Teach Students *How* to Learn: Metacognition is the Key!



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Vision

Syracuse University aspires to be a **pre-eminent and inclusive student-focused research university**, preparing engaged citizens, scholars, and leaders for participation in a changing global society.



Mission

As a university with the capacity to attract and engage the best scholars from around the world, yet small enough to support a *personalized and academically rigorous student experience*, Syracuse University faculty and staff *support student success by*:

- Encouraging global study, experiential learning, interdisciplinary scholarship, creativity, and entrepreneurial endeavors
- Balancing professional studies with an intensive liberal arts education
- Fostering a *richly diverse and inclusive community of learning* and opportunity
- Promoting a culture of innovation and discovery
- Supporting faculty, staff, and student collaboration in creative activity and research that address emerging opportunities and societal needs
- Maintaining pride in our location and history as a *place of access*, engagement, innovation, and impact

Syracuse Univ Retention and Graduation Rates

Syracuse Has One of the Best Freshman Retention Rates in the Country

With 90.0% of students staying on for a second year, Syracuse University is one of the best in the country when it comes to freshman retention.

Nationwide, the average first year to second year retention rate is 69.0%. When looking at just colleges and universities in New York , the average is 73.0%.

Syracuse Freshmen Retention Rate Rankings



Syracuse's Six-Year Grad Rate is 81.2%

National Average is 54.7%

Expected Syracuse Univ Rate is 77.6%

Syracuse's Retention Rate is **90.0%!** National Average is 69.0% New York Average is 73.0%

Overall, 81.2% of Syracuse Undergrads Finish Within Six Years

At Syracuse , there were 4,029 bachelors degree candidates in the class of 2015 . By 2017 , six years after beginning their degree, 81.2% of these students had graduated. After an additional two years, 82.2% of this class eventually completed their degree.

We consider the "on-time" graduation rate for a bachelor's degree to be four years, but colleges typically report their graduation rates after six or even eight years.

Overall Syracuse Six Year Graduation Rate (81.2%)



https://www.collegefactual.com/colleges/syracuse-university/academic-life/graduation-and-retention/

How *Might* Syracuse University Improve Its retention and Graduation Rates?

- Teach Students How to Learn
- Help Students Actively Engage in Learning
- Motivate Students to Implement Effective Learning Strategies

Agenda

- Definition of Metacognition
- Examples Demonstrating Impact
- Effective Metacognitive Strategies
- Bloom's Taxonomy and The Study Cycle
- Conclusion and Wrap-Up



Have you ever attended a presentation or read one of the books by Saundra McGuire?

- A. I've attended a presentation
- B. I've read one of the books
- C. Both A & B are true
- D. None of the above



How much do you know about metacognition?

- A. Almost nothing
- B. A little bit
- C. Quite a lot
- D. More than I care to know

Metacognition

The ability to:

- think about your own thinking
- be consciously aware of yourself as a problem solver
- plan, monitor, evaluate, 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

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), The nature of intelligence (pp.231-236). Hillsdale, NJ: Erlbaum

Why haven't most students already developed these skills?







It wasn't necessary in high school

Data from UCLA Higher Education Research Institute (HERI) First Year Student Survey – 2010 - 2019

	% Spending at least 6hrs/wk on homework	% with an A average
2010	37.3	48.4
2011	39.5	49.7
2012	38.4	49.5
2013	41.4	52.8
2014	42.9	53.1
2015	44.8	58.7
2016	44.0	55.1
2017	44.1	51.5
2018	42.3	57.6
2019	43.3	59.7

www.heri.ucla.edu/monographs/TheAmericanFreshman2019-Expanded.pdf

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?

Faculty Must Help Students Actively Engage in Learning

Help students identify and close "the gap"



Metacognition Enabled Dana to Persist In Physics



Dana, first year physics student 80, 54, <u>91, 97, 90 (final)</u>

Before Metacognition: Memorizing formulas and using online homework programs

After Metacognition: Solving problems with no external aids and testing mastery of concepts

Dana Lewis, MS in Medical Physics, 2015 University of Texas Graduate School of Biomedical Sciences at Houston



Practicing Medical Physicist as of 8/28/2016 when she completed her residency!

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

Metacognitive Reading Increased Engagement for Travis 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 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)

Flying a Kite

A newspaper is better than a magazine/ A seashore is a better place than the street/ At first it is better to run than walk/ You may have to try several times/ It takes some skill, but it is easy to learn/ Even young children can enjoy it/ Once successful, complications are minimal/Birds seldom get too close/Rain, however, soaks in very fast/ Too many people doing the same thing can also cause problems/ One needs lots of room/ If there are no complications, it can be very peaceful/ A rock will serve as an anchor/ If things break loose from it, however, you will not get a second chance/

Bransford, J.D. and Johnson, M. K. Contextual Prerequisites for Understanding: Some Investigations of Comprehension and Recall, *Journal of Verbal Behavior*, (1971), 11, 717-726, 1972.

