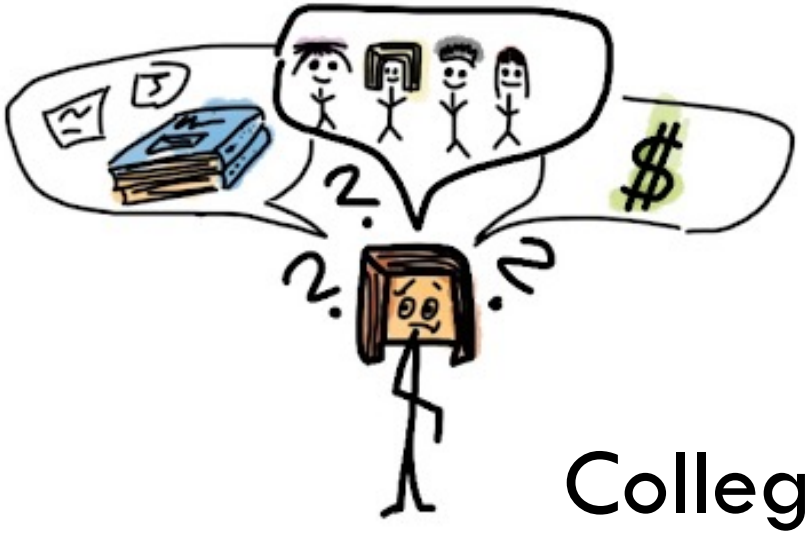
Resources to Ensure Students can *Learn to Learn* during Early Gateway STEM Courses

Matthew L. Bernacki

School of Education

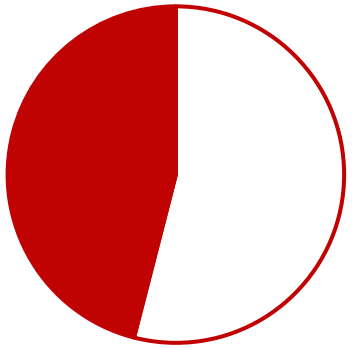
Learning Sciences and Psychological Studies

REAL #1420491
IUSE #1821594
#1821601
UNC Junior Faculty Devt



College is hard.

6 years in…



All STEM majors

From underrepresented groups

Hurtado, Eagen, Chen (2010); NSF (2014) Gattis (2007)

Responsibilities are many.

Classes are rigorous, multiple.

Skill & will are often lacking.

Perez, Cromley & Kaplan (2013)

Incoming learners need support!

- orient to college learning environment
- build learning skills
- track multiple academic responsibilities

Theoretically Grounded Opportunity

Students lack knowledge about learning strategies, struggle to use the ones they know, and to manage their learning at college.

Cognitive Science

Learning principles can be employed to improve learning.

- Spaced > Massed Practice
- Retrieval Practice > Restudy
- Self-Explanation > Reading

Self-Regulated Learning

training improves performance, often as much as d = .05

Hattie & Biggs (2006)

Wirth & Leutner (2008)

Trainings are face to face & time-intensive; do not scale to a college environment

Can brief, web-based, cognitive & metacognitive training improve students' course performance?

The *Science of Learning to Learn*

Methods: The Science of Learning to Learn

Introduction

Emily… and her dilemma

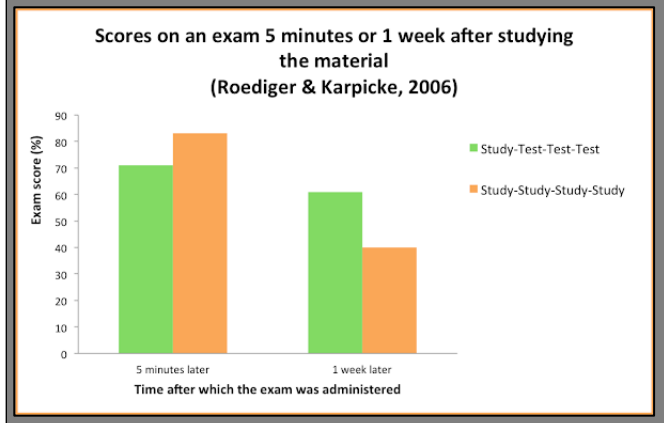
The realities of college, & the challenge

