Evidence-Based Teaching and Learning: Putting the Results of Psychological Research to Work in our Classrooms

Sarah Grison
Parkland College, sgrison@parkland.edu

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Evidence-Based Teaching and Learning: Putting the Results of Psychological Research to Work in Our Classrooms

Sarah Grison, Ph.D.
sgrison@parkland.edu
Associate Professor
Parkland College

Center for Excellence in Teaching & Learning
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Educators are experiencing a “perfect storm” of challenges

- We teach a wider variety of classes and formats, but with less support
- Our students are less prepared & busier, but we must support them all
- We must show evidence of student success, but without much training

Does this sound familiar to you?
Evidence-based teaching and learning can help us address these challenges.

If our pedagogical solutions are based on research they will have a high impact on student learning!

- **Teaching**: How can we support teachers?
- **Learning**: How can we help students learn?
- **Assessment**: How can we investigate students’ progress?
Improving Students’ Learning With Effective Learning Techniques: Promising Directions From Cognitive and Educational Psychology

John Dunlosky¹, Katherine A. Rawson¹, Elizabeth J. Marsh², Mitchell J. Nathan³, and Daniel T. Willingham⁴

¹Department of Psychology, Kent State University; ²Department of Psychology and Neuroscience, Duke University; ³Department of Educational Psychology, Department of Curriculum & Instruction, and Department of Psychology, University of Wisconsin–Madison; and ⁴Department of Psychology, University of Virginia

Summary

Many students are being left behind by an educational system that some people believe is in crisis. Improving educational outcomes will require efforts on many fronts, but a central premise of this monograph is that one part of a solution involves helping students to better regulate their learning through the use of effective learning techniques. Fortunately, cognitive and educational psychologists have been developing and evaluating easy-to-use learning techniques that could help students achieve their learning goals. In this monograph, we discuss 10 learning techniques in detail and offer recommendations about their relative utility. We selected techniques that were expected to be relatively easy to use and hence could be adopted by many students. Also, some techniques (e.g., highlighting and rereading) were selected because students report relying heavily on them, which makes it especially important to examine how well they work. The techniques include elaborative interrogation, self-explanation, summarization, highlighting (or underlining), the keyword mnemonic, imagery use for text learning, rereading, practice testing, distributed practice, and interleaved practice.

To offer recommendations about the relative utility of these techniques, we evaluated whether their benefits generalize...
Mind, Brain, and Education Science
A Comprehensive Guide to the New Brain-Based Teaching
Tracey Tokuhama-Espinosa
Foreword by Judy Willis
Our goal today is to use an evidence-based approach to answer four questions:

How can we...

1. help students read and comprehend the text?

2. engage students in the classroom?

3. encourage students to repeatedly work with the material?

4. improve student performance on tests?
1. How can we get students to read & comprehend the text?

study
(verb)
The act of texting, eating and watching TV with an open textbook nearby.

Does this seem familiar?
1. How can we get students to read & comprehend the text?

**Research-based high impact practices:**
- Self-explanation *(Dunlosky et al. 2013)*
- Active construction of knowledge *(Tokuhama-Espinosa, 2010)*

**Teaching**
Use the text learning objectives to develop reading activities

**Learning**
Answering these trains students to read actively & develop cognitive skills.

**Assessment**
Students can turn in answers to Reading Activities as homework (low-stakes or high stakes).

Here’s an example in my Psy101 class...
Grading:

Your responses for Part 1 and Part 2 will be graded separately on three criteria. This means that you can earn a maximum of 6 points a week for the Reading Activities

1. Are all of the questions answered?
2. Is the information correct and are key terms used appropriately?
3. Are the questions answered in complete sentences with excellent spelling and grammar?

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<th>Mastery</th>
<th>Developing</th>
<th>Foundational</th>
<th>Not submitted</th>
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<td>3</td>
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Questions:

1. Define biological psychology.

2. Describe the functions of the nervous system based on an example in your life.

3. Compare and contrast neurons and glial cells with other body cells.

**4. Name and describe the 6 main features of neurons that allow them to communicate with one another.

5. Define and describe action potentials. Define refractory period. Discuss the effect of myelin on action potentials.

6. Define neurotransmitter and synapse and describe their roles in nervous system activity.

7. Describe the role of receptors in the process of neural communication. Explain the role of postsynaptic potentials in the creation of an action potential in the postsynaptic cell.

