

How to increase cognitive and affective gains in student performance?

Autar Kaw

<http://AutarKaw.com>

University of South Florida



“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

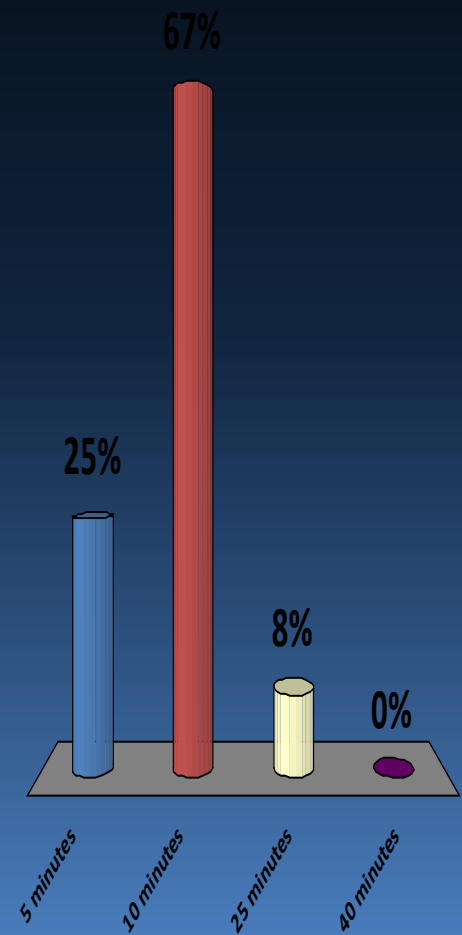
Some of this material is based upon work supported partially by the National Science Foundation under Grant Number 1322586. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

TPSE Chairs+1 Conference#2, College Park, MD, March 11, 2017

IN THE CLASSROOM

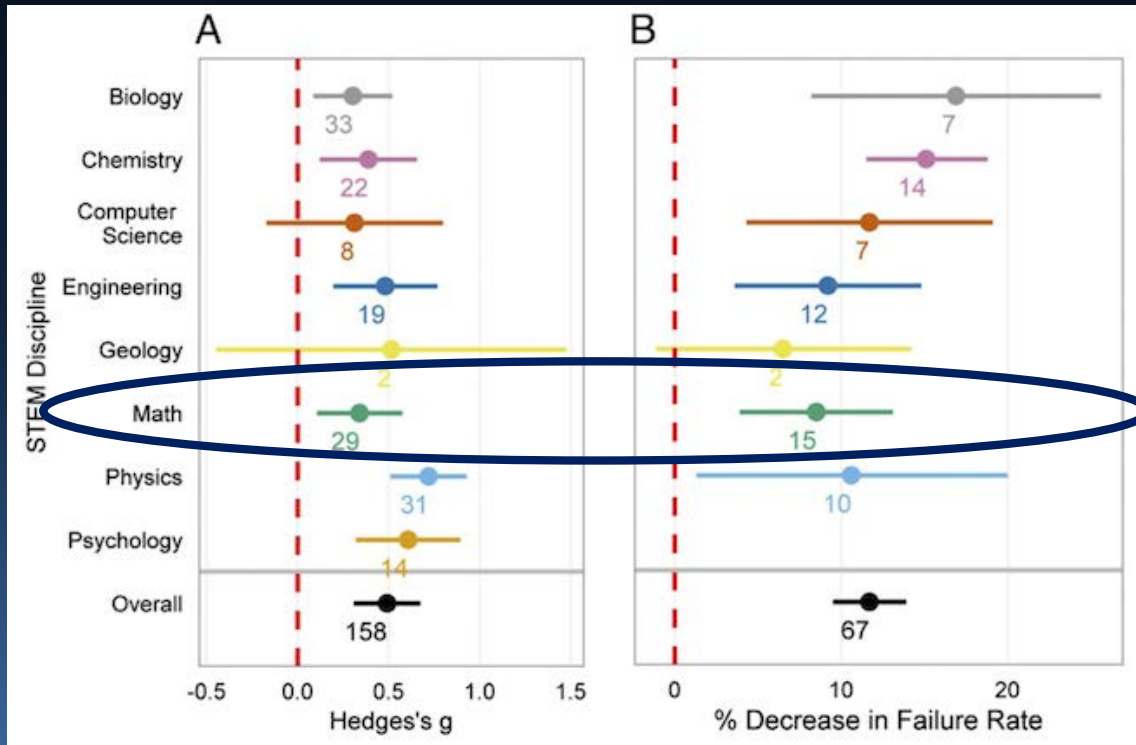
Given a 50 minute class that is of medium interest to a student, approximately at what time does the attention wane and stay waned

- 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](http://www.turningtechnologies.com)

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.

