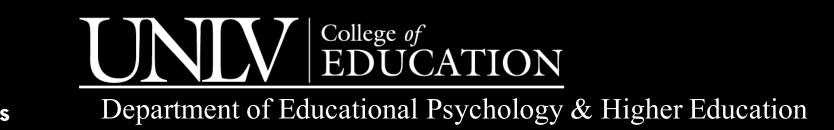
# Scalable, web-delivered supports to help students "Learn to Learn"

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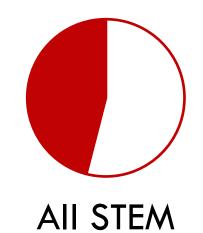


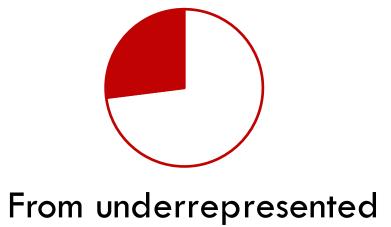
PROJECT OVERVIEW: Learning Theory and Analytics as Guides to Improve Undergraduate STEM Education (Learning TAGs)

# The Need

- Many graduate K-12 without skills necessary to manage learning (ACT, 2008)
- Incoming STEM majors typically fail to complete a STEM degree; more pronounced trend in underrepresented populations (Eagen, Hurtado & Chen, 2006)

6-year completion rate:





groups

- Primary reasons for leaving STEM include
  - perceived lack of skills to perform critical STEM tasks
  - lack of motivation to continue with training (Perez, Cromley & Kaplan, 2013)

# The Project

- Learning management systems (LMSs) are ubiquitous in higher education, provide a platform for scalable, web-delivered support
- Learning sciences provide insight about ways learning skills can be built and motivation can be supported
- LMSs + Learning Theory + Analytics provide an opportunity to
  - Provide resources to students
  - 2. Teach students how to use resources effectively The Science of Learning to Learn (below)
  - 3. Observe & adaptively respond to student learning data
    - Capture learning behaviors using log files
    - Develop prediction models that accurately identify students likely to struggle, obtain poor grades
    - Provide adaptive, personalized feedback to students via the LMS, directing resources to those likely to struggle

THE SCIENCE OF LEARNING TO LEARN

- Web-delivered set of training modules delivered via LMS
- Embedded in students' course site, teach students (in 30-45 min per module):
  - cognitive strategies known to improve learning outcomes
  - 2. methods of managing their learning process
  - 3. methods of managing self, behaviors, & one's environment
- Instructional methods aligned to research on learning (Table 1)
- Ongoing trace data on student learning behaviors collected from University servers using Splunk application, performance data from LMS gradebook

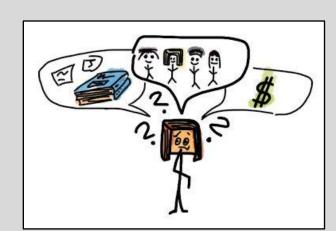
### Table 1

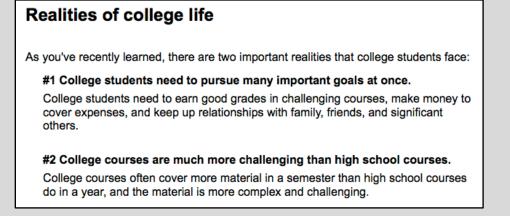
# Instructional Design of Science of Learning to Learn Modules

Brief explanation of the learning principle + assessment of learning with feedback Description of studies showing practical effect on performance in a college course Worked example illustrating how to use the learning principle in a STEM course Vignette where learning principle is applicable, opportunity to advise a protagonist Prompt to evaluate course resources that afford use of the learning principle Prompt to develop a specific plan how to use the learning principle in the course

# Module 1: Introduction & Learning Principles

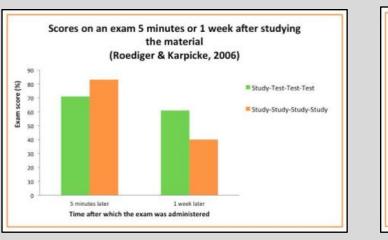
Opening Vignette: Emily the struggling student

