METACOGNITION: HOW TO IMPROVE STUDENTS' REFLECTIONS ON LEARNING

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WHAT IS METACOGNITION?

Consider the following scenario.

> **A friend asks you, "Who wrote** *Jane Eyre***?" You attempt to recall the author's name, and answer with the name "Emily Brontë." After reflecting, you tell your friend, "I'm pretty sure about that." At some future time, you're surprised to discover that Charlotte Brontë, not Emily, wrote** *Jane Eyre***.**

The events in this scenario show two levels at which mistakes can occur – at the *cognitive* level, your memory (Emily Brontë) was incorrect, but furthermore, at the *metacognitive* level, your evaluation of your memory (feeling pretty sure about Emily Brontë) was also incorrect. This process – the self-evaluation of one's knowledge – lies at the core of metacognition.[1]   And while it would be ideal to be able to reflect on the exact contents of your mind, unfortunately, as in the example above, and as research has shown, our metacognitions are often far from such an ideal.[2]

WHY IS METACOGNITION IMPORTANT FOR LEARNING?

While it may not always be a crisis to mis-evaluate your knowledge, in many instances metacognition is valuable because it can be used to guide behaviors and decisions when we teach and when students study.[3] In the example above, given that you felt "pretty sure" that Emily Brontë wrote *Jane Eyre*, there was no need for your friend, or for you, to seek any more information. In other words, your

relatively high confidence was used as a "no need to learn further" strategy. This link between one's self-evaluation and subsequent decision becomes crucial when it comes to academic learning. Let's consider the following scenario:

> **You are preparing for a math test tomorrow. After reviewing class notes and solving practice problems for over an hour, you reflect upon your knowledge. "I seem to be able to solve these problems successfully, but I'm not totally confident. I feel like I could still get confused." You decide that you need to spend additional time solving practice problems.**

In this case, you (that is, your students) judge that you have not learned the material sufficiently, which, in turn, leads to the decision to allocate more time on math. This is another example that illustrates the two key components of metacognition:[4]

- **Monitoring:** the process of reflecting on your learning or knowledge

- **Control:** the process of using your reflections to guide subsequent behaviors.

Empirically, the two processes will depend on one another:[5] If a student's reflections are accurate, they have a good chance of gathering needed information (such as investing further study). If a student's reflections are flawed (as in the Emily Brontë example), there is little chance of selecting appropriate strategies needed to improve knowledge.

WHO HAS METACOGNITION?

We all have metacognition. But the process of monitoring our thoughts is highly private. Think of the millions of times you silently evaluated your own thoughts. And think about all of the self-reflections no one else knows about, not even a best friend. While it is a good thing to have private access to your own mind, you can imagine the problem it causes for researchers who want to understand how metacognition works or for teachers who want to understand how well their students are learning. The best one can do is to ask for reports at specific times, and trust that those reports reflect true mental states.

Some research has shown that this ability – to reflect on your ideas about your own thinking – comes online at different times for children, but on certain tasks, even before kindergarten.[6] Interestingly, data show that some preliminary metacognitive processes can even be expressed behaviorally in non-human animals,[7] providing a strong case for an evolutionary path to the kind of metacognition we see in humans.

WHEN DO WE USE METACOGNITION?

While we can't always access students' self-reflections, during study, metacognition is ongoing. Below are a few of the different times when students monitor their metacognition and how those evaluations might change subsequent behavior:

- A few weeks into the semester, in the midst of studying for the Econ midterm, a student asks themselves, "How confident am I that I will be able to remember this concept on tomorrow's test?" This is called a *Judgment of Learning* (JOL), and it can occur both before, during, and even after study, indicating the chances of remembering the concept later.[8] How confident a student is will likely dictate how much longer they will study.

- After studying, a student decides to retrieve a particular concept. The student can't recall the exact name of it, but they are fairly certain that they would be able to pick it out on tomorrow's multiple-choice test. This means that the student has a *Feeling-of-Knowing* (FOK) – while they cannot retrieve the answer, they can gauge their ability to recognize it among multiple-choice distractors.[9] The FOK is similar to the TOT or the *tip-of-the-tongue* experience, where somewhat magically, you know that you know, even though you cannot say the word or phrase explicitly.[10]

Taken together, these situations show that students have the ability to monitor their thinking processes at any point, using their judgments to guide studying and test-taking strategies.

HOW CAN METACOGNITION BE IMPROVED?

As you can imagine through the examples above, our metacognitions are not perfect. Students might, for example, feel completely prepared for the test only to find out they were wrong. Fortunately, cognitive scientists are optimistic about finding ways in which to improve students' metacognition. Below are some of the methods found to be useful towards improving the accuracy of students' metacognition.