8. Name and describe the two major divisions of the nervous system.

**9. Name the two subsystems of the peripheral nervous system and explain their functions based on examples from your life.

**10. Name the two subsystems of the autonomic nervous system and describe their functions and explain their functions based on examples from your life.
4. Name and describe the 6 main features of neurons that allow them to communicate with one another.

The six main features of a neuron are an outer membrane, a nucleus, mitochondria, an axon, dendrites, and neurotransmitters. The neuron's outer membrane controls what substances can enter and leave the cell and contains receptor proteins for receiving signals from other neurons. The neuron's nucleus carries the genetic information that tells neurons how to send signals to each other. The neuron's mitochondria generate the energy needed to send signals from one neuron to another. The neuron's axon carries signals away from the cell body of the neuron to the axon terminals, where it sends signals to other neurons across the synapse (gap between two neurons). The neuron's dendrites are fibers that branch out from the cell body of the neuron; their job is to receive signals from other neurons and send those signals to the cell body of the neuron. The neuron's neurotransmitters are chemicals stored in vesicles (small bags of fluid) that are released at the ends of the axon's terminals; the neurotransmitters cross the synaptic gap to another neuron's dendrites, transmitting the signal from one neuron to another neuron.

9. Name the two subsystems of the peripheral nervous system and explain their functions based on examples from your life.

The two subsystems of the peripheral nervous system are the somatic nervous system and the autonomic nervous system. The somatic nervous system transmits information from your senses to the CNS via sensory neurons. It also transmits information from the CNS to the muscles via motor neurons. An example of this would be sensory neurons sending the sounds of your favorite song on the radio from your ear to your brain, followed by motor neurons sending a message from the brain telling your fingers to tap along to the beat. The autonomic nervous system transmits information to and from the organs and glands in the body; this transfer of messages is generally not something you can control. For example, when you're scared that you're going to crash into another car, your heart rate increases.

10. Name the two subsystems of the autonomic nervous system and describe their functions and explain their functions based on examples from your life.

The two subsystems of the autonomic nervous system are the sympathetic nervous system, which prepares your body for action in a crisis, and the parasympathetic nervous system, which helps your body relax after the crisis has passed. For example, if you lose track of your kid in a crowded grocery store, your heart rate speeds up and your muscles tense so you can run after him the minute you catch sight of him. But, once you find him and have him safely strapped into the cart, your heart rate slows down and your muscles relax again so you can finish your shopping without having a heart attack.

15. Define hindbrain. Name the 4 main structures of the hindbrain and explain their functions based on examples from your life.

The hindbrain is at the top of the spinal cord and just inside the skull. It controls many necessary autonomic functions, including heart rate, breathing, and blood pressure. The four main structures of the hindbrain are the medulla oblongata, the reticular formation, the locus coeruleus, and the cerebellum. The medulla oblongata controls breathing, heart rate, and blood pressure. When we run, our heart rate increases. The reticular formation controls our arousal and attention. When our alarm goes off in the morning, we wake up. The locus coeruleus helps direct our attention. When we're in class, we pay attention when the instructor says something will be covered on the exam. The cerebellum helps us control finely coordinated movements, store muscle memories, control impulses, and learn languages. The cerebellum helps me learn key French phrases so I can order food.
1. How can we get students to read & comprehend the text?

**Bloom’s revised taxonomy:**

We can support development of students’ cognitive skills, from lower to higher levels

- Bloom et al., 1956; Anderson et al., 2001; Henricks-Lepp et al., 2014
1. How can we get students to read & comprehend the text?

In our equal opportunity sections, requiring self-explanation via written homework (note matrices) predicted better test performance. (Watson, Grison, Luke & Shigeto, 2010)
1. How can we get students to read & comprehend the text?

What do you think about this approach to encouraging active reading in your courses?
Let’s use this approach to answer four questions

How can we...

1. help students read and comprehend the text?
2. engage students in the classroom?
3. encourage students to repeatedly work with the material?
4. improve student performance on tests?
2. How can we engage students in the classroom?