http://www.cogsci.umn.edu/docs/pdfs/Bransford1972-JVLVB.pdf

Impact of Reading Strategy

Text Forwarded from College Admissions Reviewer on 2/22/2021

...When I first started teaching Jamiyah she was not passing my exams...She wanted to drop to a lower-level Physics course. I asked her how she studies. Jamiyah told me she reads the textbook. I then asked her how she took notes. It turns out that she did not! She was reading it like a novel. After having read *Teach Students How to Learn* I decided to put one of those strategies into practice. I asked Jamiyah not to give up yet, but to make one little change. I asked her to read a paragraph, close the book and then summarize it herself. Re-open the book and continue... this way not only would she have to take notes, but she would have to think about it and summarize it in her own words. This worked. Not only did that turn her around in my class, but she applied the same technique in all her other classes and saw her grades go up... Now she has found **confidence** and knows what to do. Jamiyah will do nothing but exceptional work in college.

Reflection Questions Are Key to Engaging Students in Metacognitive Behaviors

 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

Atkinson, M. P. (2015). *Reflection and metacognition* [PowerPoint slides]. Department of Sociology, North Carolina State University. https://dasa.ncsu.edu/wp-content/uploads/sites/20/2015/06/12-reflection.metacognition.pdf

The Power of Teaching to Learn: What Happened When Ty Taught His Betta Fish



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

Bio Exam Grades:

Chem Exam Grades:

66, 98, 90; Final Grade B 62, 83; Final Grade B

Impact of Teaching to Learn Ty, LSU First Year Student

Email Received on October 26, 2018

I attended more of the Supplemental Instruction (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....

Why Is Fast and Dramatic Improvement Possible?

It's all about the *strategies*, and getting *them* to *engage their brains*!







Finding Numbers in Sequential Order



How many can you find in 15 seconds?

76	4	48	28	64	5	77	33	53	45
56	32	16	44	72	17	37	69	29	(1)
20	36	8	24	52	21	61	13	57	49
68	60	12	80	40	9	41	65	25	73
3	67	47	.79	23	70	22	38	14	54
19	31	55	51	71	6	62	2	46	50
59	7	63	27	39	74	10	42	66	26
32	75	15	13	11	72	12	3/	30	58
55	75	IJ	40	11	70	10	JT	50	50



Center for Academic Success

What were two major differences between the first attempt and the second attempt?

We knew how the information was organized

We could look at a smaller section of the grid





Bransford, J.D., Brown, A.L., Cocking, R.R. (Eds.), 2000. *How people learn: Brain, Mind, Experience, and School.* Washington, DC: National Academy Press.



National Academies of Sciences, Engineering, and Medicine. 2018. *How People Learn II: Learners, Contexts, and Cultures*. Washington, DC: The National Academies Press. https://doi.org/10.17226/24783

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***

*Cross, Patricia, "Opening Windows on Learning", League for Innovation in the Community College, June 1998, p. 21.

** Flavell, John, "Metacognition and cognitive monitoring: A new area of cognitivedevelopmental inquiry." *American Psychologist*, Vol 34(10), Oct 1979, 906-911. *** Bloom Benjamin. S. (1956). *Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain.* New York: David McKay Co Inc.



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 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 (2014)

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 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 students answered (in 2018)

At what level of Bloom's do you think you'll need to operate to make A's and B's in high school?

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



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





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Brea Manuel, BS in Chemistry, 2018

Entered PhD Program at Emory University on Full Fellowship in Fall 2018 Became a PhD Candidate in Spring 2020 Expected Graduation Date 2023 Will Do Post Doc Work at University of Maryland, Baltimore County



The focused study sessions helped me most. I actually got A+ on 3 out of 4 of my finals using that method of studying. It's important to use it everyday before finals week, and I think it would really benefit students during finals week.

Manuel, B.A., Karloff, D.B. Recruit and retain a diverse workforce. *Nat Rev Chem* (2020). https://doi.org/10.1038/s41570-020-0214-z

Thermoreversible Control of Nucleic Acid Structure and Function with Glyoxal Caging Steve D. Knutson, Aimee A. Sanford, Colin S. Swenson, Megan M. Korn, **Brea A. Manuel**, and Jennifer M. Heemstra**J. Am. Chem. Soc.* 2020, 142, 41, 17766–17781 https://doi.org/10.1021/jacs.0c08996

Sharing Bloom's and The Study Cycle Improved Learning

Dr. Kelter:

After the ND-Gateway workshop this August, I shared Dr. McGuire's presentation with several of my colleagues and students in the ABEN department.

One ABEN student was struggling in his classes. I asked how he studied, and found he didn't have good study habits. I **shared the PPT with him on August 21, 2018, and also emphasized the content in slide 32 (Bloom's Taxonomy) and slide 45 (Study Cycle)**. He wrote me an email today (September 7, 2018) and said:

"I actually am applying myself and changed my study and planning habits and it seems to be paying off already. I scored 114% on the first and only graded homework assignment so far and took the first exam on Wednesday and got 100%."