Instructional Approach (Aligned to Hattie & Donoghue, 2016)

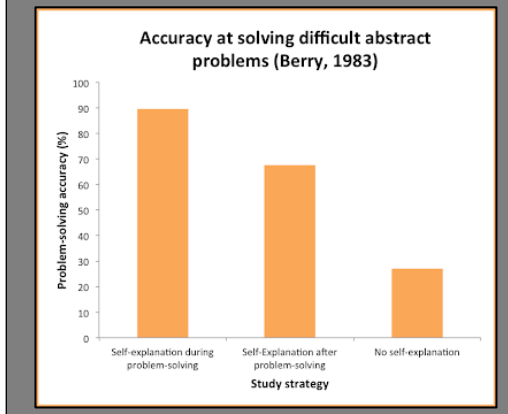
1. Learn about a learning strategy… And why it works
2. See how large an effect that strategy has had on college students' performance
3. Search for resources that help you use the strategy
4. Make plans for using the learning strategy in your course

Module 1: Cognitive Strategies

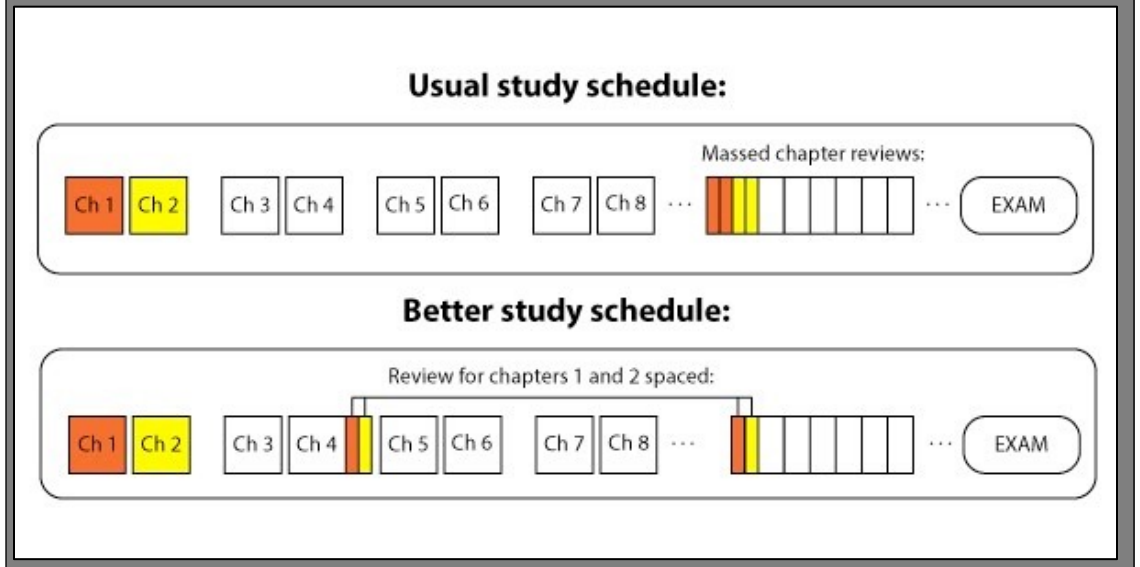
Self-testing



Self-Explanation



Spacing Practice



Material	Week 1	Week 2	Week 3	
Chapter 1	Read chapter Attend Ch 1 lecture **self-test 3 times**	Self-test twice (Tuesday & Thursday)	Self-test once (Thursday)	Exam on Friday of Week 3
Chapter 2		Read chapter, Attend Ch 2 lecture, **self-test 3 times**	Self-test twice (Tuesday & Thursday)	
Chapter 3			Read chapter Attend Ch 3 lecture, **self-test 3 times**	