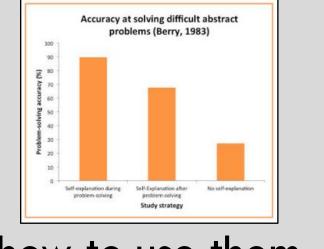




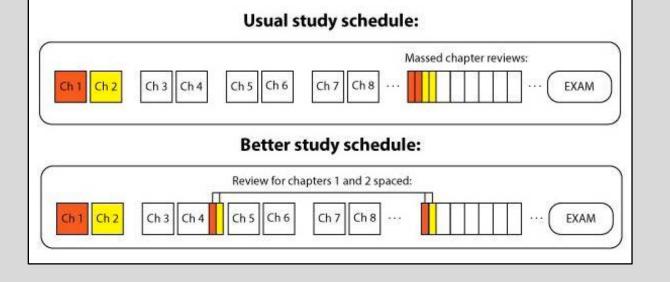
Instruction: Introduction to, evidence for learning principles

#### Self Testing • Spacing • Self Explanation





Worked examples demonstrating how to use them

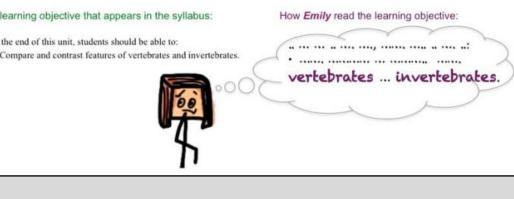


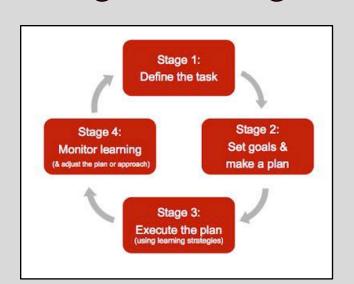
**Practice:** Identify Resources. Use what you've learned!

# 2: Planning, Organizing & Monitoring Learning

Training in self-regulated learning

Assess their course's learning objectives



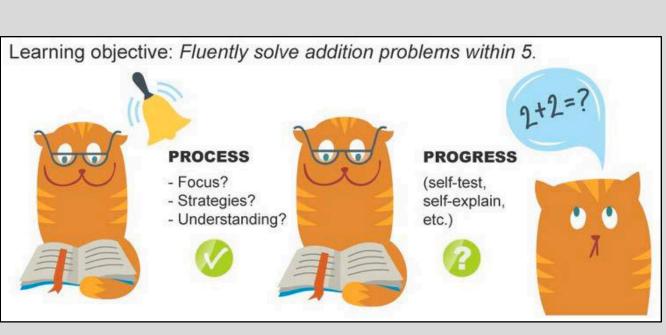


L	evel of Understanding	Common verbs in this type of learning objective		
1	Knowledge	Define, label, list, match, recall, recognize, name, identify		
2	Comprehension	Explain, summarize, paraphrase, describe, compare, classify		
3	Application	Apply, identify, solve, utilize, carry out, use, compute		

#### Plan study: set goals & subgoals, enact strategies

producing various responses in other body systems.						Identify structures in a cell nucleus	Practice labeling these features in a blank diagram.
	Study Session 1	Session 2	Session 3	Session 4		identity structures in a cell flucieus	Practice labeling these realtines in a blank diagram.
Subgoal	Develop basic knowledge and comprehension of structures & processes in the muscular system	Develop basic knowledge and comprehension of skeletal system structures & processes	Develop basic knowledge and comprehension of circulatory system structures & processes	Identify how exercise affects each body system		List the steps in the engineering design process	Rehearse the order of the steps in the process by practicing recalling them in sequence.
Plan to achieve Comprehension level of understanding per system and synthesis across systems	Read text on muscles. Rehearse definitions. Find a synopsis of the way muscles form, work, and affect other systems Self-explain until I can produce this synopsis	Read text on bones. Rehearse definitions. Find a synopsis of the structure and function of bone groups and relations to the muscular system Self-explain until I can produce this synopsis	Read text on circulatory system. Rehearse key terms. Find a synopsis of the features of the circulatory system and how it works, & relates to muscular system Self-explain until 1 can.	*Search text on exercise to identify how it affects muscular, skeletal, circulatory systems. *Read section *practice self-explaining how exercising muscles affects skeletal system		Identify the properties of a math function	Practice explaining the functions by writing down all the ones you can remember, then checking them against the description in the textbook.
Outcome	Ability to self-explain key how the muscular system works	Ability to self-explain key how the skeletal system works and how affected by muscles	produce this synopsis  Ability to self-explain key how the circulatory system works and how affected by muscles	and circulatory system  Ability to describe how  exercising muscles  affects skeletal system  and circulatory system	_	Classify elements according to their typical state of matter	Repeatedly test yourself using a textbook resource, online quiz, or set of flash cards you make.