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.

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.

LEARNING TECHNIQUES

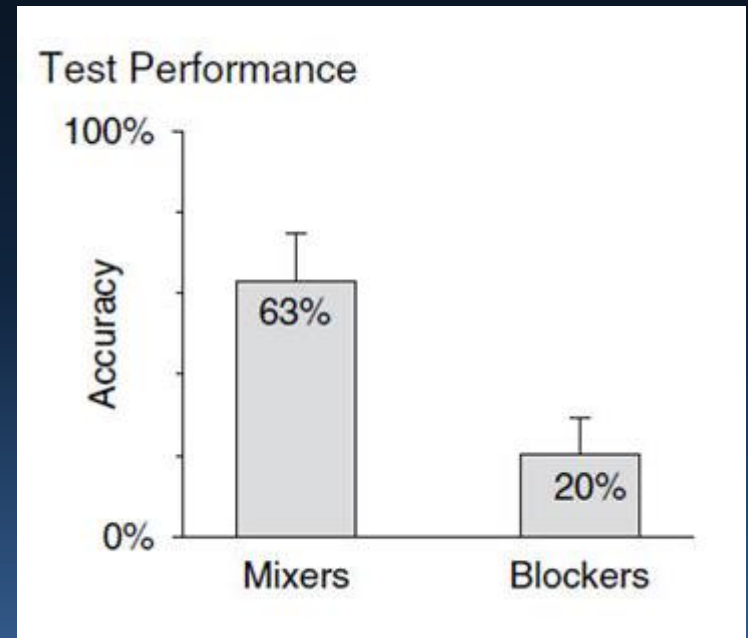
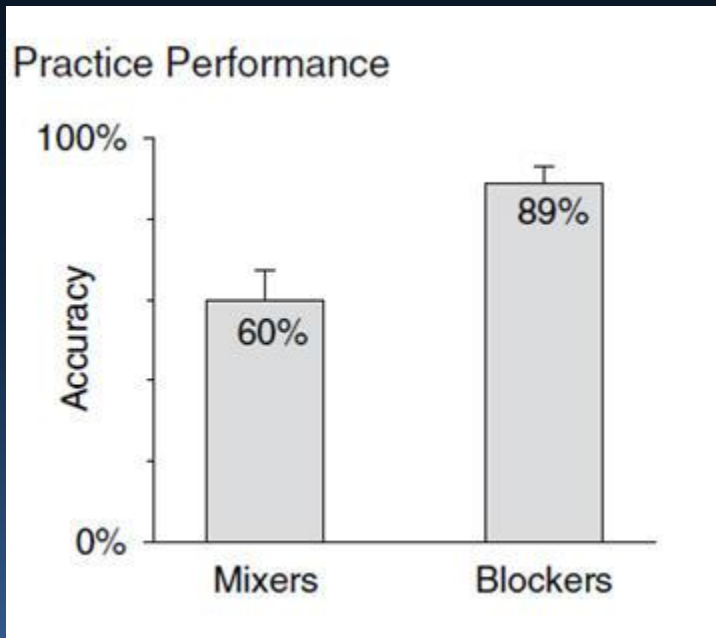
Ten Common Learning Techniques