Module 2: Self-Regulating Learning

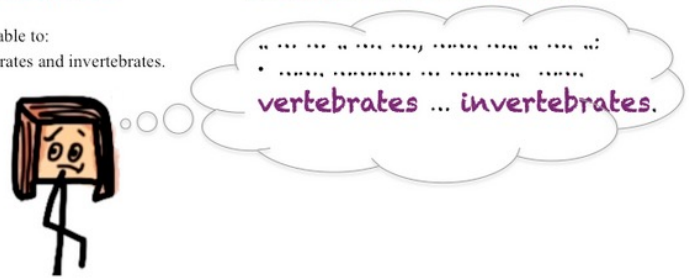
Consider Learning Objectives

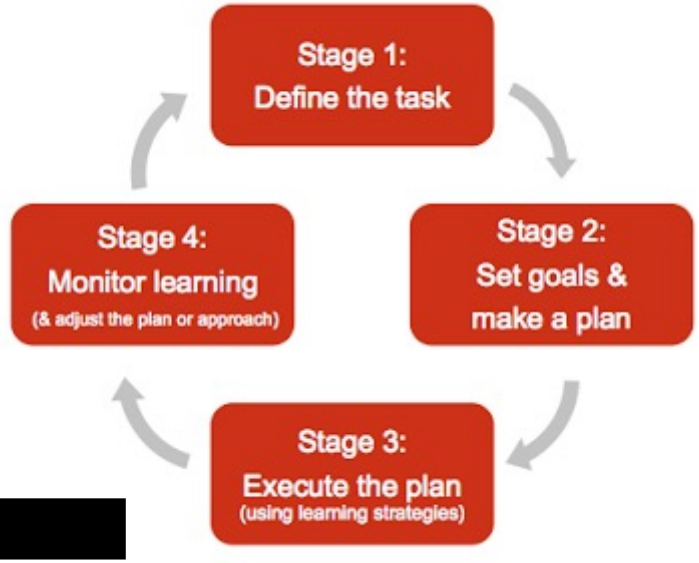
The learning objective that appears in the syllabus:

By the end of this unit, students should be able to:

- Compare and contrast features of vertebrates and invertebrates.

How *Emily* read the learning objective:





Level of Understanding		Common verbs
1	**Knowledge**	Define, label, list, match, recall, recognize, name, identify
2	**Comprehension**	Explain, summarize, paraphrase, describe, compare, classify
3	**Application**	Apply, identify, solve, utilize, carry out, use, compute
4	**Analysis**	Analyze, categorize, examine, relate
5	**Synthesis**	Discuss, compose, combine, create, modify, develop
6	**Evaluation**	Appraise, choose, evaluate, judge, estimate, assess

Select Strategies,

Monitor Learning, & Adapt

Module 3: Managing Behavior

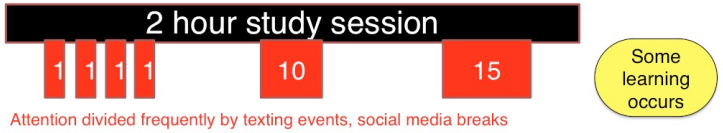
Set goals and make *implementation intentions* to help you stick to the plan.

SITUATIONAL CUE (If...,)	RESPONSE (then...)
"***If*** I am in a situation X,	***then*** I will do Y."

Keep perspective through Mental Contrasting

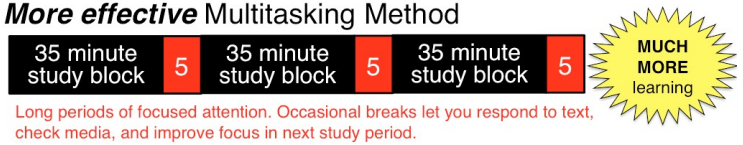
Avoid Distractions!

