

# Active Learning, Proactive Teaching, Deep and Flexible Knowing



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## Anticipation Guide

*Directions: Agree or Disagree or Edit?*

1. Anyone can teach.
2. Active, or deep learning in students is fostered by note taking and discussions with fellow students.
3. Technology allows teachers to teach more powerfully, more efficiently, and with less effort.

## Overview

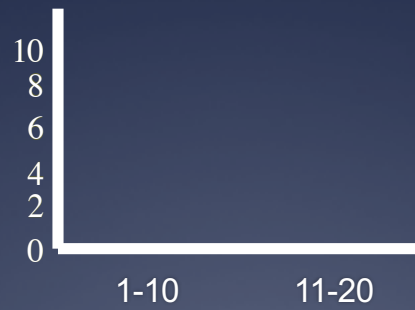
1. Introduction
2. Essentials of Learning
3. Course Embedded Assessment
4. Instructional Strategies
5. Developing Innovative Strategies
6. Course Design/Redesign (if time allows)
7. Conclusion

## Learning First



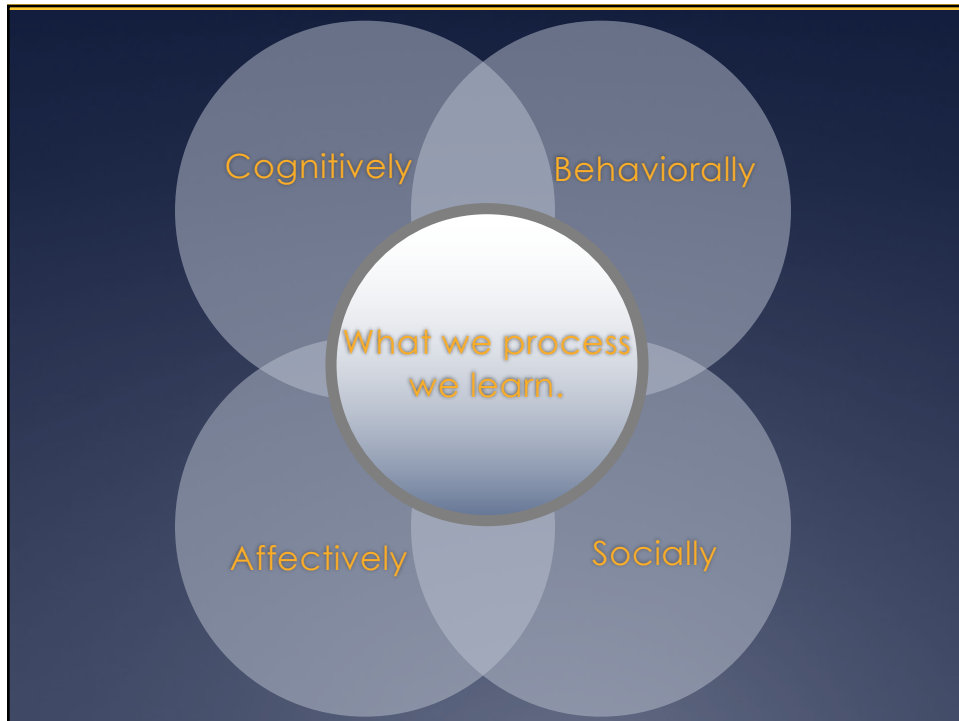
processing

## Activity #1



## Activity #1

- Meaningful Learning
  - Elaborative Learning
  - Imagery
  - Self-Generation
  - Self-Reference Effect
  - Encoding Specificity
    - State-dependent
    - Context-dependent
    - Transfer-Appropriate Processing
- Processing



## 6 Principles for Developing Deep & Flexible Knowledge

1. Learning through **practice at retrieval**
2. Learning through **varied tasks and purposes**
3. Learning at the **principle** level
4. Learning **awareness** and **control** (metacognition)
5. Learning in response to **developmental feedback**
6. Learning embedded in **prior knowledge & experience**

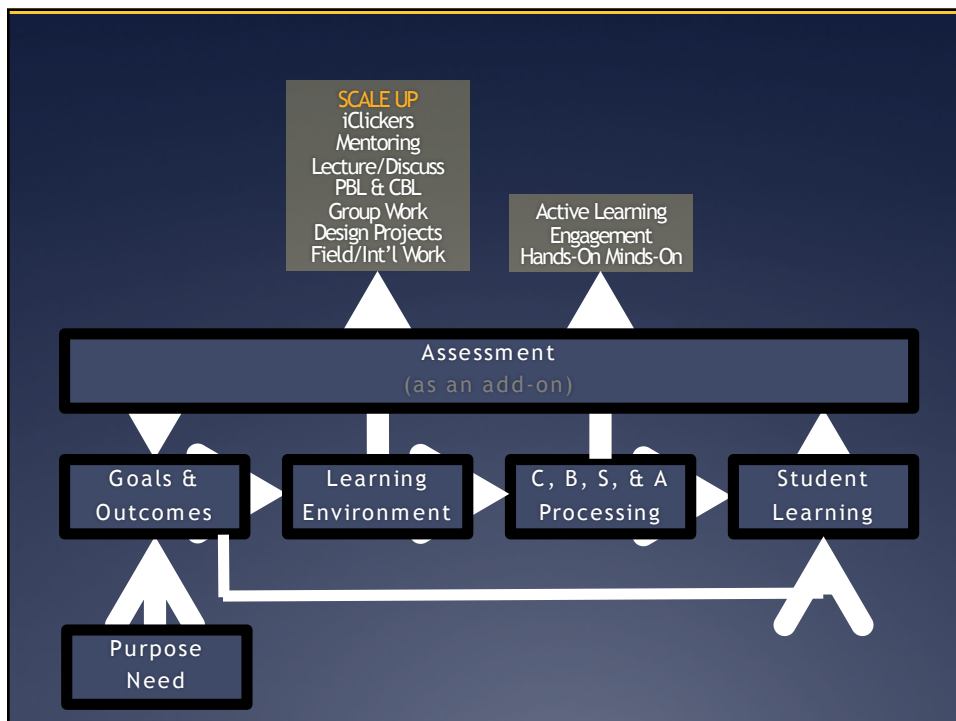
(Engle, 2006; Halpern & Hakel, 2003; Mariano, Doolittle, & Hicks, 2009; Wagner, 2006)

