Research in Teaching and Learning Forum

# The Cognitive Challenges of Effective Teaching

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# Goals for this Presentation

- Describe the weakness of the current "best practices" approach to teaching
- Discuss the contextual nature of teaching and learning
- Describe a research-based framework of nine cognitive challenges that captures the contextual nature of learning
- Discuss strategies that teachers can use for addressing each cognitive challenge.



### What Teachers Know

Disciplinary knowledge, Pedagogical content knowledge, How people learn

- All teachers have a mental model of how people learn best
  - Select, implement, and adapt pedagogy
- If the model is accurate, teaching will be effective, but if the model is flawed or incomplete, teaching will suffer
- Students have a mental model of how they learn best





### Two Truths and a Lie

Two of the following statements are *Truths* about effective studying; one is a *Lie*. Pick the lie.

- 1. Highlighting text does NOT help you learn the material
- 2. Re-reading material multiple times is NOT an effective learning strategy
- 3. Effective learning is a combination of time, effort, and motivation.

### Another One

- 1. Being raised with easy digital access to multiple sources of information and social media does NOT make you better at multi-tasking
- 2. A good way to study is to match the way you study to your personal learning style
- 3. The key to long-term learning is to learn, forget, then re-learn.

### **Learning is Contextual**

- Successful learning, and therefore successful teaching, depends on a complex interaction of multiple factors
- Any practice can be implemented well or poorly
- Every class has its own character
- There are no "best practices"

# How We Study Learning and How We Teach

#### How We Study Teaching and Learning

Student Mental Mindset Metacognition and Self-regulation Student Fear and Mistrust Lack of Prior Knowledge

Misconceptions

Ineffective Learning **Strategies** 



Constraints of Selective Attention

Constraints of Mental Effort and Working Memory

#### How We Teach



https://pxhere.com/en/photo/143255?utm content=shareClip&utm medium=referral&utm source=pxhere

# The Cognitive Challenges of Effective Teaching

- What common challenges do all teachers have to solve?
- How teachers solve a challenge depends on their teaching context
  - Teaching is constant **planning**, **assessment** and **adaptation**

The Cognitive Challenges to Teaching (that we know about thus far)

- 1) Student Mental Mindset
- 2) Metacognition and Self-regulation
- 3) Student Fear and Mistrust
- 4) Lack of Prior Knowledge
- 5) Misconceptions
- 6) Ineffective Learning Strategies
- 7) Transfer of Learning
- 8) Constraints of Selective Attention
- 9) Constraints of Mental Effort and Working Memory

And they all interact with each other!

What What **Mental Mindset Misconceptions Students Students** Fear and Mistrust **Prior Knowledge Metacognition & Self-**Transfer of **Believe** Know regulation Learning **Four Types of Challenges** Constraints of What How **Ineffective Learning Selective Attention Strategies Students Students Constraints of Metacognition &** Learn **Can Do Mental Effort & Self-Regulation** Working Memory

### What Students Believe:

### **Setting Expectations**



**Student Mental Mindset** 

I already know all this stuff

Metacognition

This is where they weed out the people who don't belong

**Student Fear and Mistrust** 

# Beliefs about Learning that Make You Stupid

- Learning is fast
- Being good at a subject is a matter of inborn talent rather than hard work
- Knowledge is composed of isolated facts
- I'm really good at multi-tasking, especially during class or studying

### Academic Mindset for Productive Persistence (Farrington, 2013)

- 1. I belong in this academic community
  - Belongingness
- 2. My ability and competence grow with my effort
  - Growth Mindset
- 3. I can succeed at this
  - Academic Self-efficacy
- 4. This work has value for me
  - Curiosity

### The Teacher's Mindset Influences their Students' Mindsets

### Student Trust in the Teacher

Students' willingness to risk vulnerability and pursue challenging work due to the belief that a teacher is competent, will demonstrate integrity, and will act in ways that are beneficial to students' learning and development

- Competence: Has the knowledge and ability to fulfill teaching obligations
- Integrity: Is truthful, conscientious, and respectful of students
- Beneficence: Works to promote and enhance student learning and development

### Wise Feedback (Yeager et al., 2012)





- 1) I am holding the class to high standards
- 2) You have the ability to reach those standards
- 3) I will provide you with needed resources

• Your paper contains a number of errors that are easily correctable. I can see that you are using some inefficient strategies to solve some of these problems. Please come by my office hours next week and let me go over this with you; I think I can really help you with this. (Anderman, 2016)

## Metacognition

- A student's awareness of their level of understanding of a topic
- Metacognition distinguishes between stronger and weaker students
- Struggling students tend to be highly overconfident

# Self-Rating

What is your best, most accurate judgment of the percentage of questions that you answered correctly on this exam? Your answer may range from 0 to 100%

% correct

### Estimated and Actual Grades for 800 Students: Econ 101



# Improving Metacognition

- Give students opportunities to test their knowledge and get feedback about their level of understanding
- Teach them how to use the feedback
- Build self-assessment skill