Typical Multitasking Method

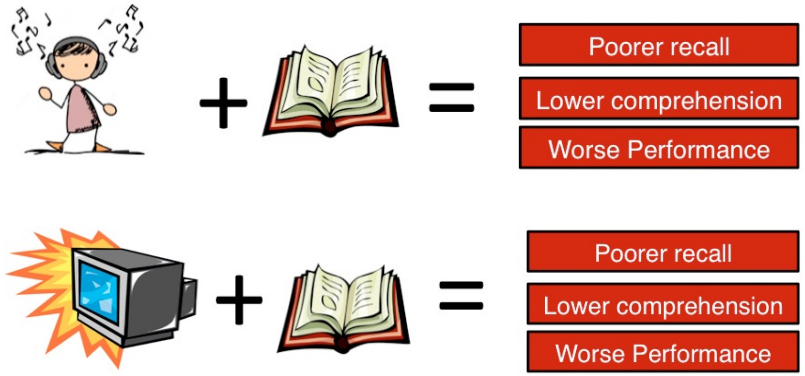


Attention divided frequently by texting events, social media breaks

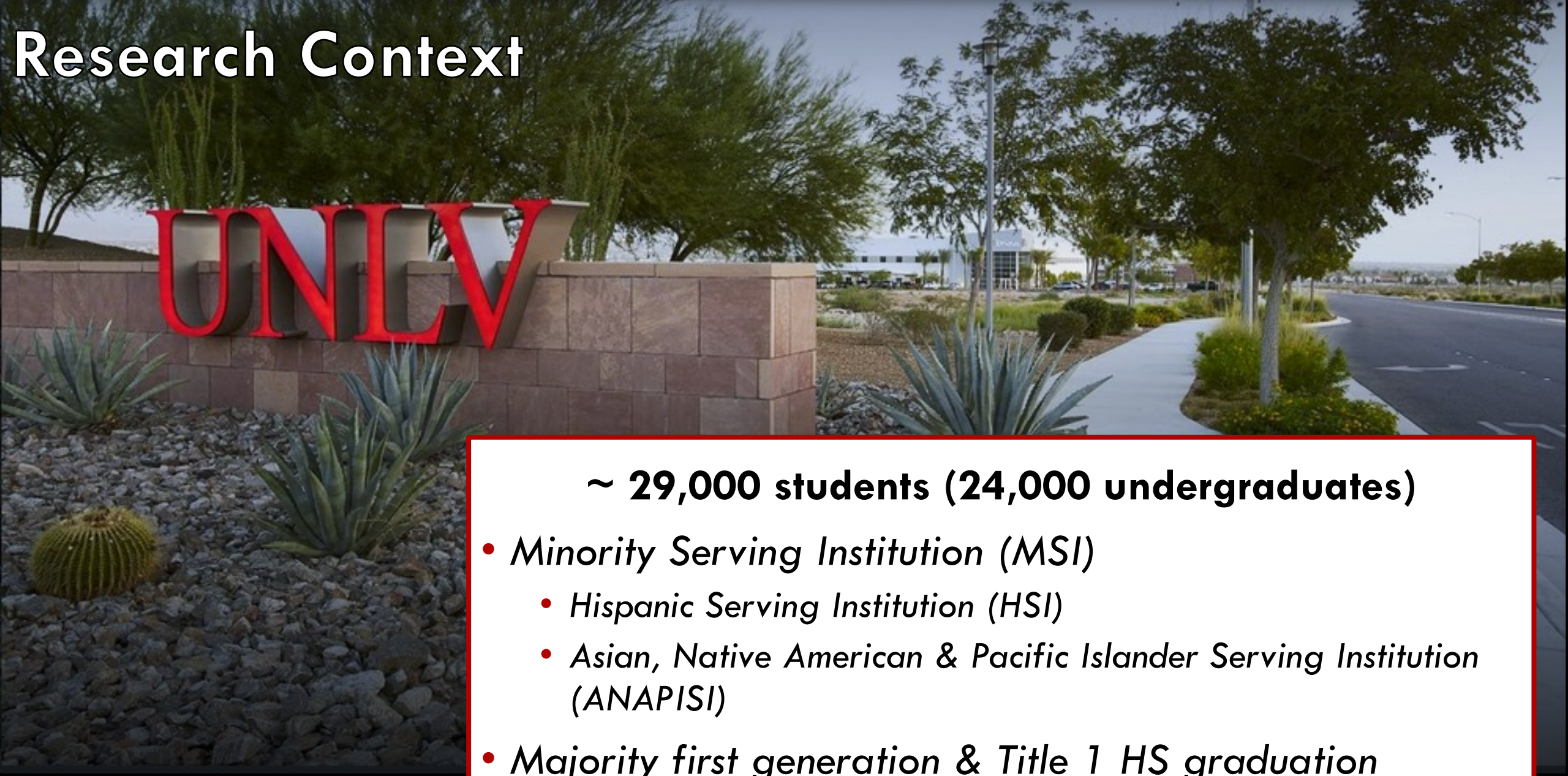
More effective Multitasking Method



Long periods of focused attention. Occasional breaks let you respond to text, check media, and improve focus in next study period.