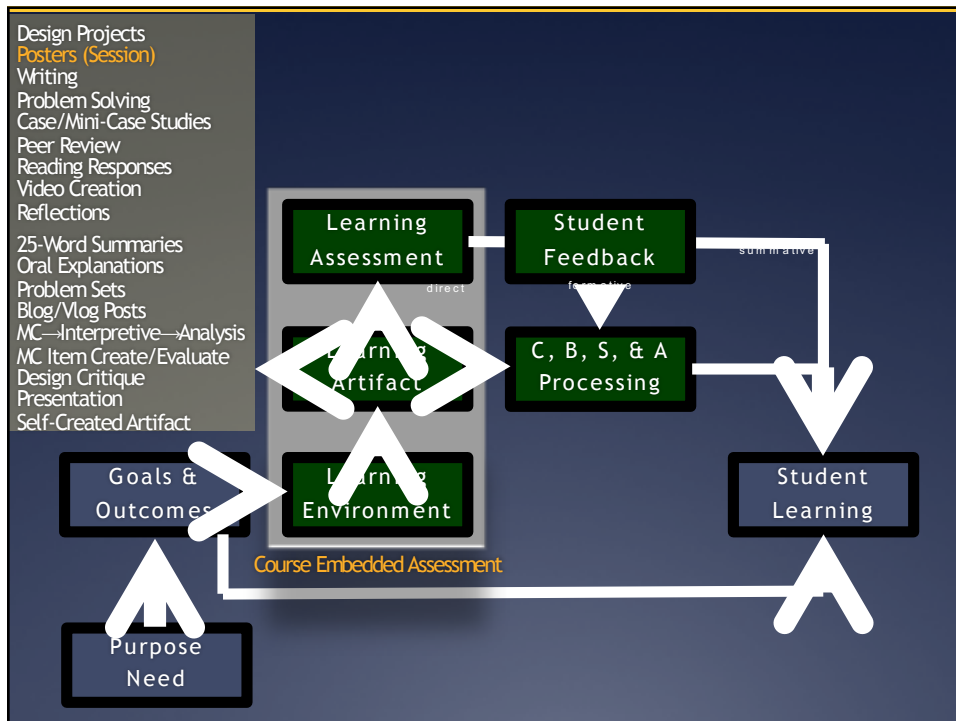
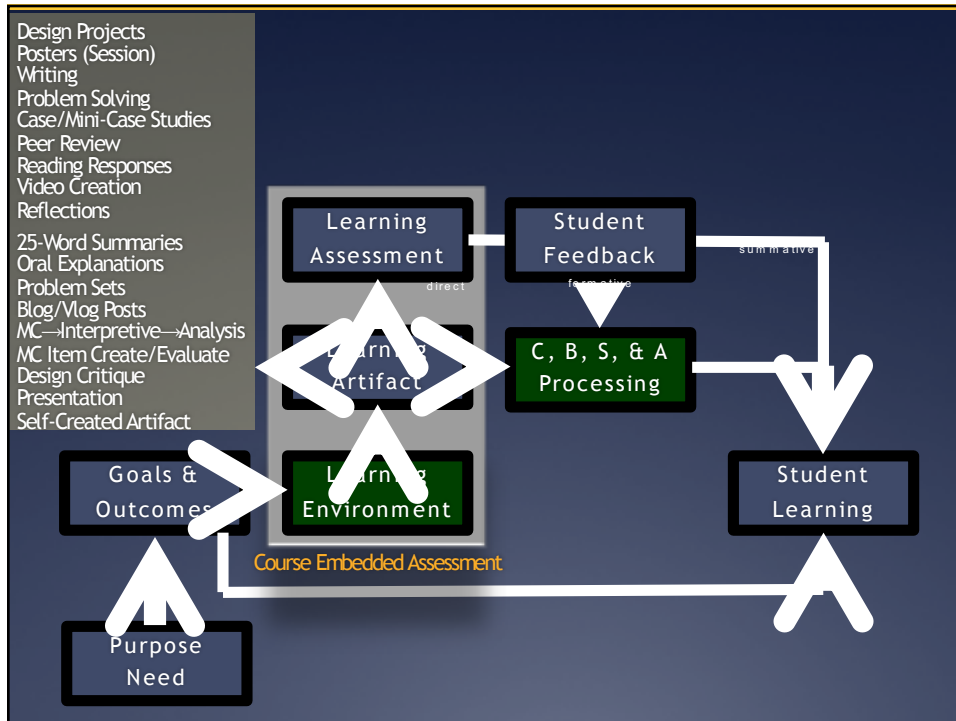
# Learning and Assessment



embedded

Perspective





## Program Assessment (Education Major)

(Academic) Program Goals: Graduates have

1. Knowledge of educational concepts, student development, & teaching techniques; and,
2. Knowledge and skills sufficient to enter the K-12 education profession

(Student) Learning Outcomes: Students who complete the education major can

1. Describe fundamental educational concepts and purposes;
2. Explain student cognitive, social, linguistic, cultural, and physical development;
3. Create quality lessons, units, and sequences that align across ID components;
4. Implement strategies designed to foster learning across a diversity of students; and,
5. Demonstrate exceptional professional, legal, and ethical conduct.