- **Retrieval practice:** Encouraging students to attempt to retrieve unknown answers on their own as much as possible can make learners more aware of their own knowledge or lack thereof.[11]

- **Spaced study:** Distributing short study sessions across a long period of time, as opposed to massing or cramming all studying into one long session, can improve the accuracy of students' metacognition, also leading to better learning.[12]

Taken together, the above methods provide a rule of thumb that can be applied when it comes to improving metacognition: Students should monitor their learning when the answer isn't currently available.[13] By doing so, students' evaluations of what they know *and what they don't know* will become more realistic.

Students should monitor their learning when the answer isn't currently available.

But it isn't always easy to monitor learning when information is not available. Consider the following scenario:

In Chemistry class, you explain to your middle school students how potential energy relates to melting and boiling points on the heating curve. As your students listen actively, they take stock: "Am I understanding this correctly?" As you continue, the students monitor the content, and feel confident they have learned and will remember today's class content.

In this situation, students can't help but reflect on their learning while the information is currently available. What can you, as their teacher, do? One strategy: have students make predictions about the concepts they are learning, prior to your presenting the information. Another strategy: remind them to go over the material after class so they see just how quickly they can forget new information. One more: Research also suggests that a simple change in the questions you ask during class might help: Rather than asking students, "Did you understand?" or "You think you'll remember this?," their ongoing evaluations will be more accurate if you ask, "You might understand it now, but when might you forget this?".[14] Here again, evaluations of both *knowing* and of *not knowing* are crucial for improving metacognition.

Evaluations of both knowing
and of not knowing are crucial
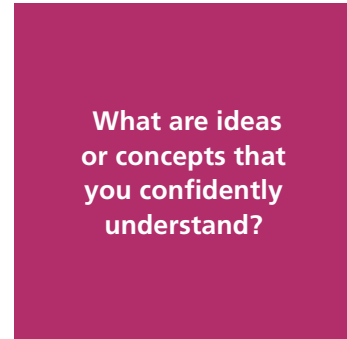for improving metacognition.

WHAT CAN METACOGNITION LOOK LIKE IN YOUR CLASSES?

In many schools, "metacognition" is practiced separately from learning. It is often incorporated in goal setting at the start of the school year and revisited when students receive grades and comments. But research suggests that metacognitive skills are best developed when they are embedded as seamlessly as possible into each class. Doing so helps answer two important motivational questions for students regarding metacognition: *How do I do it?* and *Why should I do it?*

Try these strategies with your students:

Build their habit of asking questions

Students aren't always aware of what they don't know. Similarly, they don't always know what to do when they don't know or understand. Asking questions is a powerful way to prompt reflection. Encourage students to ask themselves metacognitive questions by, for instance, providing your students with simple prompts, like these:

What are three things you've learned or are excited about from this class?

What questions do you have? What questions do you need to have clarified?

What are ideas or concepts that you confidently understand?

You can also use this prompt as an exit or pause ticket at the end of class.

For younger students, ask questions like, Where do you enjoy reading or working on math problems? What helps you focus when the passage or problem is more challenging?

Record students' thinking

Learning journals -- student-created records of their decisions, mistakes, and revisions when, for instance, solving a problem or writing a paper -- give students space to reflect on their learning. The journal could be a traditional paper journal, a google doc, or even a video or audio recording. In a math entry, for instance, a student could detail how they worked to understand a problem, how they tried to solve the problem, how they changed the frame or schema they were using initially, and how they eventually arrived at and checked a solution. In English or History class, students can reflect on their approach to a writing prompt, the kinds of evidence they provided in response, their approach to structure and syntax, and their ultimate decisions about revision.

Tap into prior knowledge and skills

When starting a new unit or assignment, ask students simple prompting questions to help them see how their prior knowledge, experiences, or feedback can help them with the current challenge. Imagine a 3rd grade classroom where students have recently taken a field trip to a local river to study its water quality. In the days following, the class reads a story about a child who depended on that river for food during the 17th century. How can you make sure your students are drawing on their field trip experience in ways that support their reading comprehension?

