Teach Students How to Learn: Metacognition is the Key!

Saundra Yancy McGuire, Ph.D.
Retired Asst. Vice Chancellor & Professor of Chemistry
Director Emerita, Center for Academic Success
Louisiana State University
The Tri-Institutional Faculty Forum is a cooperative effort of

**The Teaching Learning Center at**
Community College of Denver
Jennifer Fergusn, Director

**The Center for Teaching, Learning and Design at**
Metropolitan State University of Denver
Jeff Loats, Director

**The Center for Faculty Development at**
University of Colorado Denver
Margaret Wood, Director
Metacognition

The ability to:

- think about your own thinking
- be consciously aware of yourself as a problem solver
- monitor, plan, and control your mental processing (e.g. “Am I understanding this material, or just memorizing it?”)
- accurately judge your level of learning
- know what you know and what you don’t know

Why haven’t most students already developed these skills?

It wasn’t necessary in high school
<table>
<thead>
<tr>
<th></th>
<th>% spending at least 6 hrs/wk on homework</th>
<th>% with an A average</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>37.3</td>
<td>48.4</td>
</tr>
<tr>
<td>2011</td>
<td>39.5</td>
<td>49.7</td>
</tr>
<tr>
<td>2012</td>
<td>38.4</td>
<td>49.5</td>
</tr>
<tr>
<td>2013</td>
<td>41.4</td>
<td>52.8</td>
</tr>
<tr>
<td>2014</td>
<td>42.9</td>
<td>53.1</td>
</tr>
<tr>
<td>2015</td>
<td>44.8</td>
<td>58.7</td>
</tr>
<tr>
<td>2016</td>
<td>44.0</td>
<td>55.1</td>
</tr>
<tr>
<td>2017</td>
<td>44.1</td>
<td>51.5</td>
</tr>
<tr>
<td>2018</td>
<td>42.3</td>
<td>57.6</td>
</tr>
</tbody>
</table>
How do you think most students would answer the following?

- What did most of your teachers in high school do the day before the test?
- What did they do during this activity?
- What grade would you have made on the test if you had gone to class only on the day before the test?
Can you skip 47 days of English class and still graduate from high school?

As graduation approached last year, the list of often-absent students at Albert Einstein High School in suburban Maryland was long. More than 175 seniors repeatedly missed classes, many in courses required for their diplomas.
How Do Students Feel About Active Learning?

'The Dangers of Fluent Lectures'

A study says smooth-talking professors can lull students into thinking they've learned more than they actually have -- potentially at the expense of active learning.

By Colleen Flaherty  //  September 9, 2019

Students who engage in active learning learn more -- but feel like they learn less -- than peers in more lecture-oriented classrooms. That's in part because active learning is harder than more passive learning, according to a new study in Proceedings of the National Academy of Sciences.
Faculty Must Help Students Make the Transition to College

Help students identify and close “the gap”

- current behavior → current grades
- productive behavior → desired grades

Mind the gap
Power of Metacognitive Learning Strategies

Sydnie’s Story: Intro and emails

- First encounter on September 23, 2013
- Email on October 14, 2013
- Email on January 9, 2014
- Email on January 20, 2014
- Email on May 7, 2014
- Update on July 26, 2016  Cum GPA 3.5
- Email on February 7, 2017  Cum GPA 3.6
- Fall Sem GPA 4.18
Sydnie Landry, BS in Biology, May 2017
Louisiana State University
Final Semester GPA: 3.77

Applying to Medical School in Fall 2017
Intended Specialty: Dermatology
Effective Homework Strategy

• **Study material first**, before looking at the problems/questions

• **Work example problems** (without looking at the solutions) until you get to the answer

• **Check** to see if **answer** is correct

• If answer is not correct, **figure out where mistake was made**, without consulting solution

• **Work homework problems/answer questions as if taking a test**
I started to use the "Get more out of your homework" method. I reviewed my notes right before attempting my homework problems, and tried to work the problems *without help from the solutions manual or tutors*. If I still could not get the right answer, I'd look at my notes again to get a hint, but *not to study the problem and mimic it step by step*...
Impact of Metacognitive Learning Strategies at a Two Year College

As described Lynn Futral*, Psychology Professor, Southern Crescent Technical, Griffin, GA College

It just hit me that since I have incorporated the presentation *Metacognition: success through understanding learning styles, learning strategies, and study skills*, these post-tests are remarkably showing that students are actually retaining this information. When I compare the data from two years ago, I can clearly remember how distressed I was that students weren't retaining this information, but the test scores I am receiving today?-- I am just blown away.