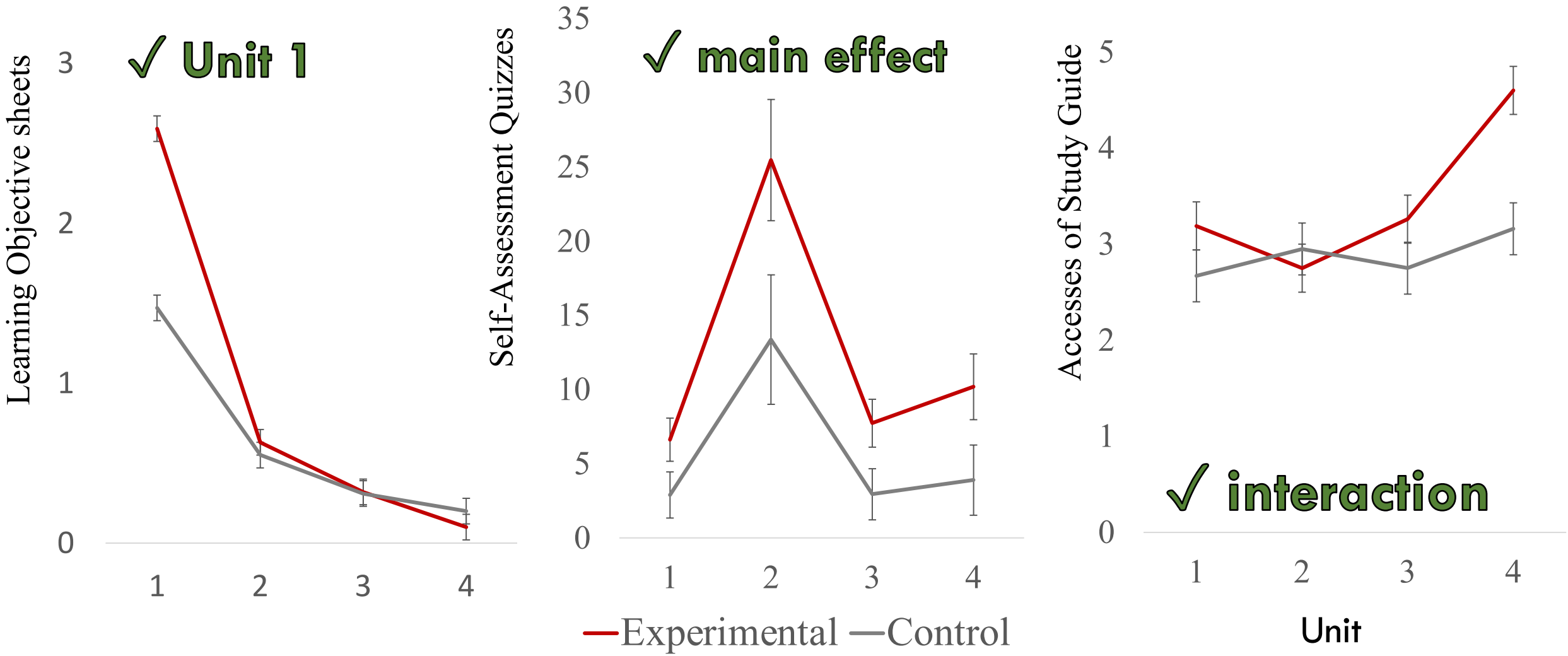
Research Context



~ 29,000 students (24,000 undergraduates)