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

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

Interleaved Practice



Practice Testing

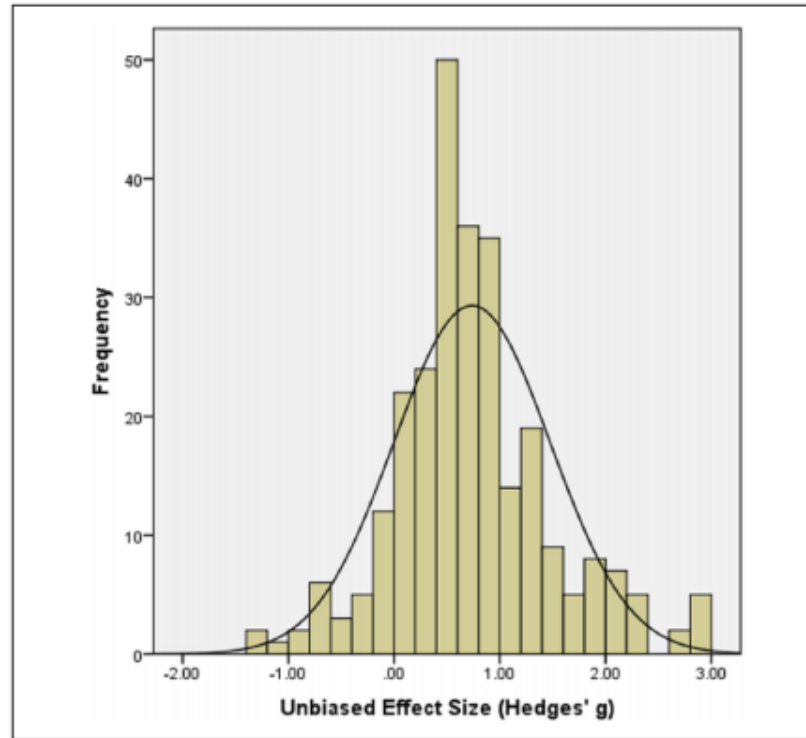


FIGURE 2. *Distribution of 272 independent effect sizes obtained from 118 articles (M = 0.74, SD = 0.74).*

Distributed Practice

Question 3

1 pts

The minimum number of zero elements in a 403×403 coefficient matrix at the end of 101 steps of forward elimination is

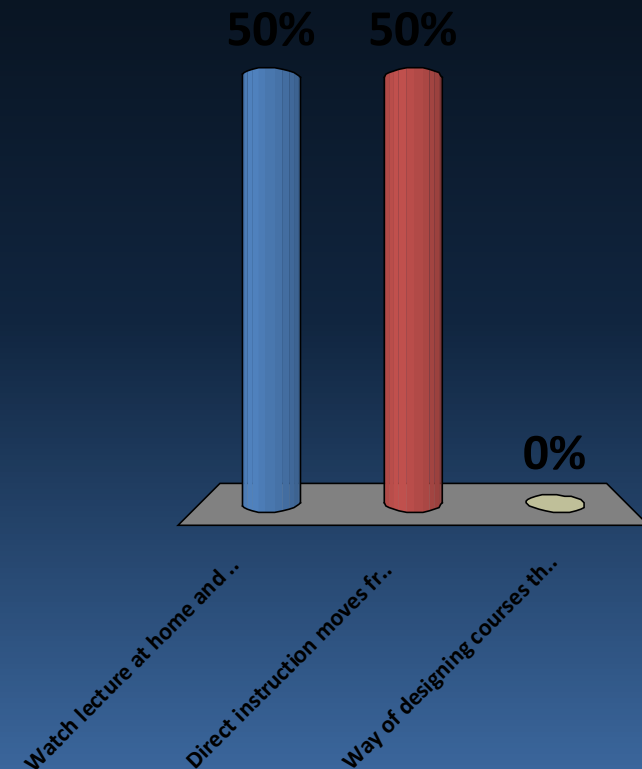
Not saved

Submit Quiz

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



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.

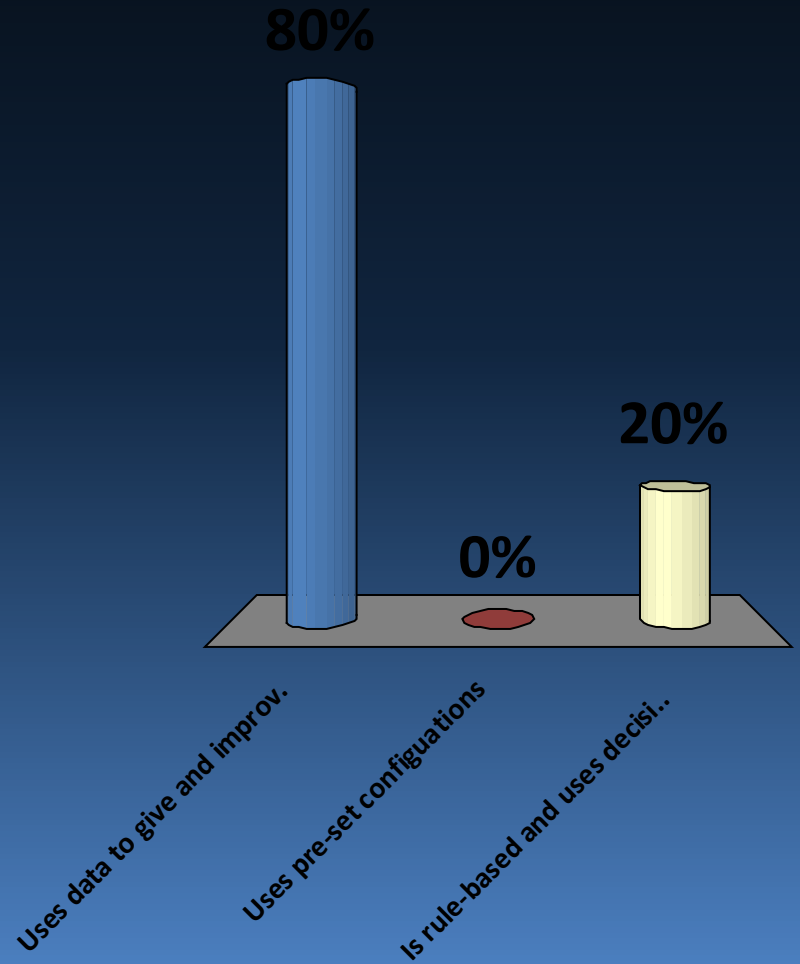
Flipped vs Blended (effect size)