### Curriculum Map

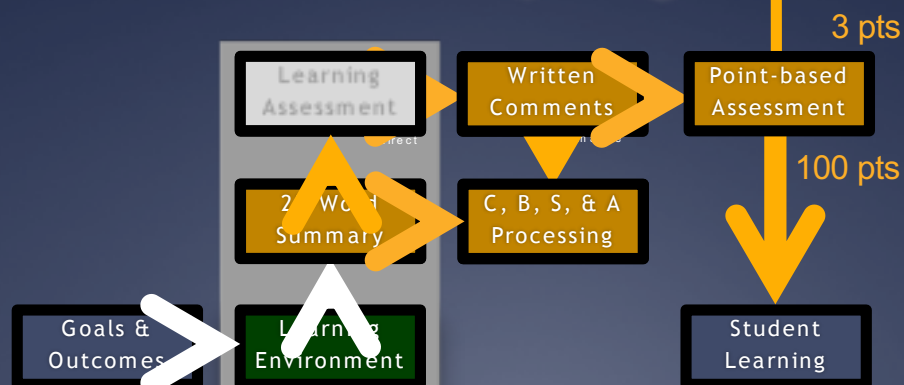
Course	SLO1	SLO2	SLO3	SLO4	SLO5
ED1001	I			I	
ED2010/Field	R		I	R	
ED3305	M & A	I			
ED3405		R	R	R	
ED4501/Field			M & A	M & A	

I = introduced; R = reinforced; M = mastered; A = assessed

Translation: Course to Program  
 90-100 → Exceeds (3)  
 70- 89 → Meets (2)  
 0- 69 → Below (1)

### Curriculum Map

Course	SLO1	SLO2	SLO3	SLO4	SLO5
1001	I	I		I	
2010/Field	R		I	R	
3305	M & A				
3405		R	R	R	
4501/Field			M & A	M & A	



## Learning First: Part II



memory

cats 

## Working Memory Capacity



STM Letters 

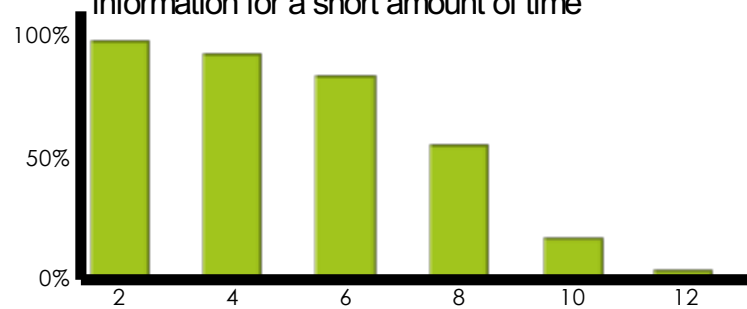


Write down as many letters as you can remember, in order.

BCYHLPFTNWBWZSCPL

## Short-Term Memory

Short term memory = retention of a small amount of information for a short amount of time



## Working Memory

- 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)
- STM = Storage
- WM = Storage + Processing = Attentional Control

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

## Working Memory Capacity

Recall the words out loud, in order.

$(3 + 7) / 2 = 5$  ? Cow

$(8 - 3) + 1 = 7$  ? Star

Cow, Star

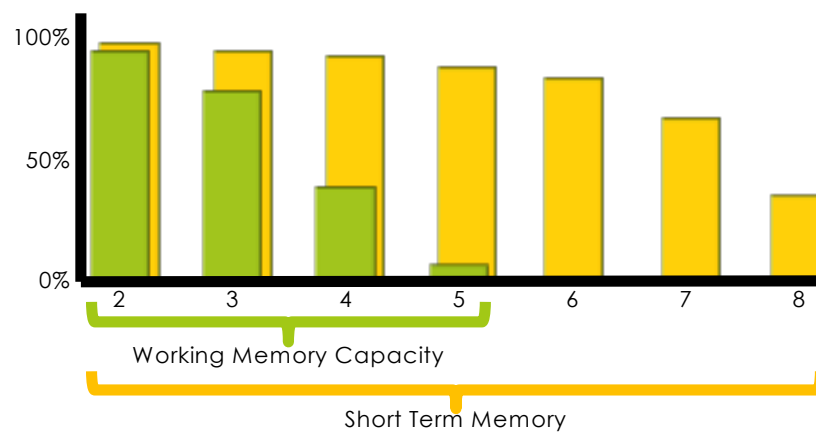
Operation Span Task

## Working Memory Capacity

Recall the words out loud, in order.

~~(5-6) ss, Phone Base~~  
5-6 ss, Phone Base

## Working Memory Capacity



## Working Memory Capacity

Positive impacts (↑WMC) include:

- Fluid Intelligence/Fluid Reasoning
- LTM Activation
- Attentional Control
- Reading/Language Comprehension
- Reasoning
- Storytelling
- **Complex Cognition**

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

## Working Memory Capacity

Working Memory Training  $\neq$  ↑ WMC

Learn & Use Strategies

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

## Segmentation

Multimedia Learning and Individual Differences: Mediating the Effects of Working Memory Capacity with Segmentation

Authors: Lusk, D., Evans, A., Jeffery, T. Palmer, K. Wikstrom, C., & Doolittle, P. (2009)

Design: 11 min multimedia tutorial

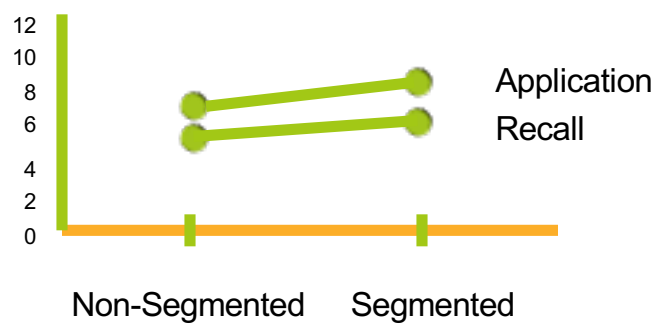
Topic: Historical Inquiry

Variables: Segmentation  
Low/High Working Memory Capacity

Publication: British Journal of Educational Technology, 40(4), 636-651

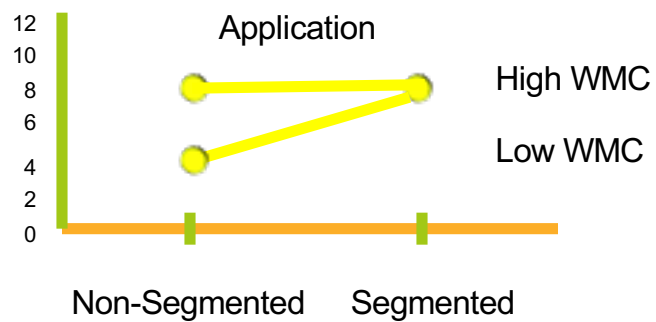
## Segmentation

Multimedia Learning and Individual Differences: Mediating the Effects of Working Memory Capacity with Segmentation