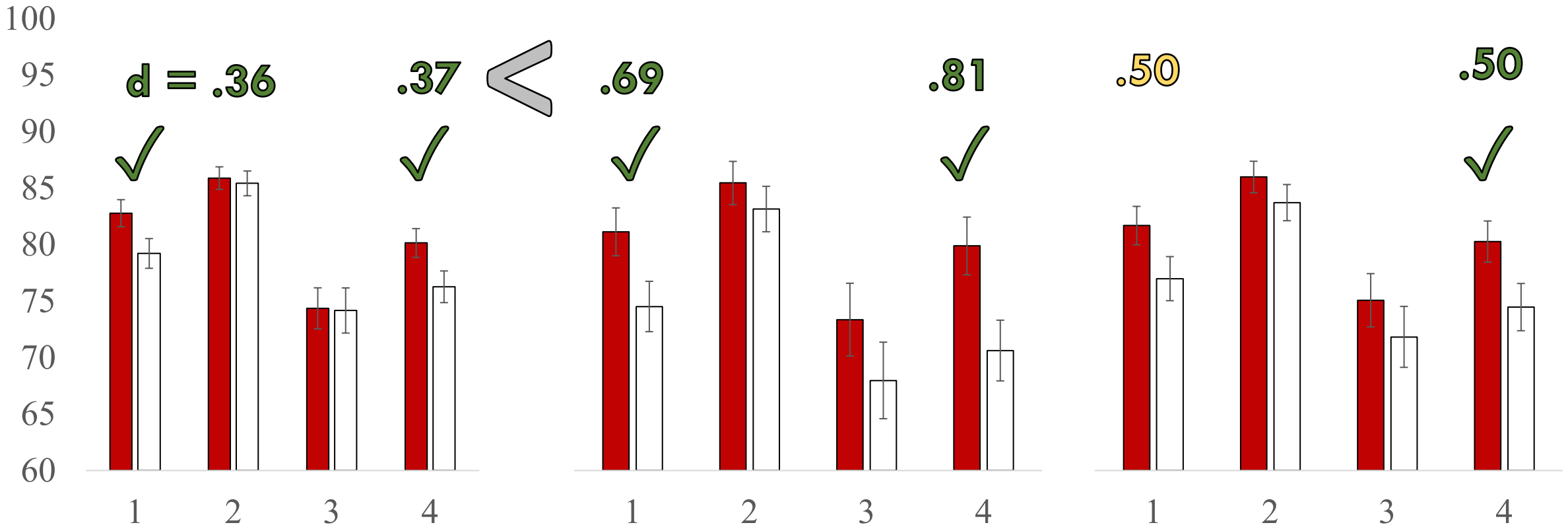
- *Minority Serving Institution (MSI)*
  - *Hispanic Serving Institution (HSI)*
  - *Asian, Native American & Pacific Islander Serving Institution (ANAPISI)*
- *Majority first generation & Title 1 HS graduation*

Results: Hypothesis 1
Effect of Learning to Learn on Behavior



Results: Hypothesis 2 & 3
Effect of *Science of Learning to Learn* on Performance

Why? Social Capital → Academic Skill gap? What to do?



All Learners | Under-represented | First Generation

Promising evidence, replication in science & math

American Psychological Association
Journal of Educational Psychology

ISSN: 0022-0663
http://dx.doi.org/10.1037/edu0000405

Can a Brief, Digital Skill Training Intervention Help Undergraduates "Learn to Learn" and Improve Their STEM Achievement?

Matthew L. Bernacki
University of North Carolina, Chapel Hill

Lucie Vosicka and Jenifer C. Utz
University of Nevada, Las Vegas

Students who drop out of their science, technology, engineering, and math (STEM) majors commonly report that they lack skills critical to STEM learning and career pursuits. Many training programs exist to develop students' learning skills and they typically achieve small to medium effects on behaviors and performance. However, these programs require large investments of students' and instructors' time and effort, which limits their applicability to large lecture course formats commonly employed in early

American Psychological Association
Journal of Educational Psychology

ISSN: 0022-0663
http://dx.doi.org/10.1037/edu0000485

Effects of Digital Learning Skill Training on the Academic Performance of Undergraduates in Science and Mathematics

Matthew L. Bernacki
University of North Carolina at Chapel Hill

Lucie Vosicka, Jenifer C. Utz, and Carryn Bellomo Warren
University of Nevada, Las Vegas

