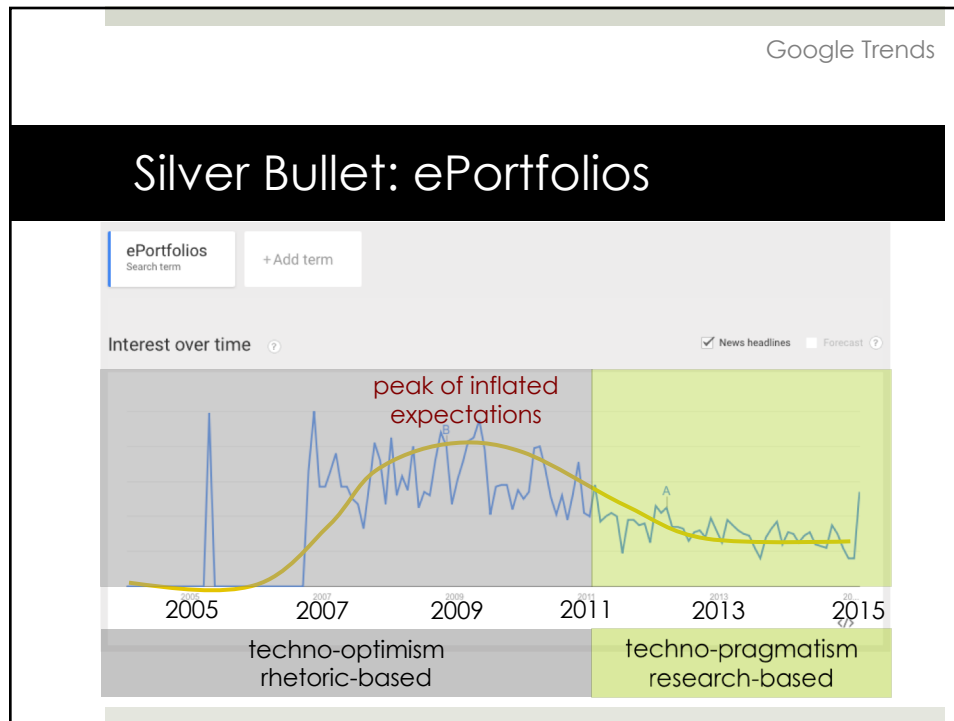peak of inflated expectations

slope of enlightenment

plateau of productivity

technological trigger

trough of disillusionment

techno-optimism
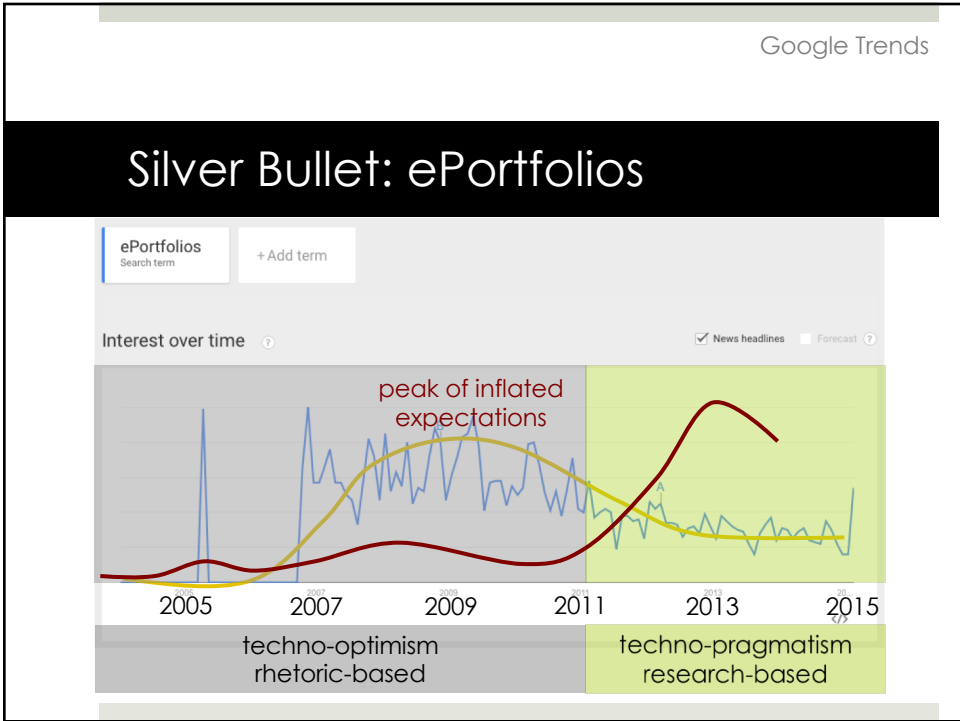rhetoric-based
hype

techno-pragmatism
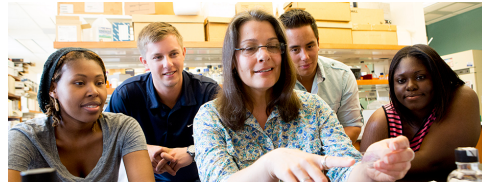research-based
theory

Silver Bullet: ePortfolios

Silver Bullets: ePortfolios

1996-2014

Article Type		N	%
Descriptive	(examples, do/don't)	92	42
Affective	(opinions, perceptions)	63	29
Outcomes	**(learning, motivation)**	**36**	**17**
Technology	(user interface, platform)	18	8
Assessment	(use of rubrics/tools)	8	4
	Total	217	

Bryant, L., & Chittum, J. (2013). ePortfolio effectiveness: A(n ill-fated) search for empirical support. *International Journal of ePortfolio, 3*(2),189-198.