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## Working Memory Capacity

WMC 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

- ▣ Students with lower WMC struggle in environments that require attentional control and heavy working memory load.



## Instructional Strategies



processing

math 

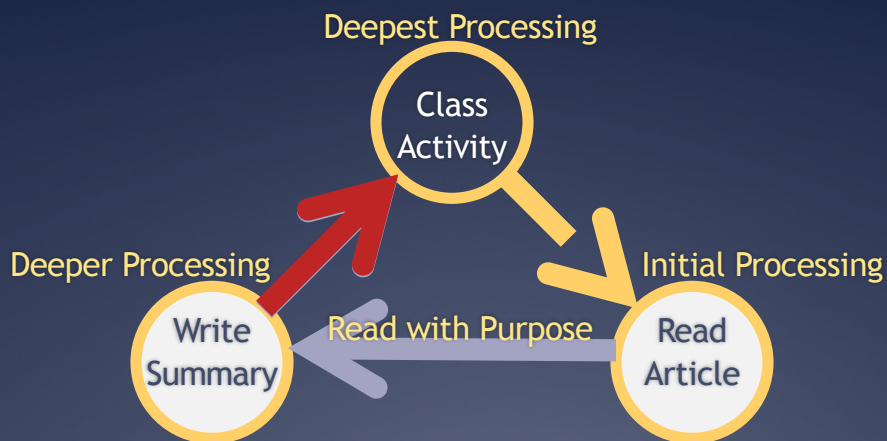
## 25-Word Summaries

**Learning Environment:** Students create a 25-word statement addressing the essential ideas, focusing on explaining and integrating ideas, not listing topics.

**Learning Artifact Processing:** Students read a chapter or article and extract, organize, summarize, and integrate the reading's essential ideas into a clear and concise statement.

**Learning Assessment:** Summaries are assessed using a scoring guide focused on structural format, clarity of thought and expression, and delineation of core message.

## 25-Word Summaries





Viable cognitive structures (knowledge) build upon experiences in a regular and consistent experiential world where individuals fit interpretations of realities to their unique knowledge constructions. [25]

The summary does a nice job of providing insight into essential elements within a fairly complex chapter. The emphasis on viable cognitive structures is certainly a main point for von Glasersfeld, however, the idea that these structures are the result of interpreting experiences "in a regular and consistent experiential world," misses one important aspect of radical constructivism. In radical constructivism "regular and consistent" is not an artifact of the experiential world itself, but rather is a construct of an individual's interpretation of an experiential world. The world around us appears to be regular and consistent, but that's because that is how we as individuals construct it.

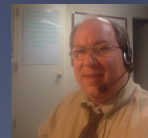
In addition the phrase "where individuals fit interpretations of realities into their unique knowledge constructions" is a bit unclear. The idea that our viable knowledge constructions "fit" our experiential world is central to von Glasersfeld's radical constructivism, thus the idea is certainly essential. How might this part of the summary be clarified?

## 25-Word Summaries

Each 25-word summary is worth 50 pts and is graded using the following criteria:

1. **Structural Format** 10 pts
2. **Clarity of Thought and Expression** 15 pts
3. **Delineation of Core Messages** 25 pts

plus Feedback:



## 25-Word Summaries

1. Learning through **practice at retrieval**
2. Learning through **varied tasks & purposes**
3. Learning at the **principle level**
4. Learning **awareness & control** (metacognition)
5. Learning embedded in **prior knowledge & experience**
6. Learning in response to **developmental feedback**

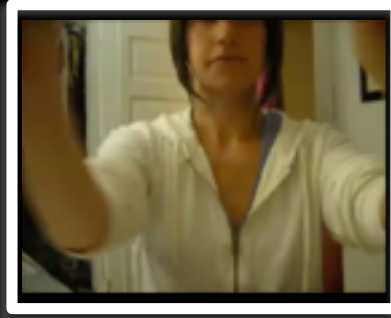
## Oral Explanations

**Learning Environment:** Students create clear and coherently organized **10-15 minute videos** that reflect the student's understanding of the current topic under discussion, plus an application to their lives.

**Learning Artifact Processing:** Students **analyze and interpret** readings, notes, and discussions; **organize** concepts and ideas; **apply** to a life issue; **create** an oral explanation.

**Learning Assessment:** Video are assessed using a **scoring guide** focused on organization, clarity of thought and expression, essential content explanation and application.

## Oral Explanation: Human Learning



## Oral Explanations

Each Oral Explanation is worth 100 pts and will be graded using the following criteria:

1. **Organization** 20 pts
2. **Clarity of Thought and Expression** 20 pts
3. **Essential Content Explanation** 30 pts
4. **Essential Content Application** 30 pts

## Oral Explanations

1. Learning through **practice at retrieval**
2. Learning through **varied tasks & purposes**
3. Learning at the **principle level**
4. Learning **awareness & control** (metacognition)
5. Learning embedded in **prior knowledge & experience**
6. Learning in response to developmental feedback

## Poster Sessions

**Learning Environment:** Student groups produce conference-style posters and **present the posters** in a poster session (s, f, a).

