Get Students to Focus on *Learning* Instead of *Grades*: 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
OUR MISSION
To improve the prospects and enrich the lives of the people of Arizona and the world through education, research, creative expression, and community and business partnerships.

OUR VISION
Through cross-cutting innovations distinctive to the University of Arizona, we will expand the student experience through engagement, advance knowledge through innovations in creative inquiry and collaboration, and forge novel partnerships to positively impact our community.

OUR VALUES
Excellence and Integrity
Collegiality and Openness
Interdisciplinary and Sustainability
Engagement and Societal Impact
Access and Opportunity
Diversity, Inclusion, and Shared Decision-Making
Univ of Arizona Retention and Graduation Rates

Freshmen Retention Rate at University of Arizona

Above average at retaining students past freshman year with a 82.0% retention rate.

Minor improvement from 77.0% to 82.0% in five years.

<table>
<thead>
<tr>
<th>Year</th>
<th>Stayed</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>77%</td>
<td>23%</td>
</tr>
<tr>
<td>2011</td>
<td>77%</td>
<td>23%</td>
</tr>
<tr>
<td>2012</td>
<td>80%</td>
<td>20%</td>
</tr>
<tr>
<td>2013</td>
<td>80%</td>
<td>20%</td>
</tr>
<tr>
<td>2014</td>
<td>82%</td>
<td>18%</td>
</tr>
<tr>
<td>2015</td>
<td>82%</td>
<td>18%</td>
</tr>
</tbody>
</table>

Graduation Rates at University of Arizona

60.3% of students graduate within a reasonable time (three or six years depending on the degree).

Above average overall graduation rates with 60.3% of students graduating in a reasonable time.

How * Might UA Improve These Rates?

- Teach Students * How to Learn
- Help Students Develop the Right Mindset
- Motivate Students to Implement Effective Metacognitive Learning Strategies
Awesome UA Resources

The Strategic Alternative Learning Techniques (SALT) Center promotes the achievement of individuals with learning and attention challenges.

ACADEMIC SUCCESS AND ACHIEVEMENT

Academic Success & Achievement (ASA) serves to engage students through a series of programs and services designed to assist in their academic success and retention at the University of Arizona. Learn more about our programs to see which is a good fit for you!

THE THINK TANK

All of the UA's tutoring and academic support programs under one roof at the Student Academic Learning Center. Services are both free and fee-based, and include group course reviews, exam prep sessions, assistance with math, science, writing and many Tier 1 and second language classes.

CATS ACADEMICS

Professional staff in CATS Academics provide comprehensive academic support for intercollegiate student-athletes. Services include assistance with degree and course planning, coordination of all learning and tutorial support, personal counseling, monitoring degree progress and NCAA academic eligibility.
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

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
  Sem GPA 4.18
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
Impact of Using Homework Strategy

Sydnie L.
First Year Biology Pre-Med Honors College Student

Email on January 20, 2014

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*...
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
A Reading Strategy that Works: 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)
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

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!
Faculty Must Help Students Make the Transition to College

Help students identify and close “the gap”

current behavior ➔ current grades

MIND THE GAP

productive behavior ➔ desired grades
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
Power of Teaching to Master Learning
Clint’s Story: Baby Groot and the Licensure Exam

Guardians of the Galaxy

- First encounter on October 29, 2015 at EKU
- Email on January 18, 2016
- Msg on April 14, 2016
- Msg on June 11, 2016

https://www.youtube.com/watch?v=BEPbXYzE5_Y
Why is Fast and Dramatic Increase Possible?

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

How accurate are you?