Does this happen to you?
2. How can we engage students in the classroom?

Research-based high impact practices:

- Elaborative interrogation & distributed learning (*Dunlosky et al. 2013*)
- Elaboration, novelty detection, attention & memory (*Tokuhama-Espinosa, 2010*)

**Teaching**
Encourages active learning and gets a fast check of learning (just-in-time-teaching).

**Learning**
Focuses attention, enhances memory, & self-application of material, can improve rapport!

**Assessment**
Students’ responses can be for participation or correctness and reveal sticky concepts.

Let’s see an example from Psy101...
Did You Get it?

Which of these is reflecting psychological processes?

A

B

C

D

E

More than one of these is reflecting a psychological process.

Use your clicker to respond! When you respond to 75% of the polls you earn a point. Earn up to 2 more points for correct answers.
What’s Your Opinion?

How will you most likely use psychology?

A

B

C

D

E
2. How can we engage students in the classroom?

(Luke, Grison, Shigeto, & Watson, 2010)
2. How can we engage students in the classroom?

*Learning After 12 Weeks Predicted By High Number of SRS Qs*

*Only for “Low” readers (z=2.3, p<0.05)*

(Luke, Grison, Shigeto, & Watson, 2010)
2. How can we engage students in the classroom?

What do you think about this approach to getting more engagement in your courses?
Let’s use this approach to answer four questions

How can we...

1. help students read and comprehend the text?

2. engage students in the classroom?

3. encourage students to repeatedly work with the material?

4. improve student performance on tests?
3. How can we encourage students to repeatedly work with the material?

Do your students do this?
3. How can we encourage students to repeatedly work with the material?

**Research-based high impact practices:**

- Repeated testing *(Dunlosky et al. 2013)*
- Rehearsal of retrieval cues, lots of feedback *(Tokuhama-Espinosa, 2010)*
- Benefits of ‘repeated testing’ *(Roediger & Karpicke, 2006; Jaffe, 2008)*
- Narloch et al., 2006)

Let’s take a look at example from Psy101...

**Teaching**
Embed opportunities for repeated practice with questions (best is via pre- & post-test).

**Learning**
Improves memory and learning, develops of cognitive skills, can reduce test anxiety

**Assessment**
If questions are in Cobra the data is captured to show performance & learning.
Steve is a bully on the third-grade playground. After Steve pushes little Johnny around, Johnny says to Steve, “Something must have happened to you as a baby that caused you to be such a jerk. Maybe you were dropped on your head.” Steve replies, “Shut up, wimp! I was born to rule.” Steve and Johnny are engaged in a debate that reflects the issue of______

a. nature and nurture.
b. authoritarian and authoritative parenting styles.
c. preconventional and postconventional moral reasoning.
d. assimilation and accommodation.
3. How can we encourage students to repeatedly work with the material?

In our equal opportunity sections, using repeated testing with online quizzes improved performance even more. 

(Watson, Grison, Luke & Shigeto., 2010)
3. How can we encourage students to repeatedly work with the material?

**Number of Online Practice Quizzes in Large Sections Affected Performance 2 Weeks Later**

_Greatest effect if similar concepts were blocked (t=2.9, p<0.05)_

*(Grison, Seiler, & Carlson, 2012)*
3. How can we encourage students to repeatedly work with the material?

What do you think about this approach to encouraging repeatedly working with material?
Let’s use this approach to answer four questions

How can we...

1. help students read and comprehend the text?

2. engage students in the classroom?

3. encourage students to repeatedly work with the material?

4. improve student performance on tests?
4. How can we improve student performance on tests?

Do your students do this?
4. How can we improve student performance on tests?

Research-based high impact practices:

• Effects of sleep (B8), stress (B9) and academic support on learning (B15) (*Tokuhama-Espinosa, 2010*)

• Reducing test anxiety (*Ramirez & Beilock, 2011*)

**Writing About Testing Worries Boosts Exam Performance in the Classroom**

Gerardo Ramirez and Sian L. Beilock*

Two laboratory and two randomized field experiments tested a psychological intervention designed to improve students’ scores on high-stakes exams and to increase our understanding of why pressure-filled exam situations undermine some students’ performance. We expected that sitting for an important exam leads to worries about the situation and its consequences that undermine test performance. We tested whether having students write down their thoughts about an upcoming test could improve test performance. The intervention, a brief expressive writing assignment that occurred immediately before taking an important test, significantly improved students’ exam scores, especially for students habitually anxious about test taking. Simply writing about one’s worries before a high-stakes exam can boost test scores.

