Fostering Higher-Order Learning Outcomes in Graduate Education: A Role for Science of Learning

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Acknowledgments

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• Special thanks to my collaborator, Catherine Overson, and to the faculty and graduate students who have worked with us on the projects described in this presentation.
Linking Kind of Knowledge, Learning Processes, and Instructional Method
My Four-Year Introduction to the Battle of Gettysburg
Pulling it Together
# Learning, Instruction, & Activity

<table>
<thead>
<tr>
<th>Learning Objective</th>
<th>Instructional Principle</th>
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## Taxonomies of Knowledge, Learning, & Instruction

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Numerous Studies on Fact Learning


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<td>Levels of Analysis</td>
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<td>(e.g., Theater Security Decision</td>
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Interleaving: Revisiting the Past

Course: Statistical Reasoning

Overson, Stiegler-Balfour, Tappin, Melville, & Benassi, 2016
WHAT WE DID
Study Background:
Sequence of Instruction and Quizzing

- **Statistical test is covered**
  - Reading and instruction by teacher

- **Completion of online module on the statistical test**
  - Review of Material on statistical test, including conditions to be met to use the test

- **Quiz**
  - **Non-Interleaving**: Quiz on the current statistical test only
  - **Interleaving**: Quiz on both the current statistical test and on previous tests

- **Repeat until all statistical tests addressed**
## Eight Statistical Tests

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<tr>
<td>z test</td>
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<tr>
<td>Single sample t</td>
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<tr>
<td>Correlated-groups t</td>
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<tr>
<td>Between-groups t</td>
</tr>
<tr>
<td>ANOVA</td>
</tr>
<tr>
<td>Chi Square</td>
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<tr>
<td>Correlation</td>
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<td>Regression</td>
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Experimental Manipulation Within Course

Statistical Reasoning (Rasco)

N = 38
Comparing Question Conditions

RESULTS
Mean Proportion Correct on Final Exam on Choosing the Appropriate Statistical Test

one sided p < .03

Error bars: 95% CI
How might you incorporate this principle into your courses?
### Taxonomies of Knowledge, Learning, & Instruction

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<td>e.g. Strategy &amp;</td>
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<td>Policy Course</td>
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<td>“Skilled in applying naval perspective through use of analytical frameworks.”</td>
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Self-Explanation: Making sense and meaning of new information

Course: Biological Science
N = 148

Overson, Benassi, Richardson, Kordonowy, 2017
Self-explanation

- Constructive learning strategy
- Self-monitoring of evolving understanding
  - Review new material
  - Relate information to prior knowledge
  - Generate questions based on new understanding
- Mechanism
  - Identification of gaps in learning
  - Helps modify flawed, existing mental models
WHAT WE DID
Student Learning Activity

• Read assigned material
• Responded to prompts after each reading section
  1. What information is new?
  2. How do the new ideas work with what you already know?
  3. List two “I wonder (if, whether, why, how, which, where, who, etc.) …” questions that you have as a result of reading this section
Research Design

• Random assignment to one of two groups
  – Self-explanation group
  – Summary group
Comparing Question Conditions

RESULTS
Does background ability matter?
Mean Performance

SATVLoHi

Error bars: 95% CI
How might you incorporate this principle into your courses?
Team Based Learning

Approach is particularly well-suited for graduate level courses that focus on higher order thinking, problem-solving, etc.
Readiness Assurance

• Pre-training
  – Lecture-capture
  – Videos
  – Reading Materials

• Could be quizzes, discussion posts, etc.
  – Individual
  – Team with feedback
Application Activities

- Case studies
- Problem solving
- Gaming Scenarios
- Lessons Learned Activities
Each team member has a role to play in the application activity.

The “Problem”

- Collaborative work to find solutions
- Cognitive conflict leads to learning
- Builds on prior knowledge
- Lacks a single right answer
- Open-ended with no clear defined solution
- Promotes Reflective Thought
TBL Process

- **Preparation**
  - Clear, measurable, and developmentally-appropriate learning objectives
  - In-class **Pre-training** to provoke discussion and guide students’ exploration
  - Out of class **exploration**

- **Application**
  - In-class group work
  - Out of class exploration

- **Assessment**
  - Group **Debriefing**
  - Team **project**
    - Paper
    - Presentation
  - Peer and self-**evaluation**
Beth Stewart
OT Therapy Intervention for Adults
N = 63 Students
Senior Undergrad/Graduate Students
Comparing Question Conditions

RESULTS
Percentage Correct on Exam by Activity Condition

Activity Condition

Solo

Team

Diff

Percent Correct on Midterm Exam

Mean Difference Score

95% Confidence Interval
How might you incorporate this principle into your courses?


Conclusions and Recommendations

• Do your courses already incorporate the kinds of principles I have discussed today?
• You can incorporate evidence-based principles, informed by science of learning, into your courses.
• You can expect to observe strong learning outcomes among your students.
Conclusions and Recommendations

• We have just scratched the service.

• Here are some sources:
Resource

Some User-Friendly websites

• Retrieval Practice
  http://www.retrievalpractice.org
  Pooja Argarwal

• The Learning Scientists
  http://www.learningscientists.org
  Megan Smith and Yana Weinstein
Some Accessible Videos

• Deep Learning (M. Chi)
  https://www.youtube.com/watch?v=uC-9lViDGL0

• How People Learn (H. Roedinger)
  https://www.youtube.com/watch?v=4tz8gVPHhFE

• Teaching, Learning, and Technology: A Role for Science of Learning (V. Benassi)
  https://www.youtube.com/watch?v=NG439BzFh7I
Thank you