**Learning Artifact Processing:** Students **select, research, organize, summarize, and communicate** specific energy content in a poster format.

**Learning Assessment:** Group posters are **assessed using rubrics** by peers, faculty, administrators, and course instructor.



John Chermak, Virginia Tech, jchermak@vt.edu

Chermak, Resources and the Environment Poster Rubric (DRAFT)

Group Number, Energy source: \_\_\_\_\_, 20 points

Criteria	3	2	1	0
Organization (3)	Well Organized, followed instructions	Well organized, did not follow instructions	Poorly organized, did not follow instructions	Random
Readability, Neatness (2)		Easy to read and understand, Good curb appeal	Adequate	Did not use template provided
Cradle to Grave concept and content (9) Resources needed, Environmental impacts, Advantages/disadvantages	Covered all aspects, well thought out and described	Covered most aspects, fairly well thought out and described	Covered some aspects, poorly thought out and described	Start over
Net energy (2)		Concept and discussion included, relevant	Minimal discussion	No discussion
Figures and Tables (2)		Clear, incorporated in discussions, integrated	Adequate	Lacking
References (2)		Well used	Some used	None used

## Poster Sessions

1. Learning through **practice at retrieval**
2. Learning through **varied tasks & purposes**
3. Learning at the **principle level**
4. Learning **awareness & control** (metacognition)
5. Learning embedded in **prior knowledge & experience**
6. Learning in response to developmental feedback

## Instructional Strategies

- |                             |                                    |
|-----------------------------|------------------------------------|
| 1. 25-Word Summaries        | 11. Jigsaw (Group Work)            |
| 2. A Reading in Quotes      | 12. Just-in-Time Teaching          |
| 3. Academic Haiku Summaries | 13. Oral Explanations              |
| 4. Anticipation Guides      | 14. Poster Session                 |
| 5. Concept Development      | 15. Reciprocal Teaching            |
| 6. Concept Maps             | 16. Think Aloud Video Explanations |
| 7. Exit Slips               | 17. Think-Pair-Share (-Square)     |
| 8. Graffiti                 | 18. 3-Min Standing Conversation    |
| 9. Fishbowl                 | 19. Video Interpretation           |
| 10. Individualized Project  | 20. Whip Around                    |

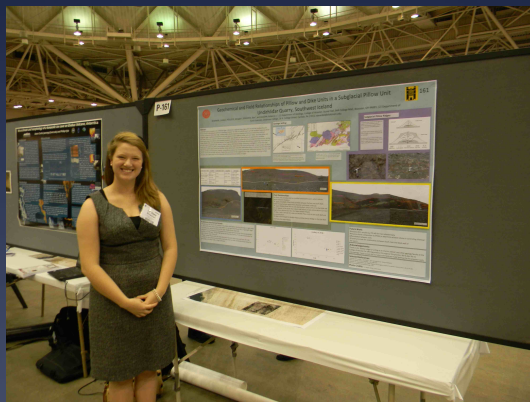
What are some of your favorite instructional strategies?

How does your strategy align with the 6 principles?

1. Learning through practice at retrieval
2. Learning through varied tasks & purposes
3. Learning at the principle level
4. Learning awareness & control (metacognition)
5. Learning embedded in prior knowledge & experience
6. Learning in response to developmental feedback

break 

## Learning First: Part III



constraints

car 



## 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?

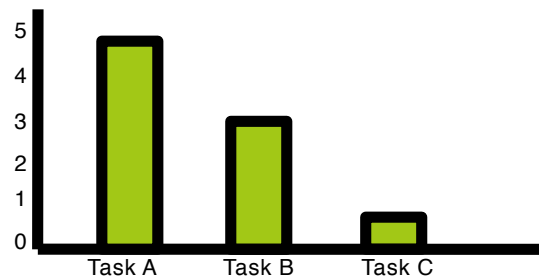
“The greater the number of objects to which our consciousness is simultaneously extended, the smaller is the intensity with which it is able to consider each.”

Hamilton, Mansel, & Veitch 1861

## Processing, WMC, & Multitasking

2 to 60 by 2s

## Results



A + A  
Low

A + C  
Med

C + C  
High

## 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)

## A Few Multitasking Results

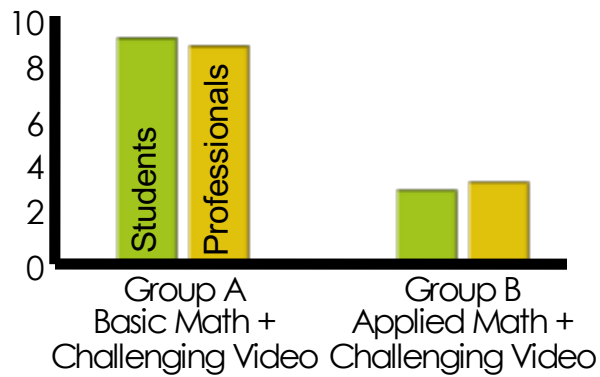
- ↑ MT with a laptop in class → ↓ retention & class performance
- ↑ MT while studying → ↓ class performance
- ↑ laptop multitasking → ↓ performance by multitasker (11 %)
- ↑ laptop multitasking → ↓ performance by nearby peers (17 %)

(Judd, 2013; Junco & Cotton, 2011; Sana, Weston, & Cepeda, 2012; Zhang, 2015)

## Accounting Students & Professionals

24 years old

50 years old

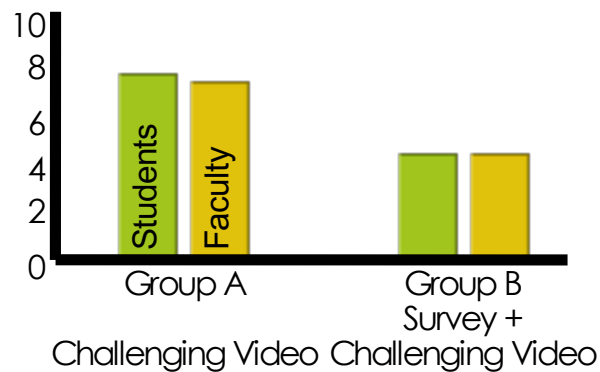


Negangard, Ozlanski, Pyzoha, & Doolittle (2015)

## Students & Faculty

19 years old

41 years old



Doolittle (2015)

## Multitasking, Teaching, 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 through **practice and feedback** to reduce the effects of multitasking.