For many students, the desire to perform their best in academics is strong. Consequences for poor performance, especially on exams, include poor evaluations by mentors, teachers, and peers; lost scholarships; and relinquished educational opportunities. Yet despite the fact that students are often motivated to perform their best, the pressure-filled situations in which important tests occur can cause students to perform below their ability instead (7).

Worries not only occur in intense academic situations but are a major component of depression and other clinical disorders (9). Expressive writing, in which people repeatedly write about a traumatic or emotional experience over several weeks or months, has been shown to be an effective technique for decreasing rumination in depressed individuals (10). Writing may alleviate the burden that worries place on WM by affording people an opportunity to reevaluate the
4. How can we improve student performance on tests?

Research-based high impact practices:

- Effects of sleep, stress, and academic support on learning (Tokuhama-Espinosa, 2010)
- Reducing test anxiety (Ramirez & Beilock, 2011)

Let’s see these!
4. How can we improve student performance on tests?

Finding: Significant learning occurred, contingent on students' high school percent rank ($z=3.37, p<.001$).

(Shigeto, Grison, Luke, & Watson, 2010)
Almost everyone has felt nervous about an upcoming exam. But sometimes exam jitters can seem to get out of hand. You walk into the exam room and suddenly your heart is beating rapidly, your breathing rate increases, and your palms get sweaty. When you begin the exam, all the information you knew seems to fly from your brain and be totally inaccessible. Later on, after the exam, you may have wondered, “How could I have gotten so many questions wrong? I knew those answers!” This extremely common experience of stress is called exam anxiety.

Recalling the three components of stress can help you understand and cope with this experience. The stressor is the actual exam itself. The stress response is in part physical: Your sympathetic nervous system prepares you to “fight or flee” from the test, which causes the increase in heart rate, respiration, and perspiration. There are also emotional responses, including fear and anxiety, and cognitive responses, which prevent you from accessing information that you had stored in your brain. Fortunately, there are four coping strategies you can use to reduce the impact of the stressor and these responses.

1. **Change how you think about the exam.** Thinking repeatedly about the worst-case scenario—“I’ll flunk the course; I’ll never get a job; everyone will think I’m stupid”—will increase the impact of the stressor. Instead, use a technique called positive reappraisal. Instead of viewing the exam as scary, view it as a challenge that you can meet successfully. To prepare as well as possible, use the study methods described inside the front cover of this book. Those methods will help you feel confident.

2. **Get plenty of sleep the night before the exam.** Avoid unhealthy behaviors, such as drinking alcohol. Many of the behaviors that stressed-out college students may engage in—skipping sleep, drinking alcohol, smoking cigarettes—further exacerbate the problem of stress (Glaser & Kiecolt-Glaser, 2005).

3. **Arrive at the exam several minutes early.** Relax and take some deep breaths. Your body can keep up the sympathetic nervous system response for only a short time. So if you can get there early and give your body time to overcome the response, your heart rate and breathing will return to normal. Taking a few minutes to write down what is making you anxious about the exam may also help you reduce stress and get a higher exam grade (Ramirez & Bellock, 2011).

4. **Finally, use good test-taking skills as you work through the exam.** Underline important parts of questions. Cross off answers you know are wrong. Take time to check every answer and come back to ones you are unsure of. Reconsider them after you have worked through all the questions, because you continue to learn as you take the exam.

If you follow these steps, you are likely to experience less exam anxiety and also get better exam grades. This result creates a positive cycle. As you get better grades on your exams, you will find it easier to eliminate exam anxiety.
4. How can we improve student performance on tests?

What do you think about this approach to improving test performance?
Any questions or thoughts?

- Thank you for the opportunity to work with you.
- Please feel free to give me any thoughts or feedback.
- Please email me at sgrison@parkland.edu