Chittum, J., Woodyard, J., & Bryant, L. (2015).

Silver Bullet: ePortfolios

ePortfolios
Search term

+ Add term

Interest over time

☑ News headlines   ☐ Forecast

peak of inflated expectations

2005   2007   2009   2011   2013   2015

techno-optimism
rhetoric-based

techno-pragmatism
research-based

Silver Bullet: Others

Google Trends

codeacademy
Search term

+ Add term

Interest over time

☐ News headlines   ☐ Forecast

2005   2007   2009   2011   2013   20...

Active Learning & Working Memory

Working Memory Capacity

- Crucible of Thought
  - Stores Immediate Experiences
  - Access Long-Term Memory
  - Processes Experience and Memory
  - Maintains Current Goal for Processing
  - (especially in the presence of distraction)

(Doolittle & Mariano, 2008; Unsworth & Engle, 2007; Vergauwe et al., 2015)

Working Memory Capacity

- WMC = Storage + Processing = Attentional Control

- Positive impacts include:
  - Fluid Intelligence
  - LTM Activation
  - Attentional Control
  - Reading/Language Comprehension
  - Reasoning & Storytelling
  - Complex Cognition

(Doolittle & Mariano, 2008; Unsworth & Engle, 2007; Vergauwe et al., 2015)

Working Memory Capacity

- WMC = Storage + Processing = Attentional Control

- High WMC = Competent Complex Cognition
- Low WMC = Challenging Attentional Control

- Strategies
  1. Segmenting Instruction
  2. Scaffolding Instruction
  3. Lower Cognitive Load/Lower Information Density
  4. Examples, Examples, Examples
  5. Practice with Feedback

Working Memory Capacity

Working Memory Training ≠ ↑ WMC

Learn & Use Strategies

(Redick, Shipstead, Wiemers, Melby-Lervag, &Hulme, 2015)

When Hype & Research Collide

Multitasking

Watson, C. E., Terry, K.,& Doolittle, P. (2012). Please read while texting and driving.
In J. Groccia (Ed.), *To improve the academy* (vol. 31) (pp. 295-310). Bolton, MA: Anchor.

Multitasking: The Myth

- Tapscott, 1998
  - multitasking

- Frand, 2000
  - "multitasking way of life"

- Prensky , 2001
  - "digital natives accustomed to the twitch-speed, multitasking "

Watson, C. E., Terry, K.,& Doolittle, P. (2012). Please read while texting and driving.
In J. Groccia (Ed.), *To improve the academy* (vol. 31) (pp. 295-310). Bolton, MA: Anchor.

Was Any Research Available?

"The greater the number of objects to which our consciousness is simultaneously extended, the smaller is the intensity with which it is able to consider each."

Hamilton, Mansel, & Veitch 1861

Processing and WMC

2 to 60 by 2s

Results

```
5
4
3
2
1
0
      Task A      Task B      Task C
```

Multitasking and Research

"The truth to multitasking is evident in the empirical studies... humans lack the cognitive, behavioral, and cortical structures necessary to multitask effectively."

-- Watson, Terry, & Doolittle (2012)

Multitasking and Research

"fMRI technology found that multitasking is not actually a concurrent process, but a sequential one that involves task-switching."
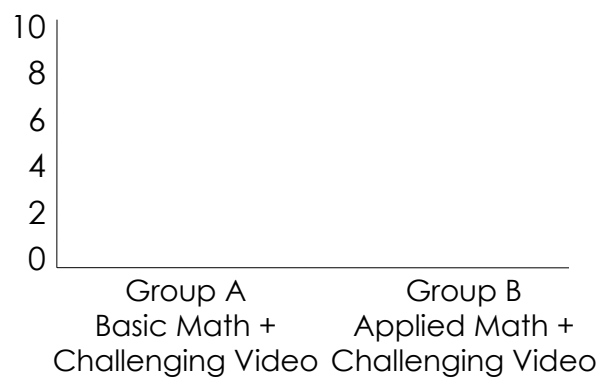
-- Charron & Koechlin, 2010

Multitasking and Research

"There is no evidence that multitasking is a new phenomenon exclusive to digital natives … there is a clear mismatch between the confidence with which [digital native] claims are made and the evidence for such claims."

-- Bennett, Maton & Kervin, 2008

Accounting Students & Professionals

24 years old   50 years old

10
8
6
4
2
0

Group A   Group B
Basic Math +   Applied Math +
Challenging Video Challenging Video

Negangard, Ozlanski, Pyzoha, & Doolittle (2015)

Students & Faculty

19 years old   41 years old

10
8
6
4
2
0

          Group A   Group B
                                     Survey +
          Challenging Video Challenging Video

Doolittle (2015)

Multitasking and Learning

1. Students need to be conscious of multitasking - multitasking decreases learning and performance.

2. Students need to create non-multitasking environments in which to read, plan, & think – be self-regulated.

3. Students should foster automaticity and expertise though practice and feedback to reduce the effects of multitasking.

Multitasking and Teaching

1. Faculty need to be conscious of multitasking - multitasking decreases learning and performance.

2. Faculty need to scaffold students' learning when multitasking is likely to be necessary.

3. Faculty should foster automaticity and expertise though practice and feedback to reduce the effects of multitasking.

In the end, higher education is in need of a change in perspective.