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

What are they arranged according to?
<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>
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***


Bloom’s Taxonomy

Remembering

Understanding

Applying

Analyzing

Evaluating

Creating

- Retrieving, recognizing, and recalling relevant knowledge from long-term memory.
- Carrying out or using a procedure through executing, or implementing.
- Making judgments based on criteria and standards through checking and critiquing.
- Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure.
- Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.
- Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

This pyramid depicts the different levels of thinking we use when learning. Notice how each level builds on the foundation that precedes it. It is required that we learn the lower levels before we can effectively use the skills above.

http://www.odu.edu/educ/llschult/blooms_taxonomy.htm
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 students answered (2008)

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

![Bar Chart]

- Level 1: 21%
- Level 2: 35%
- Level 3: 25%
- Level 4: 13%
- Level 5: 3%
- Level 6: 3%
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
At what level of Bloom’s did you have to operate to make A’s and 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 students answered (in 2008)

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

1. Remembering
2. Understanding
3. Applying
4. Analyzing
5. Evaluating
6. Creating

- Remembering: 7%
- Understanding: 6%
- Applying: 14%
- Analyzing: 35%
- Evaluating: 23%
- Creating: 15%
How students answered (in 2013)

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

1. Remembering
2. Understanding
3. Applying
4. Analyzing
5. Evaluating
6. Creating
How students answered (in 2014)

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

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?

*Intense Study Sessions

1. Set a Goal (1-2 min)  
   Decide what you want to accomplish in your study session

2. Study with Focus (30-50 min)  
   Interact with material- organize, concept map, summarize, process, re-read, fill-in notes, reflect, etc.

3. Reward Yourself (10-15 min)  
   Take a break– call a friend, play a short game, get a snack

4. Review (5 min)  
   Go over what you just studied

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><strong>B</strong></td>
<td><strong>C</strong></td>
</tr>
</tbody>
</table>

The one 50-min presentation on study and learning strategies was followed by 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**
- **D**

The 50-min presentation on study and learning strategies was followed by 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>
</tbody>
</table>

**Final Course Grade:** B C

The 50-min presentation on study and learning strategies after exam 3 was followed by an improvement of one letter grade.
Prof. Isiah Warner’s Chemistry 2001 Class
Fall 2005

<table>
<thead>
<tr>
<th>Class Average</th>
<th>Adam</th>
<th>Frederick</th>
<th>M’Famara</th>
<th>Stephanie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1</td>
<td>76</td>
<td>65</td>
<td>77</td>
<td>70</td>
</tr>
<tr>
<td>Test 2</td>
<td>52</td>
<td>67</td>
<td>65</td>
<td>46</td>
</tr>
<tr>
<td>Test 3</td>
<td>72</td>
<td>61</td>
<td>68</td>
<td>68</td>
</tr>
<tr>
<td>Final</td>
<td>78</td>
<td>107</td>
<td>88</td>
<td>88</td>
</tr>
</tbody>
</table>

Date of Final Exam: December 14, 2005
Meeting with Adam: December 12, 2005
Meeting with Frederick and Stephanie: December 2, 2005
Meeting with M’Famara: December 8, 2005

*The final was worth 100 points with a 10 bonus question.*
Metacognition: An Effective Tool to Promote Success in College Science Learning*

Ningfeng Zhao¹, Jeffrey Wardeska¹, Saundra McGuire², Elzbieta Cook²

¹Department of Chemistry, East Tennessee State University
²Department of Chemistry, Louisiana State University

*March/April 2014 issue of JCST, Vol. 43, No. 4, pages 48-54
Help Students Develop the Right Mindset


Mindset* is Important!

- **Fixed Intelligence Mindset**
  - Intelligence is static
  - You have a certain amount of it

- **Growth Intelligence Mindset**
  - Intelligence can be developed
  - You can grow it with actions

New York: Random House Publishing
Responses to Many Situations are Based on Mindset

<table>
<thead>
<tr>
<th></th>
<th>Fixed Intelligence Mindset Response</th>
<th>Growth Intelligence Mindset Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenges</td>
<td>Avoid</td>
<td>Embrace</td>
</tr>
<tr>
<td>Obstacles</td>
<td>Give up easily</td>
<td>Persist</td>
</tr>
<tr>
<td>Tasks requiring effort</td>
<td>Fruitless to Try</td>
<td>Path to mastery</td>
</tr>
<tr>
<td>Criticism</td>
<td>Ignore it</td>
<td>Learn from it</td>
</tr>
<tr>
<td>Success of Others</td>
<td>Threatening</td>
<td>Inspirational</td>
</tr>
</tbody>
</table>
Which mindset about intelligence do you think *most students* have?