Many science, engineering, technology, and math (STEM) majors fail to complete their degrees, and those who leave report they lack learning skills required for STEM coursework. In 2 studies, we examined the effects on students' exam performances when they were assigned to complete a brief digital learning skills training program we embedded into their course site on the university learning management system for their large lecture science and math courses. Study 1 examined whether delivering brief trainings that teach learning skills to students directly within their STEM course site during the first weeks of class would encourage undergraduate science learners to adopt effective learning behaviors and improve their achievement on exams. Additional analyses examined benefits to a group underrepresented in the STEM workforce: first-generation

Data-driven deployment using LMS data, prediction algorithm…

Computers & Education 158 (2020) 103999

Contents lists available at ScienceDirect

Computers & Education

journal homepage: http://www.elsevier.com/locate/compedu

Predicting achievement and providing support before STEM majors begin to fail

Matthew L. Bernacki *, Michelle M. Chavez, P. Merlin Uesbeck

University of Nevada, Las Vegas, 4505 South Maryland Parkway, Las Vegas, NV, 89154, USA

ARTICLE INFO

Keywords:
Learning management systems
Early warning systems
Learning analytics
Prediction modeling
STEM learning

ABSTRACT

Prediction models that underlie "early warning systems" need improvement. Some predict outcomes using entrenched, unchangeable characteristics (e.g., socioeconomic status) and others rely on performance on early assignments to predict the final grades to which they contribute. Behavioral predictors of learning outcomes often accrue slowly, to the point that time needed to produce accurate predictions leaves little time for intervention. We aimed to improve on these

A Briefer, More Engaging, and Personalized

Science of Learning to Learn

Response rates were low.
Needed a leaner and more engaging product.

Welcome to the Science of Learning to Learn course!

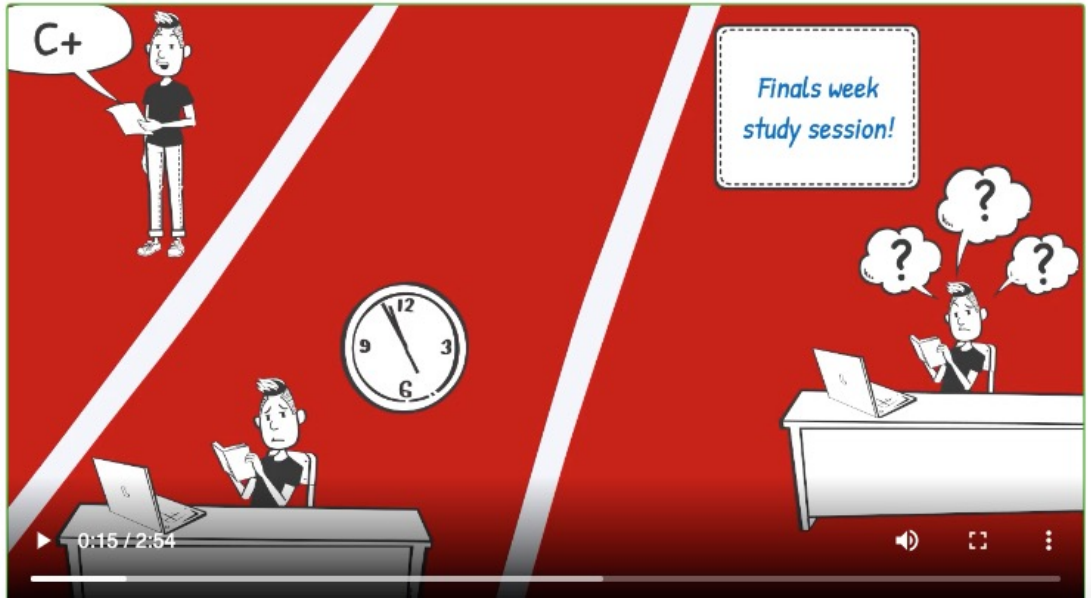
Are you having trouble achieving the grades you want?

Is studying taking too much of your time?

Do you soon forget what you studied?

This activity is designed to introduce you to some strategies that can improve your approach to learning, and help you consider how you might apply them to a course. You can click forward to view the lessons and take part in some exercises to help you learn to learn.