*email received on 5/9/2015*
Data from Psych Prof at Crescent Tech CC  
Received on 1/8/2014

Sample of 9 “at risk” students

<table>
<thead>
<tr>
<th>Exam 1</th>
<th>Exam 2</th>
<th>Exam 3</th>
<th>Exam 4</th>
<th>Final Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>62.67</td>
<td>77.00</td>
<td>78.20</td>
<td>82.00</td>
<td>82.6</td>
</tr>
</tbody>
</table>

“The final exam was comprehensive. The students were placed in teams and each team was assigned three chapters to review to the class in preparation for the final exam.”
Reflection Questions

• What’s the difference, if any, between *studying* and *learning*?

• For which task would you work harder?
  A. Make an A on the test
  B. Teach the material to the class
Impact of Teaching The Material to His Betta Fish on Ty’s Learning in Biology and Chemistry

- First encounter on September 17, 2018
- Email on October 25, 2018

Bio Exam Grades: 66, 98, 90  B in course
Chem Exam Grades: 62, 83  B in course
Impact of Teaching to Learn
Ty, First Year LSU Student

Email Received on October 26, 2018

I attended more of the SI sessions and the exam reviews. Before the exam reviews and SI Sessions I would try to answer as many of the questions as possible to see about where I was in terms of grasping the information, then at the exam reviews/SI sessions I would know what I needed to understand. Next after the reviews/SI sessions I would go to my room and “teach” the materials to my betta fish. The material I couldn’t explain, I would study more. I would continue that cycle until I could explain everything in my notes....
Betta fish purchased on September 21, 2019 by Howard University Bison STEM Scholars

Sat, Sep 21, 12:34 PM

Look what you inspired!!
The Story of Two Students

- **Travis**, *junior psychology student*
  
  47, 52, **82, 86**
  
  B in course

- **Dana**, *first year physics student*
  
  80, 54, **91, 97, 90** *(final)*
  
  A in course
Travis, junior psychology student
47, 52, 82, 86

Problem: Reading Comprehension

Solution: Preview text before reading*
Develop questions*
Read one paragraph at a time
and paraphrase information

* Developing an anticipatory set
First Voyage of Christopher Columbus

WITH HOCKED GEMS FINANCING HIM/ OUR HERO BRAVELY DEFIED ALL SCORNFUL LAUGHTER/ THAT TRIED TO PREVENT HIS SCHEME/ YOUR EYES DECEIVE/ HE HAD SAID/ AN EGG/ NOT A TABLE/ CORRECTLY TYPifies THIS UNEXPLORED PLANET/ NOW THREE STURDY SISTERS SOUGHT PROOF/ FORGING ALONG SOMETIMES THROUGH CALM VASTNESS/ YET MORE OFTEN OVER TURBULENT PEAKS AND VALLEYS/ DAYS BECAME WEEKS/ AS MANY DOUBTERS SPREAD FEARFUL RUMORS ABOUT THE EDGE/ AT LAST/ FROM NOWHERE/ WELCOME WINGED CREATURES APPEARED/ SIGNIFYING MOMENTOUS SUCCESS

An Effective Reading Strategy: SQ5R

- **Survey** (look at intro, summary, bold print, italicized words, etc.)
- **Question** (devise questions survey that you think the reading will answer)
- **Read** (one paragraph at a time)
- **Recite** (summarize in your own words)
- **Record or wRite** (annotate in margins)
- **Review** (summarize the information in your words)
- **Reflect** (other views, remaining questions)
Dana, first year physics student
80, 54, **91, 97, 90** (final)

Problem: Memorizing formulas and using www.cramster.com

Solution: Solve problems with no external aids and test mastery of concepts
Dana Lewis, MS in Medical Physics, 2015
Univ of Texas Graduate School of Biomedical Sciences at Houston
Thesis research at UT MD Anderson Cancer Center

Practicing Medical Physicist as of 8/28/2016 when she completed her residency!
Why the Fast and Dramatic Increase?

It’s all about the *strategies*, and getting *them* to **engage their brains**!
Counting Vowels in 45 seconds

A E I O U

How accurate are you?