### The Challenge of What Students Believe

The Challenge	Defined	<b>Possible Solutions</b>
Student Mental Mindset	Student beliefs about the value of a topic, how hard they expect to work, & how well they expect to do	Explain the purpose and value of work & what is involved in doing well; promote belonging and productive persistence
Fear and Mistrust	Student fears about teacher judgment and failure	Acknowledge fears & provide wise feedback
Metacognition	Student beliefs about their level of mastery of course content	Provide ample low-stakes opportunities for feedback about learning & instruct students how to use feedback

### What Students Know: Using Knowledge



### Prior Knowledge Predicts Learning

"I've got King Five suited in the Big Blind. There's a straddle on. The Button then raises to 40. I call for 30 more. The Under the Gun calls. We're going three ways to the flop. Its Jack, Six, Four, rainbow."

> Brad Owen, Professional Poker Player



VLOG 177: https://youtu.be/G9itw9IVm s



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Source: Wieman & Perkins (2005). Transforming physics education. *Physics Today*, 58(11), p.36.

## Inert Knowledge

 Students have relevant prior knowledge but fail to access it or apply it in novel situations

– Failure of transfer

- All new learning is context dependent
- Students often fail to see the relevance of what they learn beyond doing well on the exam

### The Challenge of What Students Know

# **The Challenge Insufficient Prior** Knowledge **Misconceptions**

**Transfer of Learning** 

Students lack the prior knowledge needed to make sense of new information

Defined

Students hold faulty or mistaken beliefs about the content that lead them to misinterpret or reject new information

### Students fail to apply their knowledge to new problems and situations

### **Possible Solutions**

Provide supplemental instruction to help students acquire relevant prior knowledge

Activate misconceptions then provide accurate versions of the concepts

Provide opportunities for students to practice applying their knowledge to new problems and contexts

### What Students Can Do: Recognizing Constraints



### Selective Attention

Attention is like a small spotlight in a darkened room.

- Narrow focus
- Anything that draws attention away from what we should be focusing on hurts learning
- We miss anything outside our focus of awareness

# **Inattentional Blindness**

We miss most everything outside our focus of attention, and we are unaware that we missed anything

# What the Distracted Driver Sees (or Misses) (Strayer, et al., 2011)



**Figure 8** A representation of what a driver might perceive when they are not talking on the phone (left panel) and when they are talking on a hands-free cell phone (right panel).

### The Importance of **Undivided** Attention

- NO evidence that multi-tasking is as effective as concentrating on one task at a time
- Even small distractions significantly reduce learning
  - Resisting temptation is a distraction
- There is no such thing as a *momentary* distraction
- Remove distractions from your presence
- Focused attention isn't so much about willpower as it is about your environment



### **Beware Seductive Details**

Highly interesting and entertaining information that is only tangentially related to the topic but is irrelevant to the author's intended theme







Much of teaching is attention management

### **Cognitive Load Theory**

(e.g., van Merrienboer & Sweller, 2005)

- *Mental effort:* the amount of concentration a person has available
  - Always a limited resource
- **Cognitive Load:** the total amount of mental effort a task requires to complete it
- A person can do multiple tasks as long as the total cognitive load does not exceed available mental effort
- If cognitive load exceeds available mental effort, then performance suffers



# Student mental effort must meet the demands of instructional cognitive load



# Name the days of the week out loud and in order as fast as you can

# About this Activity

- Were you *engaged*?
- Were you *active*?
- Were you *practicing retrieval?*
- Were you working hard and struggling?
- What was the 4<sup>th</sup> day in the list?

# The Days of the Week

(In Alphabetical Order)

- 1) Friday
- 2) Monday
- 3) Saturday
- 4) Sunday
- 5) Thursday
- 6) Tuesday
- 7) Wednesday

### Implications of Cognitive Load Theory

- If the cognitive load exceeds available mental effort, then learning will not occur
- If the cognitive load takes up most or all of available cognitive effort, then there will not be enough mental effort available for learning or schema formation

### The Challenge of What Students Can Do

The Challenge	Defined	<b>Possible Solutions</b>
Selective Attention	People have a narrow focus of awareness and miss anything outside that focus	Have only one clearly defined focus of attention during class
Mental Effort/Working Memory	People are limited in how hard they can concentrate and how much information they can store in conscious memory	Present information in manageable, coherent chunks and promote student reflection

### How Students Develop: Guiding Learning

You should all be thinking about getting ready for the next exam.

I have three exams that day—what can I do? I'll just study for all of them whenever I have time.

Poor Self-Regulation

I'll retype my lecture notes and read them over a few times.