Monitor learning process & progress ... and adapt.

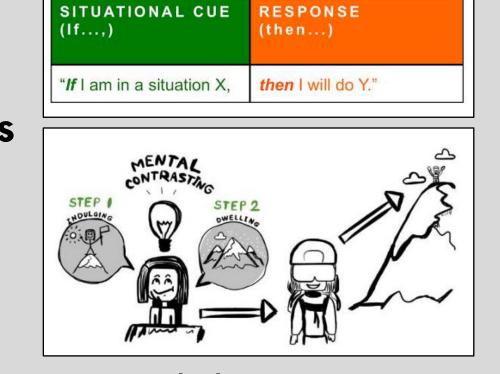


# 3: Regulating Behavior & Environment

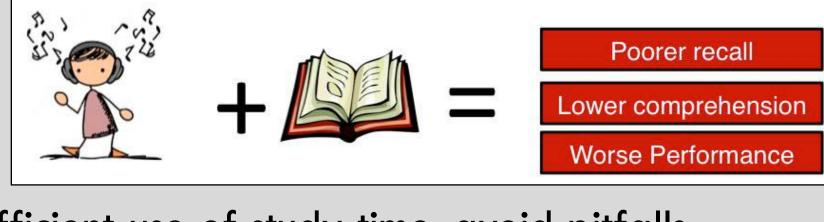
Training to help students Make

implementation intentions Engage in

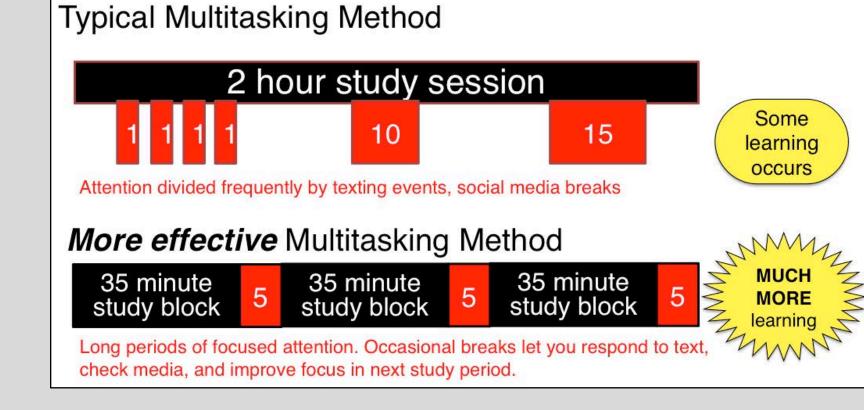
mental contrasting



#### Regulate their environment to avoid distraction

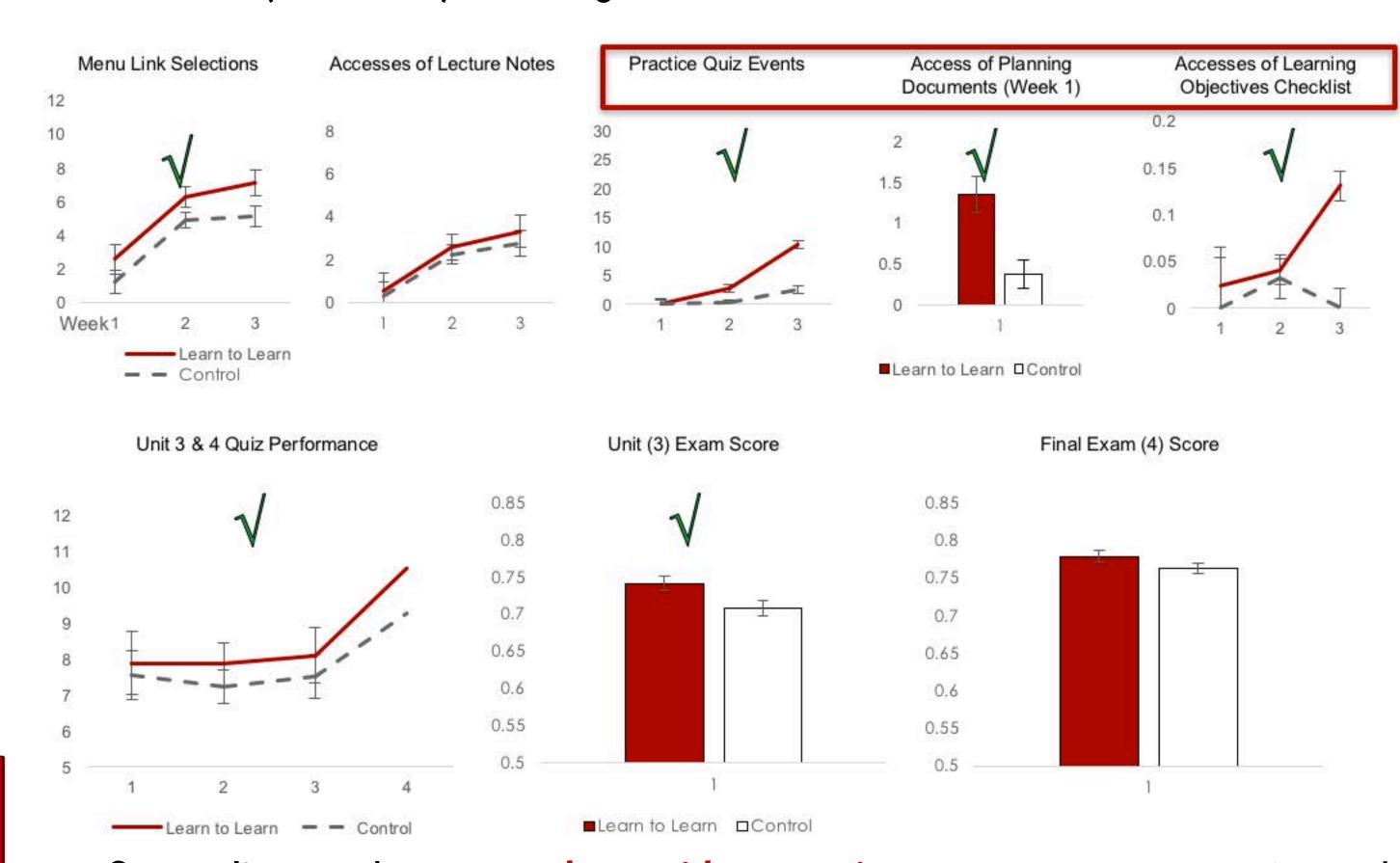