Count all the vowels in the words on the next slide.
<table>
<thead>
<tr>
<th>Dollar Bill</th>
<th>Cat Lives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dice</td>
<td>Bowling Pins</td>
</tr>
<tr>
<td>Tricycle</td>
<td>Football Team</td>
</tr>
<tr>
<td>Four-leaf Clover</td>
<td>Dozen Eggs</td>
</tr>
<tr>
<td>Hand</td>
<td>Unlucky Friday</td>
</tr>
<tr>
<td>Six-Pack</td>
<td>Valentine’s Day</td>
</tr>
<tr>
<td>Seven-Up</td>
<td>Quarter Hour</td>
</tr>
<tr>
<td>Octopus</td>
<td></td>
</tr>
</tbody>
</table>
How many *words* or *phrases* do you remember?
Let’s look at the words again...

What are they arranged according to?
<table>
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<td>Seven-Up</td>
<td>Quarter Hour</td>
</tr>
<tr>
<td>Octopus</td>
<td></td>
</tr>
</tbody>
</table>
NOW, how many words or phrases do you remember?
What were two major *differences* between the two attempts?

1. We knew what the task was

2. We knew how the information was organized
What we know about learning

• Active learning is more lasting than passive learning
  -- Passive learning is an oxymoron*

• Thinking about thinking is important
  – Metacognition**

• The level at which learning occurs is important
  – Bloom’s Taxonomy***


Creating

Evaluating

Analyzing

Applying

Understanding

Remembering

Putting elements together to form a coherent or functional whole

Making judgments based on criteria and standards through checking and critiquing

Breaking material into constituent parts

Carrying out or using a procedure through executing, or implementing

Constructing meaning from oral, written, and graphic messages

Retrieving, recognizing, and recalling relevant knowledge from long-term memory

http://www.lsu.edu/students/casmakebettergrades/successresources/CAS_Blooms.pdf
Bloom’s Taxonomy

- **Remember**
  - Recall facts and basic concepts
  - Define, duplicate, list, memorize, repeat, state

- **Understand**
  - Explain ideas or concepts
  - Classify, describe, discuss, explain, identify, locate, recognize, report, select, translate

- **Apply**
  - Use information in new situations
  - Execute, implement, solve, use, demonstrate, interpret, operate, schedule, sketch

- **Analyze**
  - Draw connections among ideas
  - Differentiate, organize, relate, compare, contrast, distinguish, examine, experiment, question, test

- **Evaluate**
  - Justify a stand or decision
  - Appraise, argue, defend, judge, select, support, value, critique, weigh

- **Create**
  - Produce new or original work
  - Design, assemble, construct, conjecture, develop, formulate, author, investigate

When we teach students about Bloom’s Taxonomy...

They GET it!
How do you think students answered?

At what level of Bloom’s did you have to operate to make A’s or B’s in high school?

1. Remembering
2. Understanding
3. Applying
4. Analyzing
5. Evaluating
6. Creating
How do you think students answered?

At what level of Bloom’s do you think you’ll need to operate to make A’s in college courses?

1. Remembering
2. Understanding
3. Applying
4. Analyzing
5. Evaluating
6. Creating
How do we teach students to move higher on Bloom’s Taxonomy?

Teach them the Study Cycle*

*adapted from Frank Christ’s PLRS system
The Study Cycle

**Preview**
- **Preview before class** – Skim the chapter, note headings and boldface words, review summaries and chapter objectives, and come up with questions you’d like the lecture to answer for you.

**Attend**
- **Attend class** – GO TO CLASS! Answer and ask questions and take meaningful notes.

**Review**
- **Review after class** – As soon after class as possible, read notes, fill in gaps and note any questions.

**Study**
- **Study** – Repetition is the key. Ask questions such as ‘why’, ‘how’, and ‘what if’.
  - Intense Study Sessions* - 3-5 short study sessions per day
  - Weekend Review – Read notes and material from the week to make connections

**Assess**
- **Assess your Learning** – Periodically perform reality checks
  - Am I using study methods that are effective?
  - Do I understand the material enough to teach it to others?

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**Intense Study Sessions**

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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Set a Goal</td>
<td>1-2 min</td>
</tr>
<tr>
<td>2</td>
<td>Study with Focus</td>
<td>30-50 min</td>
</tr>
<tr>
<td>3</td>
<td>Reward Yourself</td>
<td>10-15 min</td>
</tr>
<tr>
<td>4</td>
<td>Review</td>
<td>5 min</td>
</tr>
</tbody>
</table>

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Center for Academic Success
B-31 Coates Hall • 225.578.2872 • www.cas.lsu.edu
What happens when we teach metacognitive learning strategies, Bloom’s Taxonomy, and the Study Cycle to an entire class, not just individuals?
Performance in Gen Chem I in 2011 Based on One Learning Strategies Session*