## Multitasking, Learning, & Technology

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 through **practice and feedback** to reduce the effects of multitasking.

## Strategy Innovation



do it

innovation 

## What Do We Mean by Innovation?

- Create new & implemented & positive change
- Create new & value
- New ideas & implementation

# What Do We Mean by Innovation?

Three Attributes of Innovation

Create New → Implement → Positive Outcome



## 1. Solve a Problem

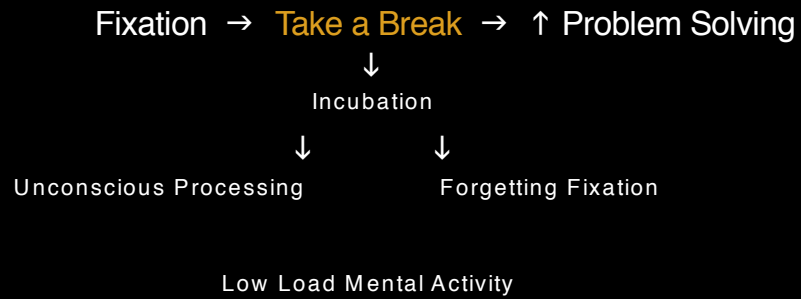
What's Your Problem?

Constructivism and Education

How do I get students to *read*? 1999 MC Quizzes  
2000 MC Quizzes  
2001 na  
2002 1-Page Papers  
2003 1-Page Papers  
2004 1-Page Papers  
2005 na  
2006 MC Quizzes  
2007 MC Quizzes

problem

## 2. I'm Stuck! Walk Away.



- Breaks work better for divergent tasks, than convergent tasks
- More preparation before a break → ↑ problem solving
- A longer break → ↑ problem solving

(Gilhooly, et al., 2014; Kohn & Smith, 2009; Segal, 2004; Sio & Ormerod, 2009, 2014)

## 2. I'm Stuck! Walk Away.

### Constructivism and Education

How do I get students to <i>read</i> ?	1999	MC Quizzes
	2000	MC Quizzes
	2001	na
	2002	1-Page Papers
	2003	1-Page Papers
	2004	1-Page Papers
	2005	na
	2006	MC Quizzes
	2007	MC Quizzes
How do I get students to <i>think</i> ?	2012	25-Word Summaries
	2013	25-Word Summaries
	2014	25-Word Summaries
	2015	25-Word Summaries

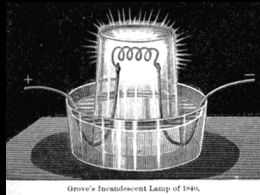


### 3. Build On Others

Edison didn't "invent" the light bulb. He made it better.



Davy  
1802



Grove  
1840



Edison  
1880s

### 3. Build On Others

If we're free from the burden of trying to be completely original, we can stop trying to make something out of nothing.

-- Austin Kleon, *Steal Like an Artist* (2012)

Nat'l Ed TV	Sesame Street	MIT OpenCourseWare	YouTube	Khan Academy	MOOCs
1951	1968	2002	2005	2006	2012

Video-based Learning

## 4. Work Hard. No Aha!

Journalists have always asked me what the crucial idea was or what the singular event was that allowed the Web to exist one day when it hadn't before. They are frustrated when I tell them there was no Eureka moment...it was a process of accretion.

-- Tim Berners-Lee, *Weaving the Web* (1999)

A **TED2005** Talk – James Watson

James Watson >>>

## 5. Don't Wait. Do It.

Do it, fix it, try it.

-- Tom Peters & Bob Waterman  
*In Search of Excellence* (1982)

Don't worry, be crappy.

-- Guy Kawasaki, ex-Apple  
*TEDxBerkeley* (2014)

Give them the third-best to go on with;  
the second best comes too late,  
and the best never comes

-- Robert Watson-Watt, Air Ministry, UK  
(also Arnold Wilkins)

## 5. Don't Wait. Do it.

- **Doolittle's** guidelines for constructing a summary
  1. Look for and write all the main points.
  2. Write main points as sentences or phrases, not terms.
  3. Review and add/subtract main points as needed.
  4. Combine similar main points to shorten the list without losing meaning.
  5. Organize main points around similar concepts.
  6. Write your summary from this organization and list.

## 5. Don't Wait. Do it.

- **Students'** guidelines for constructing a summary
  1. Provide time to read, annotate, write, and rewrite
  2. Provide time between reading/annotating and writing
  3. Develop a strategy for annotating (notetaking)
  4. Look for important details while reading
  5. Read the entire article before committing to main ideas
  6. Every word counts – write and rewrite
  7. Writing summaries develops over time

## To innovate is to make things better.

Innovate a program, course, or strategy  
to increase student learning.

Solve a Problem  
I'm Stuck! Walk Away  
Build on Others  
Work Hard. Don't Aha!  
Don't Wait. Do It.

## New Outcomes? Gen Ed?

The perfect time to think about and innovate new  
programs, courses, and pedagogies.



# General Education Minors

## Criteria for a Cross-disciplinary Gen Ed Minor

1. 18 credit hours (minimum)
2. 9 credit hours of Pathways courses\* (minimum)
3. 6 credit hours at 3000/4000 level (minimum)
4. Addresses 3 Pathways outcomes\* (minimum)
5. Meets *both* integrative outcomes\*
6. Contains a capstone course\*
7. Located in a specific department, but multi-college
8. All students must have access to the minor

\* criteria not present in regular minors

## MIND AND LANGUAGE

PROPOSED PATHWAYS MINOR  
CONTRIBUTING UNITS: ENGLISH, PHILOSOPHY, PSYCHOLOGY, AND SOCIOLOGY

### 1. OVERVIEW

This proposed pathways minor is designed to address the following three types of questions:

**Questions about the mind:** What is the nature of consciousness? How do the cognitive processes of perception, memory, and learning work? What is the nature of mental illness?