Make efficient use of study time, avoid pitfalls

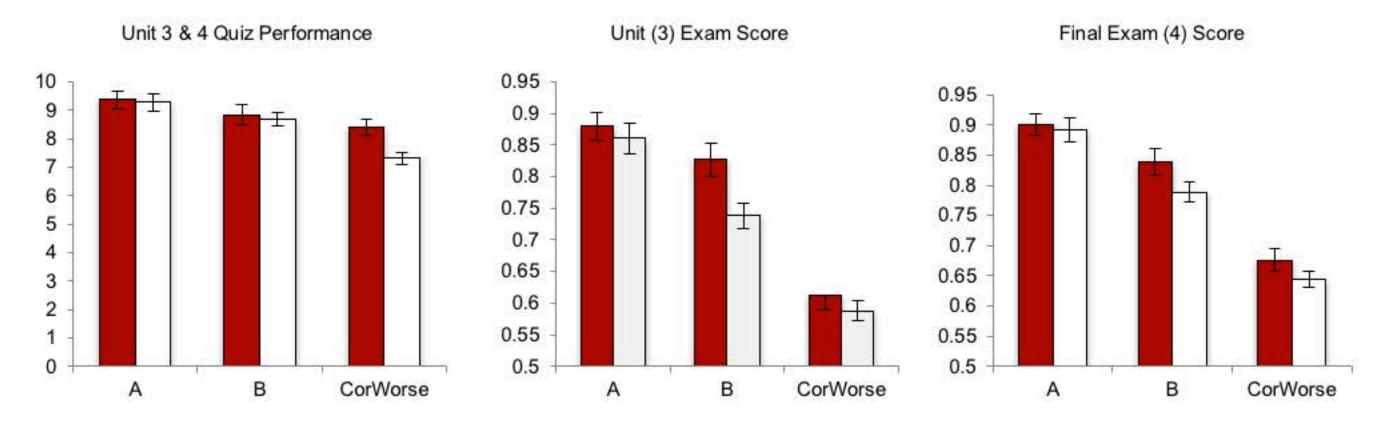


# RESULTS & FUTURE DIRECTIONS

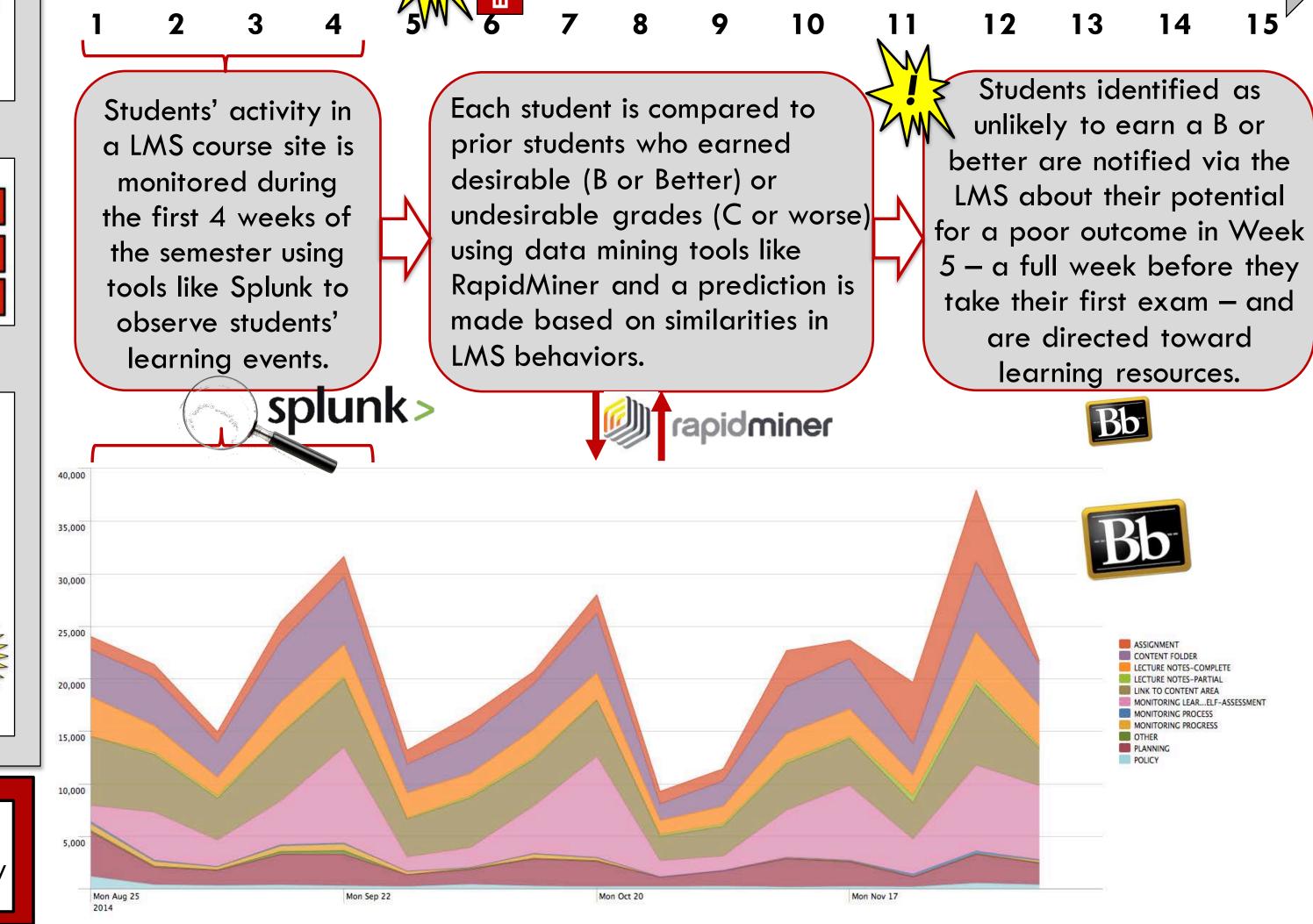
Learning to Learn training had a demonstrable impact on biology students' (N = 205) learning behavior & achievement in a lecture course



Struggling students — students with poor prior exam scores — experienced the greatest benefits from Learning to Learn.



- Learning to Learn training benefits struggling students, burdens others
- NEW CHALLENGE: 1) identify students who need help
  - 2) deliver timely help to them and only them
- A pilot project (underway) targets training to students in need.







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