Please press play to watch this video. When the video is done, click the blue arrow to go to the next page.



Predicting exam questions and preparing for them

These questions test just a few of the learning objectives that you've covered in your course, but there are many more learning objectives. With the exam coming up, it's **time to plan how you'll prepare**.

Now that you know the challenge you face, consider some recommended ways you can prepare for – and succeed on – the very first exam. The good news is, you still have time!

First, let's gather some useful tools.

Go into Sakai and pull up the following resources on your screen:

Learning Objectives (these appear at the beginning of each lesson in Sakai)

Lesson 1. Exploring Life and the Process of Science

Learning Objectives:

- Distinguish science from unjustified claims and explain how science is iterative.
- Describe elements of research design and how they impact scientific findings/conclusions
  - (e.g. identify strengths and weaknesses in research related to bias, sample size, randomization, experimental control)
- Interpret data and choose best way to communicate data in graphs.
- Formulate a testable hypothesis and design a controlled experiment and explain the necessity of replicates.

Syllabus (the section **"Be Active in Your Studying"** has a key for understanding how learning objectives are likely to be tested)

Be Active in Your Studying

Resources were developed at one school and deployed at another.

Empowering students to choose a relatable narrator;

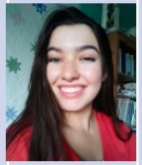
Re-record with UNC undergrads; personalize the training

CHOOSE YOUR GUIDE!

Students often prefer to learn from peers who they relate to and who might be able to share advice based on lessons they have learned during their past semesters of coursework. On the next page, you can select a guide who you find relatable, and they can provide the narration for the rest of the training, and a few insights from their experiences when they have or have not used particular approaches to learning.

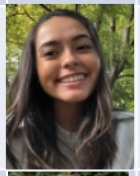
Choose a student to be your guide. Guides' backgrounds and characteristics vary widely, so pick one you find to be most relatable. They'll all cover the same topics and you'll complete the same activities, but the guides may offer something unique that you may find specifically valuable. You might choose someone who shares your ethnic, racial or sexual identity, or hails from a similar educational, family, cultural, or language background as you.

Allison has been your narrator so far. She is a first-generation Chinese-American woman, who grew up in one of the few non-white families in her rural hometown. She experimented with several majors before a research assistantship inspired her to double major in Psychology and Human Development.



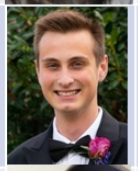
Paulina is a second generation American of Spanish, South, and Central American descent, who grew up in the city and went to school at home. She took some time off before beginning her studies in Cell and Molecular Biology.

Shama is a young Indian American woman who is the first in her family to attend college. She recalls being unable to rely on her family to help her apply to college, and continues to balance her American and Indian cultures as she studies Biology, Chemistry, and Music.



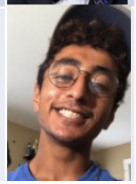
Rebecca grew up in suburban area where she attended high school and was raised in a family shaped by a mix of Peruvian and American cultures. She is the oldest of four siblings. On campus she studies Biology and Sociology on the pre-medical track.

Dat is a first-generation college student who was born in Vietnam and came to the U.S. with his parents. He recalls not having much money growing up and sometimes not having enough food. He spoke Vietnamese before learning English, and attended rural schools.



Connor grew up in a small suburban town, is majoring in Biology as well as Peace War and Defense, and is a member of the campus's LGBTQ community.

Manny is a Neuroscience major who hails from a small town. The beliefs of people in his hometown made him initially question whether he would belong on campus and whether he could achieve his academic goals, but he is excelling now.



Tarun grew up in an Indian American family who lived in an urban area, where he attended high school. He recalls not being as diligent a student as he could have been in high school, but has begun to excel as he double majors in mathematics and biochemistry.

Future opportunities

at UNC

- Can be deployed in any course
  - Let's chat!
- Can connect to LMS data to see impacts on behavior
- Study students motivations related to learning, impact of training

in NC

- Many UNC students are ready to learn as freshmen, some are not;
  - push back to summer orientation
  - Provide during high school
  - Middle school?