University	Sample Size (Flip/Blended)	Lower Order	Higher Order	Student Satisfaction
USF	88/126	Trivial +ve	Trivial -ve	Medium -ve
ASU	69/76	Trivial +ve	Small +ve	Small +ve
AAMU	23/13	Large -ve	Small -ve	Large -ve
Overall	180/215	Trivial -ve	Trivial +ve	N/A

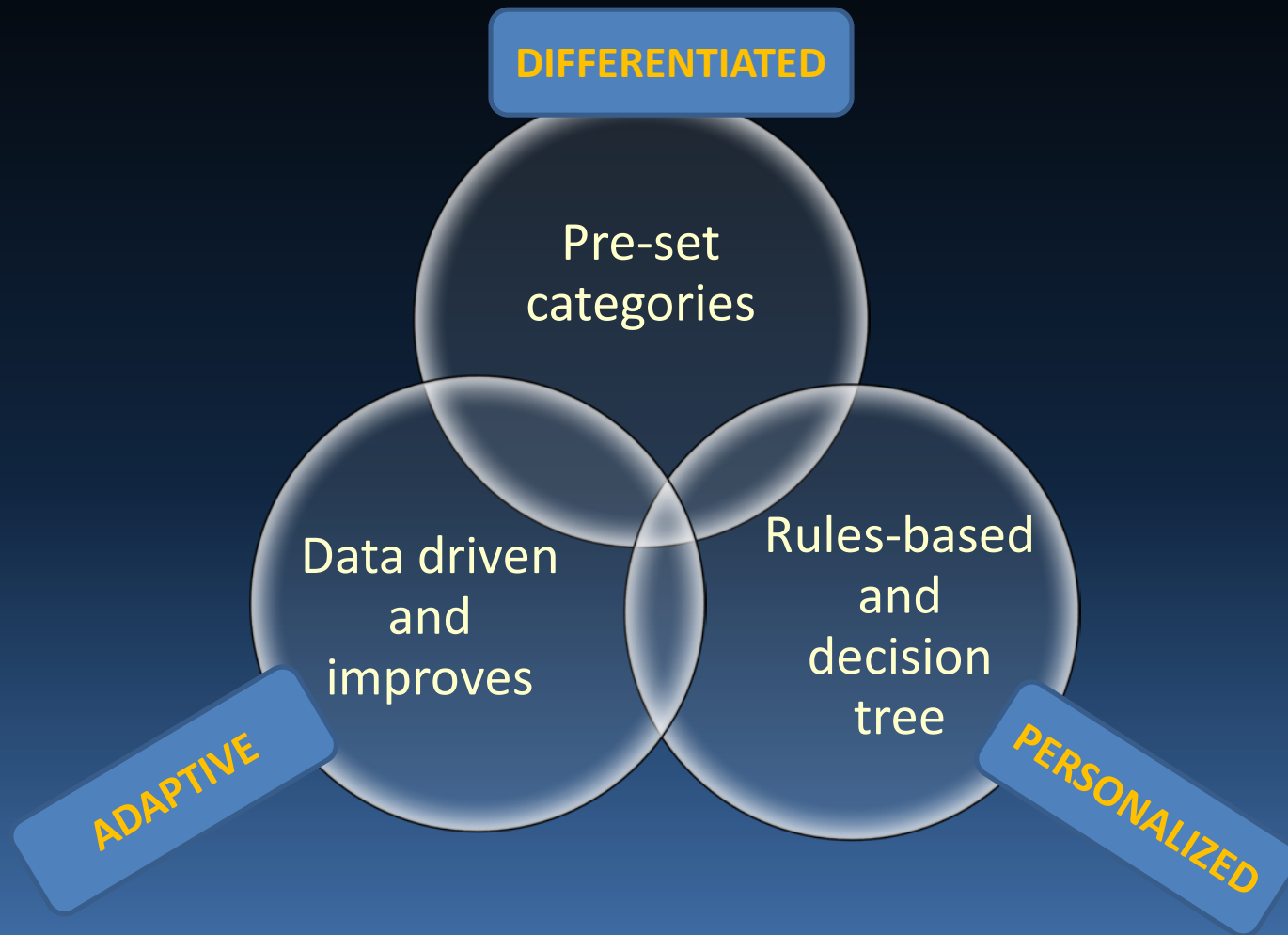
Sources: Evaluating Blended and Flipped Instruction in Numerical Methods at Multiple Engineering Schools by Clark, Kaw, Lou, Scott, Besterfield-Sacre, under review; [Editorial on Flipped Classrooms in STEM](#); [Several articles on use of flipped in STEM](#)