CHECKING YOUR METACOGNITION

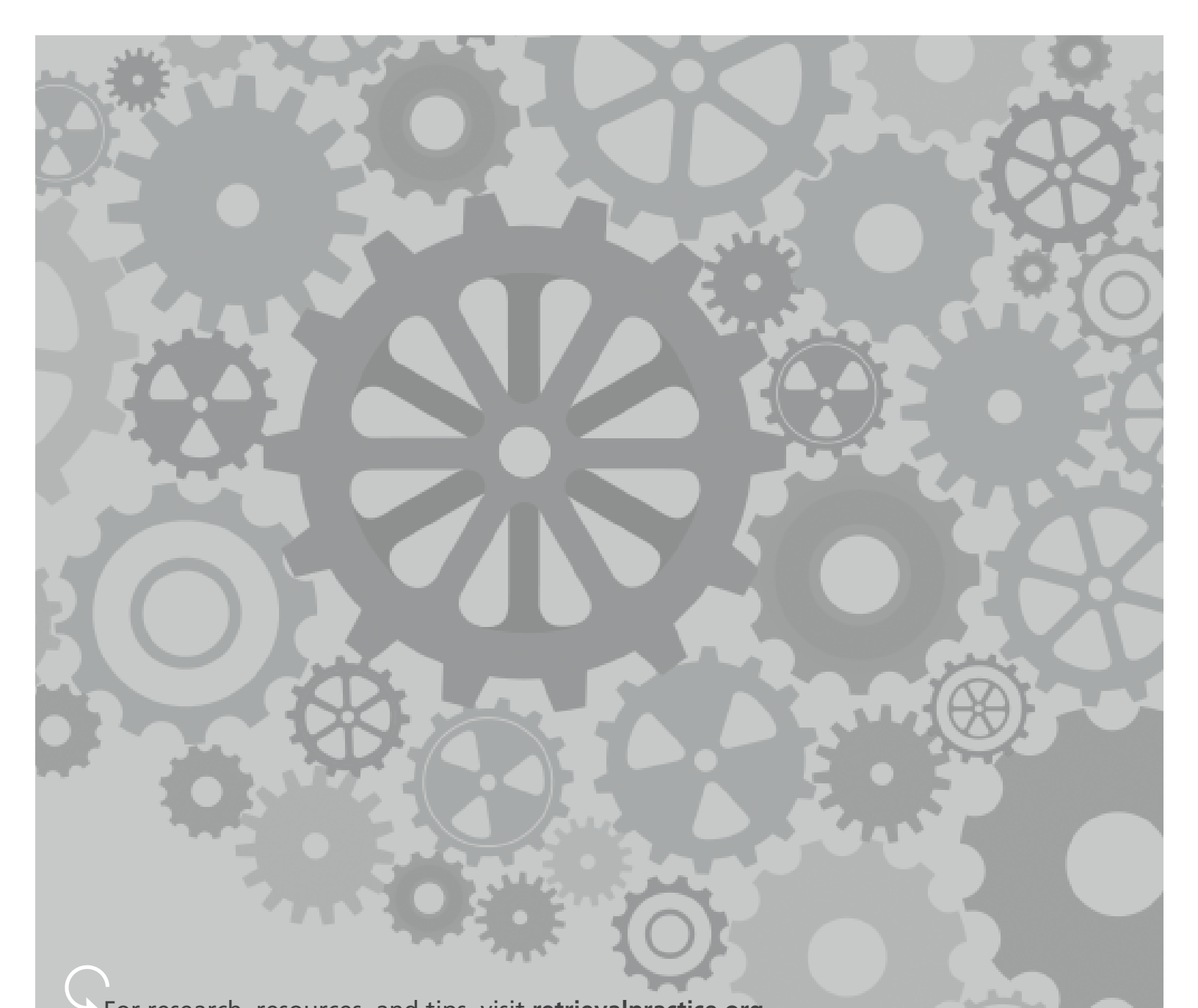## Here are some key takeaways for improving metacognition:

1. **Metacognitions are private. We cannot know what students are thinking as they learn. We can, however, make them aware of the illusions to understanding that can occur.**

   a. Remind students periodically that they control their learning. Teachers are there for guidance.

   b. Tell students of illusions that are common.

2. **Metacognition may not be explicit. Sometimes students might not be aware of their own knowledge or lack thereof. Having them re-assess their thinking can help encourage them to monitor their ongoing thoughts.**

   a. Have them go back to evaluate what they have learned during study, but also after they have finished studying.

   b. Prior to taking the test, have them write their own questions. This is a great way to make them aware of knowledge they lack.

3. **Metacognition can be improved. Retrieval practice and spacing, for example, are all strategies that require coming up with answers without outside help, resulting in more realistic evaluations.**

   a. For the first few minutes of class, throw out 3-5 questions. But don't give the students the answers (and certainly don't grade). This strategy takes only a few minutes and employs effective strategies such as retrieval and spacing.

   b. Remind students that one reason that studying in short sessions will help learning is that their evaluations of their own learning will become more accurate.

4. **Metacognition also includes knowing that you do not know. Help students to know that their judgments might be incorrect.**

   a. Rather than going straight through a lecture, take some time to have students make predictions about the materials.

   b. Remind students to review the material after the lecture.

   c. During a lecture or class, ask students "You got it now, but when do you think you might forget?"

5. **Metacognition will break down very frequently. But it helps to know that those errors are precisely the events that will allow your students to improve next time.**

   a. Show students that we all learn from mistakes.

   b. Encourage students to take on the teacher role when possible – in study groups, by tutoring, through class participation. Teaching is the best way to learn because you become aware of your gaps in understanding!

For research, resources, and tips, visit **retrievalpractice.org**

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