<table>
<thead>
<tr>
<th></th>
<th>Attended</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1 Avg.:</td>
<td>71.65%</td>
<td>70.45%</td>
</tr>
<tr>
<td>Exam 2 Avg.:</td>
<td>77.18%</td>
<td>68.90%</td>
</tr>
<tr>
<td>Final course Avg.*:</td>
<td>81.60%</td>
<td>70.43%</td>
</tr>
<tr>
<td><strong>Final Course Grade:</strong></td>
<td>B</td>
<td>C</td>
</tr>
</tbody>
</table>

The one 50-min presentation on study and learning strategies resulted in an improvement of one full letter grade!

## Performance in Gen Chem 1202 Sp 2013
Based on One Learning Strategies Session

<table>
<thead>
<tr>
<th></th>
<th>Attended</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1 Avg.:</td>
<td>71.33%</td>
<td>69.27%</td>
</tr>
<tr>
<td>Homework Total</td>
<td>169.8</td>
<td>119.1</td>
</tr>
<tr>
<td>Final course Avg*</td>
<td>82.36%</td>
<td>67.71%</td>
</tr>
</tbody>
</table>

**Final Course Grade:**
- B (Attended)
- D (Absent)

The 50-min presentation on study and learning strategies resulted in an improvement of two letter grades!
**Performance in Gen Chem 1202 Sp 2015**  
Based on One Learning Strategies Session

<table>
<thead>
<tr>
<th></th>
<th>Attended</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1, 2, 3 Avg:</td>
<td>68.14%</td>
<td>69.67%</td>
</tr>
<tr>
<td>Exam 4 Avg:</td>
<td>83.45%</td>
<td>75.91%</td>
</tr>
<tr>
<td>Final Exam Avg:</td>
<td>80.98%</td>
<td>75.24%</td>
</tr>
<tr>
<td>Final course Avg*:</td>
<td>84.90%</td>
<td>78.83%</td>
</tr>
<tr>
<td><strong>Final Course Grade:</strong></td>
<td><strong>B</strong></td>
<td><strong>C</strong></td>
</tr>
</tbody>
</table>

The 50-min presentation on study and learning strategies *after exam 3* was followed by an improvement of one letter grade.
Until Fall 2013, the student success rate of a large introductory chemistry class...was 50%...We then implemented a face-to-face class format based on The Study Cycle concepts presented by Dr. Saundra McGuire in her book “Teach Students How to Learn”. Curriculum revisions enabled faculty to deliver well-focused lectures, with access to supporting practice problems and labs that connected clearly with each week’s learning objective... Starting in Fall 2016, some sections introduced active and cooperative learning, which led to a steady improvement in the overall success rate, ending at 75% in Fall of 2018.

*Manuscript accepted for publication. Personal communication April 19, 2019
What happens when we **offer** metacognitive learning strategies, Bloom’s Taxonomy, and the Study Cycle to an entire university, not just individuals or specific classes?
Quantitative Results from Feb 2017 AYC Challenge

- **979 students** in eight sections of STEM gateway courses (3 disciplines; 6 courses)
- **Ordinary Least Squares Regression (OLS) performed** to generate a statistically significant model (p<0.001)
- Controlling for exam 1 score and high school GPA, we estimate that attending Dr. McGuire's workshop was associated with **final grades** that were 3.22 points higher (100 pt scale). *Completing the challenge* was associated with a final grade **5.61 points higher**.
- **Final course grades:**
  - Course only: **C+**
  - Attended metacognition workshop session: **B**
  - Attended workshop *and* completed AYC Challenge: **B+**
A Campus-wide Strategy to Develop Metacognition in Gateway Courses
by Eric Kaldor and Holly Swanson, University of Rhode Island

2018 Robert J. Menges Award for Outstanding Research in Educational Development
Professional and Organizational Development (POD)
Univ of Louisville AYC Challenge
Currently in Progress

ACE YOUR COURSE CHALLENGE

Thursday, February 6
4-5:30 p.m.
Strickler Hall - Rm 101

Join visiting expert Dr. Saundra McGuire for a transformative presentation on learning strategies proven to increase course grades!

95%
of students who incorporated her strategies after attending a similar presentation at the University of Rhode Island noted increased confidence when learning material in a challenging course!

WHAT PREVIOUS ATTENDEES SAY:

“I was a confused freshman before ... but now I am confident I can succeed in college!”

