

Learning How to Learn: Preparing STEM Students to Become More Effective Learners

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- Student Success Team, College of Engineering
- Academic Support and Retention staff

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Today's Presentation

- Learn about evidence-based strategies from cognitive sciences that advisors can use promote student success.
- Learn how UI College of Engineering advisors have woven these strategies into their work with students.
- Leave with actionable resources to share with your students and colleagues.



Supporting Student Learning

"The work of advising educators is geared toward helping students succeed and persist in college – part of which means **helping them develop into the best learners possible."**

(Cummings 2016)



Learning How to Learn

Would you say that you study the way you do because a teacher (or teachers) taught you to study that way?

Kornell & Bjork (2007)	Morehead et al. (2016)	n=1097, Fall 2018-Fall 2023
80% No	64% No	62.5% No
20% Yes	36% Yes	37.5% Yes



Learning at Iowa

All Incoming Students



Transition to College

- On-lowa! Excel lecture
- Success at Iowa modules

Teaching Students Effective Learning Strategies

Advising and Coaching

- On-going professional development
- 1-on-1 resources
- Success workshops
- Probation Follow-up

Academic Support

- Peer leader training e.g. tutors, TAs, SI
- Metacognitive Mentors



Residence Halls

- RA staff training
- Bulletin Board
- Floor meetings
- 1-on-1 Hawktalks

Course Integration

- Transition seminars
- Large intro lectures
- Content & assignments

What have you been hearing from students?

My professor ripped apart my paper. I'm just not a good writer. I don't even want to try anymore. I have a huge math exam that I haven't even started studying for! I'm so stressed about it but I feel so overwhelmed!



Three Ms for Effective Learning

Mindset

Know that you can learn



Track your learning and struggles



Use effective learning methods







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"I'm not a math person" "I'm just good at languages" "I don't even have to try"

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Can grow with deliberate effort & use of effective strategies



Mindset Misconceptions

Confusing growth mindset with a positive, optimistic attitude. Learning is active (e.g., Ruohoniemi & Lindblom-Ylanne, 2009).

Believing that growth mindset is solely about praising and rewarding effort, no matter what type.

Deliberate practice (Ericsson & Pool, 2016).

Espousing a growth mindset without making structural changes in institutional policies and reward structures.

Goal: Process (learning) not product (grade).





Star performers with innate capabilities; high stakes; "proving and performing"

Learning mode; everyone can succeed with the right support, structure, and resources.



What about a STEM *discipline's* mindset?

"Being a top scholar in <discipline> requires a special aptitude that just can't be taught."

Leslie et al. (2015)





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Reframing a Student's Fixed Mindset

- Think of something you're good at now that was challenging at first. What convinced you that you could learn it or wanted to learn it? What steps did you take to learn it?
- Mindset Triggers Assessment (Murphy, 2024)





Netacognition



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Metacognition



Effective learning requires **reflecting** on, **directing**, and **controlling** thinking.



Elements of Metacognition

1. Planning

-Identify best strategies and approach

2. Monitoring

–In-the-moment awareness of how you're doing

3. Evaluating —Review how the learning went

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Promoting Metacognitive Reflection

Ask students:

- 1. How do you study/learn/practice?
- 2. Why do you study this way?
- 3. Does it work?

(retrievalpractice.org)

4. Are you sure? How do you know it works?



Using Metacognition: Resources for Students

Metacognitive Prompts

Reflection questions to help plan, monitor, and evaluate learning.

Time Management Strategies

Worksheet to guide monitoring and evaluating.



Cognitive Wrapper & Exam Analysis

Structured tool to evaluate effectiveness of study habits and connections between **effort**, **strategies**, and **outcomes**.





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Memory

- Memory is central to learning.
- It is not memorization need to go beyond just remembering facts and be able to apply the knowledge.
- Memory demonstration Try to remember as many of the following words as possible without writing them down.



shutter



Memory Demonstration

- Write down as many words as you can remember
- Who had:
 - Door?
 - Shutter?
 - Frame?
 - House?
 - Window?

Window was not included! You had a feeling *window* was on the list.

 It is easy to overestimate how well you remember something. Items that are more familiar seem more memorable – "the illusion of fluency."



Students' ratings of strategy effectiveness

Blasiman, Dunlosky & Rawson (2016)



Students' ratings of strategy effectiveness

Blasiman, Dunlosky & Rawson (2016)





Three Effective Learning Strategies

These will feel hard – that is why these strategies are called **"Desirable Difficulties"**

- Mix It Up (Spacing & Interleaving)
- Memory Recall (Retrieval Practice)
- Make it Meaningful (Elaboration)



Spaced Practice





Spaced Practice – Why it works

Ebbinghaus' Forgetting Curve

(Image: mindtools.com)





Spaced Practice – Why it works

Learning Curve

(Image: mindtools.com)





Which option results in better learning?





Mixing it up (interleaving) for the win!



Using Interleaving: Student Resources

- Gather problems and examples from different concepts & chapters
 - Solving problems at random will avoid automatically anticipating what is needed to solve. This teaches students to identify the type of problem and thus the correct way to approach it.
 - Swap practice problems with peers so different types of problems are covered.
- Plan to work on different classes during each of study session
 - A possible weekly schedule example on next slide



An example of interleaved practice





Memory Recall (Retrieval Practice)

Roediger & Karpicke (2006):

Results





Using Retrieval Practice: Student Resources

Self-Testing

- Flashcards/Quizlet and practice tests
- Commit to an answer before looking at it

Explain material in own words

- Rewrite concepts without looking at the notes
- Teach concepts to a friend, classmate, or pet

Create a concept map, outline, or study guide

- Devote time at the end of each week to outline the key concepts covered in class, without looking at notes.
- Revisit notes to fill in the gaps – this can form the basis of an exam study guide



Make it Meaningful (Elaboration)

Platinum Copper Diamond Marble Slate Bronze Silver Brass Aluminum

Gold Ruby Granite Lead Emerald Limestone Sapphire Iron Steel





Bower, Clark, Lesgold, & Winzenz (1969)

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Using Elaboration: Student Resources

• Activate knowledge: Complete reading in advance so you can connect the new information to something you already know.

• Actively engage with your notes:

- Look for the organizing structure of the lecture or reading or lab.
- Connect ideas and topics to understand the relationships between them.
- Generate your own examples and supporting statements.
- Fill in gaps in your understanding: Get clarification by going to office hours, tutoring, or Supplemental Instruction, or by asking your study group.



Discussion

How can you use the ideas and strategies shared today with your students and colleagues?





Advising Strategies Menu

Compilation of Three Ms-based advising and coaching strategies to help students:

- Foster a growth mindset
- Develop metacognitive skills
- Improve effective memory strategies.





Additional Resources

LEARNING AT IOWA learning.uiowa.edu



Tutor Iowa







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Evaluation

bit.ly/NACADASESSIONEVAL

Session ID: 043







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Questions?

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