How to increase cognitive and affective gains in student performance?

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“All discussion of reform must begin with the ordinary student, not the genius, not the prospective scientist or professor of abnormal psychology but the citizen of the republic who must earn a living in addition to living a humane life.” - Paige Smith, *Killing the Spirit: Higher Education in America*, 1990, p. 200

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IN THE CLASSROOM
Given a 50 minute class that is of medium interest to a student, approximately at what time does the attention wane and stay waned?

A. 5 minutes
B. 10 minutes
C. 25 minutes
D. 40 minutes
Solution: Active Learning

“Defined as where a student actively constructs knowledge”

Sources and References: Active Learning Leads to Higher Grades and Fewer Failing Students in Science, Math, and Engineering, Active learning increases student performance in science, engineering, and mathematics
Reflection Exercise

What simple 1-2 minute exercises can we use in the classroom for active learning?
Reflection Exercise

What common mistakes do instructors make in incorporating active learning?
Personal Response Systems

Source: Turning Technologies
What are the goals of using clickers?

• Measure prior knowledge.
• Engage students in active learning.
• Promote peer-to-peer interaction.
• Provide their own understanding.
• Model the process of critical thinking.
• Sends a message that instructor is vested in student learning.

Source: Clicker Resource Guide
What type of questions should I ask?

• **Stage 1**: If you are new to clickers yourself, ask simple questions.

• **Stage 2**: Ask challenging conceptual questions.

• **Stage 3**: Structure the clicker questions around the lecture.

Source: Clicker Resource Guide
Reflection Exercise

Let us develop one conceptual clicker question for a topic of your favorite course.
Reflection Exercise

Let us list the type of clicker questions that are of high impact.
Ten Common Learning Techniques

1. Elaborative interrogation
2. Self-explanation
3. Summarization
4. Highlighting/underlining
5. Keyword mnemonic
6. Imagery for text
7. Rereading
8. Practice testing
9. Distributed practice
10. Interleaved practice

## Ten Common Learning Techniques

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Elaborative interrogation</td>
<td>Moderate</td>
</tr>
<tr>
<td>2.</td>
<td>Self-explanation</td>
<td>Moderate</td>
</tr>
<tr>
<td>3.</td>
<td>Summarization</td>
<td>Low</td>
</tr>
<tr>
<td>4.</td>
<td>Highlighting/underlining</td>
<td>Low</td>
</tr>
<tr>
<td>5.</td>
<td>Keyword mnemonic</td>
<td>Low</td>
</tr>
<tr>
<td>6.</td>
<td>Imagery for text</td>
<td>Low</td>
</tr>
<tr>
<td>7.</td>
<td>Rereading</td>
<td>Low</td>
</tr>
<tr>
<td>8.</td>
<td>Practice testing</td>
<td>High</td>
</tr>
<tr>
<td>9.</td>
<td>Distributed practice</td>
<td>High</td>
</tr>
<tr>
<td>10.</td>
<td>Interleaved practice</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Source: [Improving Students’ Learning with Effective Learning Techniques](https://www.psychologicalscience.org/psti/14/5/31), Psychological Science in the Public Interest, Vol. 14, 2013
Interleaved Practice

Practice Performance

<table>
<thead>
<tr>
<th>Practice Type</th>
<th>Accuracy</th>
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<tbody>
<tr>
<td>Mixers</td>
<td>60%</td>
</tr>
<tr>
<td>Blockers</td>
<td>89%</td>
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</tbody>
</table>

Test Performance

<table>
<thead>
<tr>
<th>Practice Type</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixers</td>
<td>63%</td>
</tr>
<tr>
<td>Blockers</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: Interleaved Practice: A Secret Enhanced Learning Technique, Jake Jenkins, April 29, 2013,
Practice Testing

Source: Rethinking the Use of Tests: A Meta-Analysis of Practice Testing
Question 3

The minimum number of zero elements in a 403x403 coefficient matrix at the end of 101 steps of forward elimination is
RECENT PEDAGOGIES
What is flipped learning?

A. Watch lecture at home and do problems in class
B. Direct instruction moves from group learning space, and group space is used for dynamic, interactive and engaging activities
C. Way of designing courses that emphasize self-regulated learning and deep learning on a personal level

Source: FlippedLearning.org & Flipping the College Classroom by Barbi Honeycutt
Why teach the flipped class?

• Interact with lecture videos and textbook on own. Schedule yourself and watch several times.
• Class time can be used for higher level thinking skills.
• Student engagement and motivation increase due to accountability and interactions.
## Flipped vs Blended (effect size)

<table>
<thead>
<tr>
<th>University</th>
<th>Sample Size (Flip/Blended)</th>
<th>Lower Order</th>
<th>Higher Order</th>
<th>Student Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>USF</td>
<td>88/126</td>
<td>Trivial</td>
<td>Trivial</td>
<td>Medium</td>
</tr>
<tr>
<td>ASU</td>
<td>69/76</td>
<td>Trivial</td>
<td>Small</td>
<td>Small</td>
</tr>
<tr>
<td>AAMU</td>
<td>23/13</td>
<td>Large</td>
<td>Small</td>
<td>Large</td>
</tr>
<tr>
<td>Overall</td>
<td>180/215</td>
<td>Trivial</td>
<td>Trivial</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Sources: Evaluating Blended and Flipped Instruction in Numerical Methods at Multiple Engineering Schools by Clark, Kaw, Lou, Scott, Besterfield-Sacre, under review; Editorial on Flipped Classrooms in STEM; Several articles on use of flipped in STEM
What does adaptive learning involve?

A. Uses data to give and improve pathways to learning
B. Uses pre-set configurations
C. Is rule-based and uses decision trees
Adaptive Learning

- Pre-set categories
- Data driven and improves
- Rules-based and decision tree

Sources: [http://Knewton.com](http://Knewton.com); What is adaptive learning
Adaptive Learning Analytics

Source: http://SmartSparrow.com
## Adaptive Learning Results

<table>
<thead>
<tr>
<th>ASU Math Readiness</th>
<th>Fall 2009-Spring 2011</th>
<th>Fall 2011-Spring 2012 (with Knewton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass Rates</td>
<td>64%</td>
<td>75%</td>
</tr>
<tr>
<td>Withdrawal Rates</td>
<td>16%</td>
<td>7%</td>
</tr>
<tr>
<td>Students Finishing Early</td>
<td>n/a</td>
<td>45%</td>
</tr>
</tbody>
</table>

Source: [https://www.knewton.com/asu/](https://www.knewton.com/asu/)
Adaptive Learning MetaStudy

Figure 11. Blended Adaptive vs. Blended Course Completion

Course
- ASU Math 117 (1/3)
- UNG English (1/3)
- UNG ESLR (1/1)

Average Effect Size (across terms)

Source: Lessons Learned From Early Implementations of Adaptive
Adaptive Learning MetaStudy

Figure 12. Blended Adaptive vs. Blended Course Grades for Pell Grant Students

Source: Lessons Learned From Early Implementations of Adaptive
How to increase cognitive and affective gains in student performance?

QUESTIONS?

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