**Questions about language:** What is a language? What are the grammatical structures of the English language? How can we tell whether an argument in English is valid using a formal system such as first-order logic?

**Questions about connections between mind and language:** How is language represented and processed? We speak in languages – do we think in a language as well? What is the relationship between the meanings of words and contents of our concepts? How might the language we speak influence the way we think?

### 2. REQUIREMENTS

- Either PHIL1204 (Knowledge and Reality) or PSYC 2004 (Introduction to Psychology).
- A capstone experience (see §3).
- At least 6 hours from the Mind Sequence (§2.1), 6 from the Language Sequence (§2.2), and 6 at the 3000-4000 level
- 18 hours required in total.

### 2.1. THE MIND SEQUENCE

- PSYC 2044: Psychology of Learning (Pre: PSYC 2004).
- PSYC 2064: Nervous Systems & Behavior (Pre: 2004).
- PSYC 2094: Principles of Psychological Research (Pre: PSYC 2004).
- PSYC 4074: Sensation and Perception (Pre: PSYC 2004, 2064, and 2094).
- PSYC 4114: Cognitive Psychology (Pre: PSYC 2004, 2044, and 2094).
- PHIL 4204: Philosophy of Mind (Pre: one PHIL course).
- SOC 4714: Sociology of Mental Illness (Pre: SOC 1004).

### 2.2. THE LANGUAGE SEQUENCE

- PHIL 3505: Modern Logic and its Development.
- PHIL 42XX\*: Philosophy of Language (Pre: one PHIL course). (New course)
- ENGL 4044: Language and Society (Pre: ENGL 1106 or 1204H).
- ENGL 4064: Modern English Linguistics.
- ENGL 4074: English Syntax (Pre: ENGL 1106).
- ENGL 4084: Topics in Linguistics (Pre: ENGL 4064 or 4074).



### 3. CAPSTONE

Capstone experiences that address the interface of mind and language; these can include undergraduate research, presentations, lab work, etc.

### 4. NEEDS

1. Help with developing adequate learning outcomes.
2. Help with codifying capstone experiences.
3. Suggestions about other courses that would be appropriate for the minor.

### 5. CONTACT

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[trogdon@vt.edu](mailto:trogdon@vt.edu)



# Computation, Cognition, and Creativity

Contributing Units: Computer Science, Music, Philosophy (and hopefully many more)



## THEME/OVERVIEW

This Pathways Minor enables students to gain a deeper understanding of the technological world in which they live, work, and create by experiencing the rich interplay between many fields of study and computation. The minor explores such fundamental questions as:

- what does it mean to be human in a world of thinking machines,
- how are notions of self and community influenced by social media,
- how can the intertwining of art and computation lead to new forms of creative expression, design, and scholarship,
- what are the distinctive social implications and ethical dilemmas posed by computing technology that is pervasive and invisible.

The intent of the minor is to foster interdisciplinary interaction, understanding, and perspective.

## ENDORSEMENTS

"My ECE Signals and Systems class became much more exciting since I could hear so many of the theoretical concepts of that course put into direct creative applications (in Digital Sound Manipulation)" – *Electrical and Computer Engineering student in MUS 2584.*

"The two best over the assignment together, with the history major taking the lead in making a simple set of computer instructions calculate temperatures from real National Weather Service data." – *Story in the Bonner Times about students in the Computational Thinking class.*

## OUTCOMES

- Critique and Practice in the Arts and Design
- Several outcomes in the Critical Thinking in the Humanities area are covered, including (1, 2, and 4)
- Several of the outcomes in the Quantitative and Computational Thinking including the social impacts of computing, dealing with large-scale data, understanding multiple fields in which computation can be applied

## IDENTIFIED COURSES

- CS2984 Introduction to Computational Thinking
- MUS2984 Digital Sound Manipulation
- MUS3314 Linux Laptop Orchestra
- MUS3065 Computer Music and Multimedia I
- MUS3066 Computer Music and Multimedia II
- PHIL4015 Special Topics in Philosophy: Minds & Machines
- PHIL4204 Philosophy of Mind

This is a very incomplete list of possibilities. We have had discussions with faculty in English, Psychology, and the digital humanities but have not yet identified specific courses.



Being creative with computation.

New ways of engaging the world.

## CONTACT INFORMATION

- Dennis Kafura (Computer Science) kafura@cs.vt.edu
- Ben Jantzen (Philosophy) bjantzen@vt.edu
- Eric Lyons (Music) ericlyon@vt.edu

## NEEDS

Collaborators are sought in any field of study where there are opportunities to show

- the interplay between computation and another field of study, where each sheds light on the nature of the other,
- Aspects of the fundamental nature of computation, cognition or creativity that changes our understanding of the others.

Of most value are courses that

- emphasize interdisciplinary interactions among students, and
- incorporate pedagogical practices to encourage engagement and experimentation/practice.

## SALES PITCH

- Students in STEM fields have an opportunity to approach a wide variety of ideas and modes of expression through a familiar perspective and yet find themselves transported into unfamiliar and exciting intellectual landscapes
- Students in the humanities, arts, and non-STEM fields have an opportunity to see the potential of computation to enhance their own fields or see how the perspective of their disciplines can shape the evolving nature of computation.

## CAPSTONE

- The capstone experience is open for discussion and ideas. In keeping with the nature of the minor the capstone should integrate computation, cognition, and/or creativity in some compelling way.
- There may be more than one capstone, allowing students to specialize their experience.
- Collaborators will have an active role in defining the characteristics of the capstone.