I also applied the suggestion in Slide 14 to my class, and **invited students to coteach some lectures with me.** They did a fantastic job by adding much more content and real world experience to the class. This is truly a wonderful experience for me because I saw that students poured their passion and talent into the lecture.

Please extend my appreciation to Dr. McGuire.

Thanks,

Xinhua Jia, Ph.D., P.E. Associate Professor, Agricultural and Biosystems Engineering North Dakota State University

Two Different Mindsets About Intelligence

Fixed Mindset

Intelligence is static You have a certain amount of it

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

Dweck, Carol (2006) *Mindset: The New Psychology of Success.* New York: Random House Publishing

Responses to Many Situations are Based on Mindset



Which mindset about intelligence do you think *most students* have?

Fixed
 Growth



Which mindset about student intelligence do you think *most faculty* have?

Fixed
 Growth



Email from a General Chemistry Student with a Fixed Mindset

"...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



Home > Study links faculty attitudes on intelligence to student success in STEM, with large impact on minority student success

Study links faculty attitudes on intelligence to student success in STEM, with large impact on minority student success

Submitted by Scott Jaschik on February 18, 2019 - 3:00am

A new study suggests that faculty members' attitudes about intelligence can have a major impact on the success of students in science, mathematics and technology courses. Students see more achievement when their instructors believe in a "growth mind-set" about intelligence than they do learning from those who believe intelligence is fixed. The impact was found across all student groups but was most pronounced among minority students.

The study -- by brain science scholars at <u>Indiana University at Bloomington</u> [1] -- was published in the journal <u>Science</u> <u>Advances</u> [2] and presented last week at the annual meeting of the American Association for the Advancement of Science.

The researchers collected data on 150 faculty members in a range of STEM disciplines and 15,000 students over two years at a large public research university that is not identified. Faculty members were asked to respond to a general statement about intelligence along the lines of "To be honest, students have a certain amount of intelligence, and they really can't do much to change it."

The study then looked at student performance in courses taught by those who agreed with that perspective and those who did not.

The findings:

While all students perform better when STEM professors endorse a growth mindset belief, the racial achievement gap is almost halved when professors endorse a growth-mindset belief.



www.insidehighered.com/news/2019/02/18/study-links-faculty-attitudesintelligence-student-success-stem-large-impact

Interview with 2021 Princeton neuroscience graduate conducted on 6/8/2021

I came from a public high school, and I struggled a lot freshman year getting used to Princeton's culture and academics. I and my friends used to say we're from public high schools; that's why we're like this. People from private high schools are in a better position because they had opportunities that we didn't have. The growth mindset chapter in the book was so, so important because before that I thought if you're smart, you're smart; if you came from a private high school you're set; if you're from a public high school you can't even grow. Now I know that you have challenges that you have to overcome, but you can do better. When I got a C in my first neuro class, the professor asked "why are you even majoring in neuro, you have a C in my class"... I got an A+ on my senior thesis... That's one example of going from literally getting C's my freshman year and thinking I shouldn't be at Princeton and majoring in neuroscience to getting all A's while taking all neuroscience courses my **senior year...** if it wasn't for the growth mindset I wouldn't be here. **I now** know that just because you're from a public high school doesn't mean you can't thrive at Princeton.

LSU Analytical Chemistry Graduate Student's Cumulative Exam Record Before and After Using Metacognitive Strategies

<u> 2004 – 2005</u>		<u> 2005 – 2006</u>		
9/04	Failed		10/05	Passed
10/04	Failed	Began work with CAS and the Writing Center in October 2005	11/05	Failed
11/04	Failed		12/05	Passed best in group
12/04	Failed		1/06	Passed
1/05	Passed		2/06	Passed
2/05	Failed		3/06	Failed
3/05	Failed		4/06	Passed last one!
4/05	Failed		5/06	N/A



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 <u>REALLY</u> 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 student engagement

- teach our students how to learn
- don't judge student potential on initial performance, and don't let them or anyone else do this
- encourage students to *persist in the face of initial failure* and provide examples of success stories
- motivate students to use metacognitive strategies



Additional References

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Acknowledgments

- LSU Center for Academic Success colleagues (especially Sarah Baird)
- Colleagues in the International Learning Support Community
- The thousands of students who changed their attitudes and behaviors and taught ME that students CAN learn how to learn!

A Resource for Instructors



McGuire, S.Y. (2015). Teach Students How to Learn: Strategies You Can Incorporate into Any Course to Improve Student Metacognition, Study Skills, and Motivation. Sterling, VA: Stylus

The Book for Students



McGuire, S.Y. (2018). Teach Yourself How to Learn: Strategies You Can Use to Ace Any Course at Any Level. Sterling, VA: Stylus

Resource For Parents



McGuire, S.Y. (2022). The Parents' Guide to Studying and Learning. Alexandria, VA: Wise Action Press