1. Fixed
2. Growth
Which mindset about *student* intelligence do you think *most* faculty have?

1. Fixed
2. Growth
Which mindset about student intelligence do you think most STEM faculty have?

1. Fixed
2. Growth
Email from a Spring 2011 General Chemistry Student

“...Personally, I am not so good at chemistry and unfortunately, at this point my grade for that class is reflecting exactly that. I am emailing you inquiring about a possibility of you tutoring me.”

April 6, 2011

“...I made a 68, 50, (50), 87, 87, and a 97 on my final. I ended up earning a 90 (A) in the course, but I started with a 60 (D). I think what I did different was make sidenotes in each chapter and as I progressed onto the next chapter I was able to refer to these notes. I would say that in chemistry everything builds from the previous topic.”

May 13, 2011

Semester GPA: 3.8
First Year Class
Histology Exam Improvement

- Metacognition Discussion – August 13, 2004
- Histology Exam – August 23, 2004
- Previous class averages: 74 – 78
- Challenge to class on August 13: 84 average
- Reported average on August 24: 85!
How Can We Motivate Students to *Use* Learning Strategies?

Sharing Strategies that Have Worked for Others Can Be *Very* Motivational
Top 5 Reasons Students Made an F on Test 1 in General Chemistry

1. Didn’t spend enough time on the material
2. Started the homework too late
3. Didn’t memorize the information I needed to memorize
4. Did not use the book
5. Assumed I understood information that I had read and re-read, but had not applied
Top 5 Reasons Folks Made an A on Test 1:

1. Did preview-review for every class
2. Did a little of the homework at a time
3. Used the book and did the suggested problems
4. Made flashcards of the information to be memorized
5. Practiced explaining the information to others
At the end of a 60 minute learning strategies presentation by the professor, students were given a survey to determine their self-assessment of whether they were using or not using the strategies. The average scores of the different groups on the first two exams are shown below.

<table>
<thead>
<tr>
<th>Self-Reported Use of Strategies</th>
<th>Exam 1</th>
<th>Exam 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not use the strategies</td>
<td>58</td>
<td>54</td>
</tr>
<tr>
<td>Used metacognitive strategies</td>
<td>95</td>
<td>80</td>
</tr>
</tbody>
</table>
Comments from Engineering Students about what they changed for Test 3*

• I changed my study habits by doing the homework early. I also started reading some of the material before going to the class. The most effective was spending more time on the material.

• I started studying for the exam sooner. I also took more time to do the homework. I reviewed/rewrote my notes from class.

• I studied for the class as close to everyday as possible

• I got together with other classmates and helped them with their weakness and of course they helped me with mine as well.

*class average increased from 65.7% to 80.5%!
(for students who took all three course exams)
<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*
Dr. Algernon Kelley, December 2009
From a Xavier University student to Dr. Kelley in Fall 2011

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
- making learning *visible*
- *not judging* student potential on initial performance
- encouraging students to *persist in the face of initial failure*
- encouraging the *use of metacognitive tools for deep and integrative learning*
Useful Websites

• www.cas.lsu.edu
• www.howtostudy.org
• www.vark-learn.com
• www.drearlbloch.com
References


  [http://academic.pg.cc.md.us/~wpeirce/MCCCTR/metacognition.htm](http://academic.pg.cc.md.md.us/~wpeirce/MCCCTR/metacognition.htm)  
  *Excellent student reference*