“I was really nervous that my 52 on my first exam was for sure going to ‘ruin my life;’ however, I came to this presentation and started applying these techniques to my daily routine... I just got my second exam today and I received a 91!”

Register at uoflayc2020.eventbrite.com
Knowledge of Metacognition and Mindset Can Greatly Increase the Success of Minority and First Generation Students

- They are less likely to have been academically challenged in high school
- They are less likely to be encouraged to stick with it
- They are more likely to experience the impact of a paradigm shift
Linda Nilson’s Top Ten Best Teaching Practices for Creating Self-Regulated Learners

10. Setting clear, assessible learning outcomes and assess on them
9. Giving students practice, practice, practice
8. **Teaching students how to learn/study in your course**
7. Giving students prompt feedback and many varied grading opportunities, including “authentic” ones
6. Communicating high expectations
5. Integrating “desirable difficulties” into student learning
4. Giving “student-active” breaks every 12 – 20 min
3. Holding students accountable for reading assignments when due
2. Using the “best tool(s) for the job”
1. Getting mid-semester student feedback—on your own or with help of a colleague or instructional consultant
<table>
<thead>
<tr>
<th>Date</th>
<th>Result</th>
<th>Date</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/04</td>
<td>Failed</td>
<td>10/05</td>
<td>Passed</td>
</tr>
<tr>
<td>10/04</td>
<td>Failed</td>
<td>11/05</td>
<td>Failed</td>
</tr>
<tr>
<td>11/04</td>
<td>Failed</td>
<td>12/05</td>
<td>Passed best in group</td>
</tr>
<tr>
<td>12/04</td>
<td>Failed</td>
<td>1/06</td>
<td>Passed</td>
</tr>
<tr>
<td>1/05</td>
<td>Passed</td>
<td>2/06</td>
<td>Passed</td>
</tr>
<tr>
<td>2/05</td>
<td>Failed</td>
<td>3/06</td>
<td>Failed</td>
</tr>
<tr>
<td>3/05</td>
<td>Failed</td>
<td>4/06</td>
<td>Passed last one!</td>
</tr>
<tr>
<td>4/05</td>
<td>Failed</td>
<td>5/06</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Began work with CAS and the Writing Center in October 2005
Oct. 17, 2011

Hello Dr. Kelley. ... I am struggling at Xavier and I REALLY want to succeed, but everything I've tried seems to end with a "decent" grade. I'm not the type of person that settles for decent. What you preached during the time you were in Dr. Privett's class last week is still ringing in my head. I really want to know how you were able to do really well even despite your circumstances growing up. I was hoping you could mentor me and guide me down the path that will help me realize my true potential while here at Xavier. Honestly I want to do what you did, but I seriously can't find a way how to. Can I please set up a meeting with you as soon as you’re available so I can learn how to get a handle grades and classes?

Oct. 24, 2011

Hey Dr. Kelley, I made an 84 on my chemistry exam (compared to the 56 on my first one) using your method for 2 days (without prior intense studying). Thanks for pointing me in the right direction. I’ll come by your office Friday and talk to you about the test.

Nov 3, 2011

Hey Dr. Kelley! I have increased my Bio exam grade from a 76% to a 91.5% using your system. Ever since I started your study cycle program, my grades have significantly improved. I have honestly gained a sense of hope and confidence here at Xavier. My family and I are really grateful that you have taken time to get me back on track.
Conclusion

We *can* significantly increase learning by...

- teaching students *how* to learn
- helping students develop the right mindset
- making the implicit *explicit*
- *not judging* student potential on initial performance
- encouraging students to *persist in the face of initial failure*
- *Motivating students to use metacognitive learning strategies*
Special Note

Please visit the CAS website at [www.cas.lsu.edu](http://www.cas.lsu.edu). We have on-line workshops that will introduce you and your students to effective metacognitive strategies.

Have fun teaching your students powerful metacognitive strategies that will lead to increased academic success!

Saundra McGuire
Acknowledgments

- Sarah Baird, Learning Strategist
- LSU Center for Academic Success
- Dr. Elzbieta Cook, LSU General Chem Instructor
- National College Learning Center Association
- All of the faculty who implemented these strategies and provided feedback
- All of the students who changed their attitudes and behaviors and showed me what was possible!
Useful Websites

• reach.louisville.edu/
• www.cas.lsu.edu
• www.howtostudy.org
• www.vark-learn.com
• Searches on www.google.com
Additional References


New Online Course on Teach Students How to Learn (https://tinyurl.com/TSLcourse) Offered by Dr. Bridget Arend