What does adaptive learning involve?

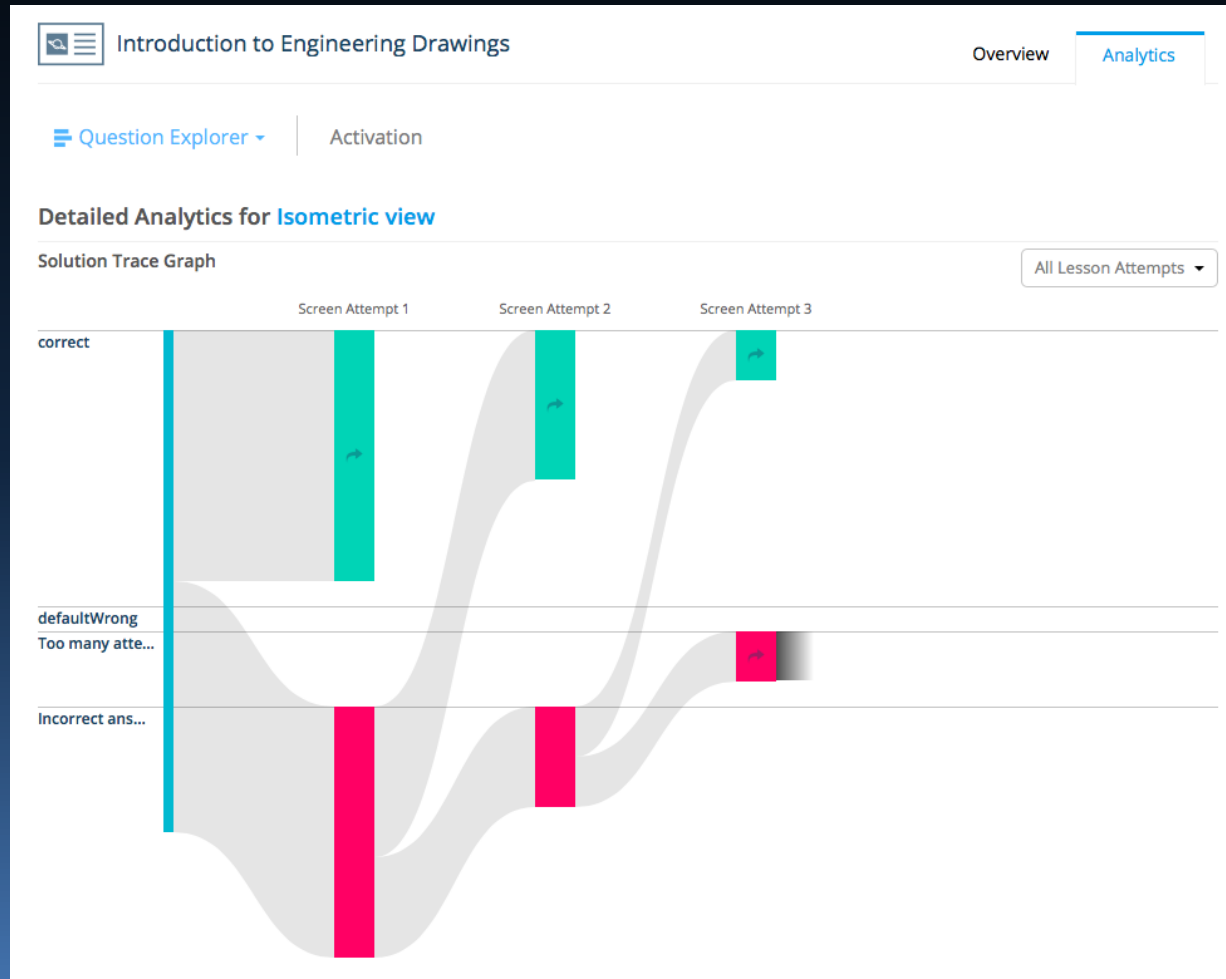
- A. Uses data to give and improve pathways to learning
- B. Uses pre-set configurations
- C. Is rule-based and uses decision trees