# INNOVATION PATHWAY MINOR

College of Engineering, College of Business, College of Science, College of Architecture and Urban Planning



## THEME/OVERVIEW

Innovation is considered one of the core principles of our country's ability to continue to lead the world in high tech, high paying jobs and economic growth (Clough, 2004). Industry firms that are more profitable also tend to be more innovative (McGregor, 2007).

It is important for students from multiple disciplines be able to innovate and collaborate together to fulfilling the need for more innovation.

This Innovation Minor is a step towards an interdisciplinary learning experience where students can learn innovation and ideation techniques and be immersed into the entrepreneurial process through courses in multiple colleges and disciplines – mirroring the experiences they will be facing in the industrial sector.

## OUTCOMES

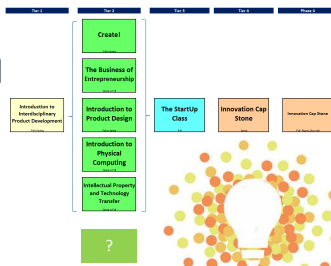
- The ultimate outcome would be the formation of a new product venture
- A second outcome is the positive change in Entrepreneurial Intentions, Self-efficacy and Mindset change created through this minor.

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## IDENTIFIED COURSES

- CREATE!
- The StartUp Class
- The StartUp Capstone Course
  - New Class
- Business of Entrepreneurship and Small Enterprises
  - New Class or Modification of Existing
- Introduction to Product Design
  - New Class or Modification of Existing
- Intellectual Property and Technology Transfer
  - New Class or Modification of Existing
- Introduction to Interdisciplinary Product Development
  - Modification of Existing



## NEEDS

- Discourse
- A course directed specifically at the education of students to present verbal and prose to technical and product information to industry representatives.
- Ethics and World Views
  - A course or portion of a course directed to educate students to make ethical and moral decisions and to understand the impact their decisions have on their community, both locally and globally.

## SALES PITCH

- Multi-Disciplinary Students
- Multi-Disciplinary Educators
- Students from multiple Colleges
- Educators from multiple Colleges
- Educators, mentors and coaches from Industry

## CAPSTONE

- As a course preceding the StartUp Class, this course offers mentored guidance and coaching toward creating a new technologically innovative venture. This course is intended to aid student teams formed in or before the StartUp Class to achieve the outcome of a new technological venture – or entrepreneurship.

# Closure



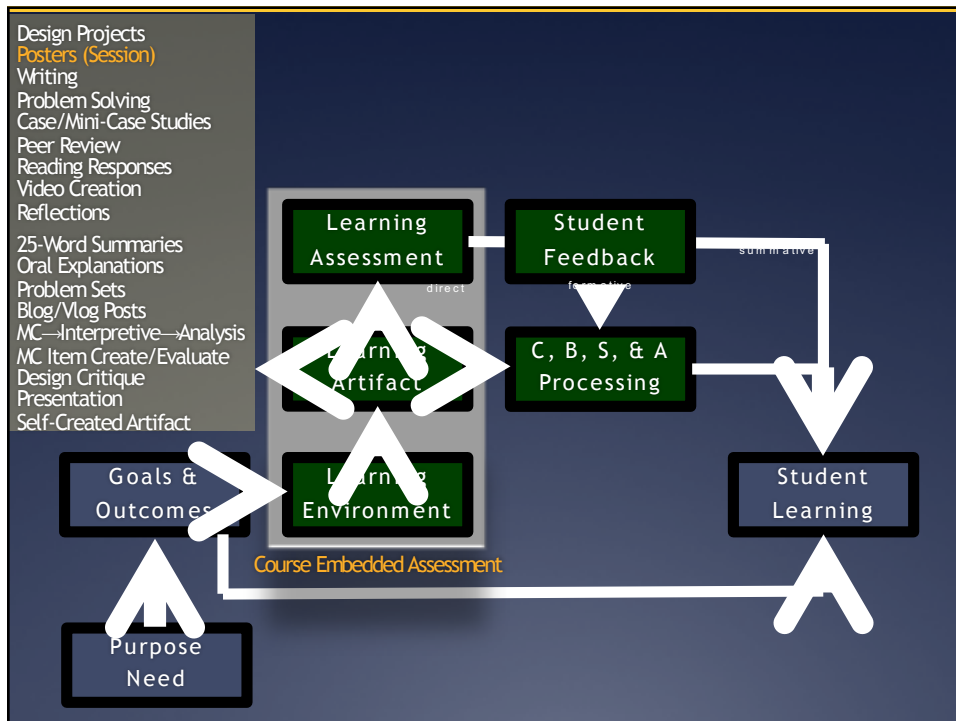
integration



# 6 Principles for Developing Deep & Flexible Knowledge

1. Learning through **practice at retrieval**
2. Learning through **varied tasks and purposes**
3. Learning at the **principle** level
4. Learning **awareness** and **control** (metacognition)
5. Learning in response to **developmental feedback**
6. Learning embedded in **prior knowledge & experience**

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





## Instructional Strategies

1. 25-Word Summaries
2. A Reading in Quotes
3. Academic Haiku Summaries
4. Anticipation Guides
5. Concept Development
6. Concept Maps
7. Exit Slips
8. Graffiti
9. Fishbowl
10. Individualized Project
11. Jigsaw (Group Work)
12. Just-in-Time Teaching
13. Oral Explanations
14. Poster Session
15. Reciprocal Teaching
16. Think Aloud Video Explanations
17. Think-Pair-Share (-Square)
18. 3-Min Standing Conversation
19. Video Interpretation
20. Whip Around

To innovate  
is to make things better.

Innovate a program, course, or strategy  
to increase student learning.

Solve a Problem  
I'm Stuck! Walk Away  
Build on Others  
Work Hard. Don't Aha!  
Don't Wait. Do It.

# Active Learning, Proactive Teaching, Deep and Flexible Knowing



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