### Ineffective Learning Strategies

I'll block out the day before the exam to study

# Effective Learning Depends on

- Storage Strength: Encoding information in a way that optimizes meaningful associations and minimizes confusions
- Retrieval Strength: Optimizing the likelihood that information will be recalled and applied accurately when appropriate

### Improving Storage and Retrieval Strength

### **Storage Strength**

- Elaboration: Making meaningful associations
- Distinctiveness: Focus on key distinctions
- Chunking: Building coherent, meaningful groups of information
- Personalization: Making a personal connection
- Overlearning: Going beyond bare mastery
- Working through examples

### **Retrieval Strength**

- Retrieval practice or self-testing
- Spaced practice
- Interleaving
- Deliberate practice

### What Doesn't Lead to Effective Learning

- Time spent studying
- Effort
- Repetition
- Highlighting
- Familiarity with material
- Motivation to learn
- Learning Styles
- Memorization of isolated facts
- Studying while distracted or Multi-tasking

# **Bad Study Strategies**

- Are usually easy to do, e.g., rote memorization of key terms, highlighting only key terms, reading only chapter summaries; "studying" with friends, studying with distractions
- They promote familiarity, not learning
  - Mindless re-reading or skimming
- They lead to shallow processing
- They build false confidence

### The Challenge of How Students Learn

The Challenge	Defined	<b>Possible Solutions</b>
Ineffective Learning Strategies	Students use ineffective learning strategies that limit their learning	Incorporate effective strategies such as self-testing and self- explanation in the course
Self-Regulation	Students have difficulty planning, monitoring, evaluating and regulate their learning	Adopt assignments in which students plan how to study for exams and work on course projects

WhatMental MindsetWhatMisconceptionsStudentsFear and MistrustStudentsPrior KnowledgeBelieveMetacognition & Self-<br/>regulationKnowTransfer of<br/>Learning

# **Our Challenges**

What Students Can Do Constraints of Selective Attention Constraints of Mental Effort & Working Memory How Students Learn

Ineffective Learning Strategies

Metacognition & Self-Regulation

### Best Practices vs. Cognitive Challenges

- Learning is contextual, therefore teaching is contextual
- There is no such thing as best practices
- The Cognitive Challenge Framework captures the complexity of teaching

Effective teaching is more than just selecting the "best" practice, it is knowing how to get the best from the practices you select

Shank You

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QUESTIONS

# More on the Cognitive Challenges of Effective Teaching

### Cognitive Challenges of Effective Teaching

Bill Cerbin

Psychology Teacher Network (2021)

https://tinyurl.com/yk9czv7x



We Can Do Better than "Best Practices" Stephen L. Chew *The Teaching Professor* (2023) <u>https://t.co/RZ4N1b3jhi</u>



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### Video Series: How to Get the Most Out of Studying

Webpage: <a href="http://www.samford.edu/how-to-study/">http://www.samford.edu/how-to-study/</a>

- (Optional) Introductory Video: Developing a Mindset for Successful Learning
- Video 1: Beliefs That Make You Fail...Or Succeed
- Video 2: What Students Should Understand About How People Learn
- Video 3: Cognitive Principles for Optimizing Learning
- Video 4: Putting the Principles for Optimizing Learning into Practice
- Video 5: I Blew the Exam, Now What?





### How to Learn in Pandemic Times

### https://youtu.be/XOKG2LrnwYo



# APA Study Skills Module

 The APA IPI Study Skills Module: <u>https://bit.ly/3epVPHO</u>

The APA Introductory Psychology Initiative

Lesson Plan: Improving Study Skills through Psychological Science

Instructions for Instructors

- Complete lesson plan with lecture This lesson plan outlines an introduction to effective study skills that can be integrated into your outline and slides
- Activities and Demonstrations
- Formative and summative assessments



### Video Series: The Cognitive Challenges of Effective Teaching Playlist: <u>https://tinyurl.com/yfgg8au3</u>

- 1. Introduction and Overview <u>https://youtu.be/tUdSxYIVAPM</u> (13:23)
- 2. Student Mental Mindset and Student Fear and Mistrust https://youtu.be/BUhZZCg3KzA (15:36)
- 3. Ineffective Learning Strategies <a href="https://youtu.be/KfkX-lpG3sQ">https://youtu.be/KfkX-lpG3sQ</a> (14:43)
- 4. Metacognition and Self-Regulation <a href="https://youtu.be/4brOiCjMxp0">https://youtu.be/4brOiCjMxp0</a> (8:52)
- 5. Prior Knowledge and Misconceptions <a href="https://youtu.be/lbXvQG5cNxQ">https://youtu.be/lbXvQG5cNxQ</a> (10:35)
- 6. Transfer of Learning <a href="https://youtu.be/UiPPxDFQM2E">https://youtu.be/UiPPxDFQM2E</a> (12:21)
- 7. Constraints of Selective Attention <a href="https://youtu.be/ZKL8bNeLFLk">https://youtu.be/ZKL8bNeLFLk</a> (13:53)
- 8. Constraints of Mental Effort and Working Memory <u>https://youtu.be/BeLuGzbyqus</u> (16:02)
- Implications of the Cognitive Challenges
  Framework <u>https://youtu.be/QXgqJxKGsr4</u> (22:50)