Adaptive Learning



Adaptive Learning Analytics

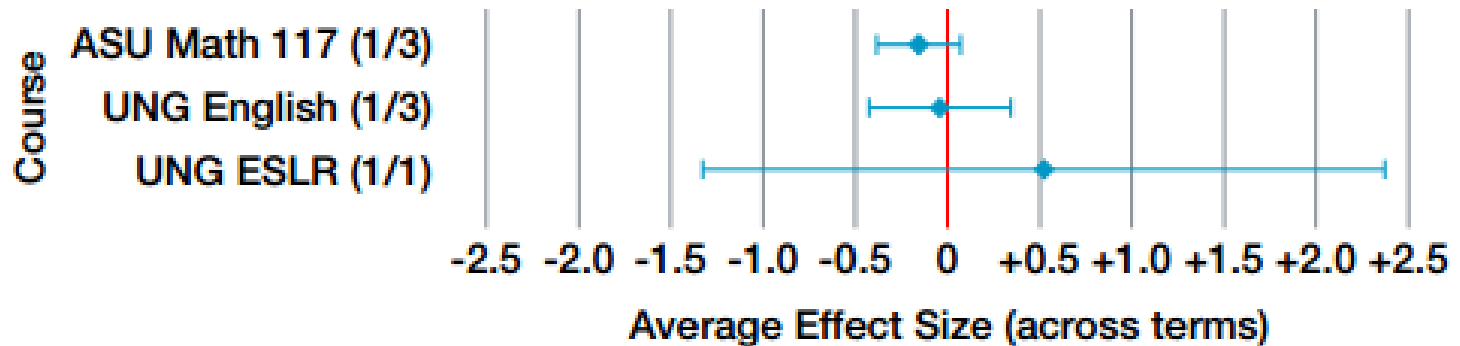


Adaptive Learning Results

ASU Math Readiness	Fall 2009- Spring 2011	Fall 2011- Spring 2012 (with Knewton)
Pass Rates	64%	75%
Withdrawal Rates	16%	7%
Students Finishing Early	n/a	45%

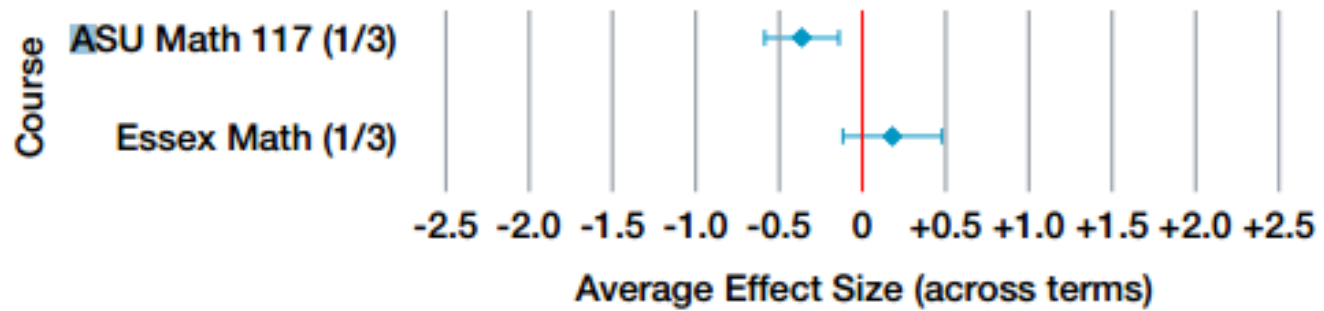
Adaptive Learning MetaStudy

Figure 11. Blended Adaptive vs. Blended Course Completion



Adaptive Learning MetaStudy

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



How to increase cognitive and affective gains in student performance?

QUESTIONS?

Autar Kaw

kaw@usf.edu

University of South Florida