Top Ten Metacognitive Teaching Strategies

Helping Students Learn How to Learn

Definition

meta = 'about' and cognition = 'thinking'

Metacognition: Purposefully thinking about one's own thinking strategies - or being able to "learn to think" and "think to learn"

Metacognition is the regulatory system people use to understand and control their own cognitive (brain) performance. It involves people being very aware of how they learn, what strategies meet their needs, being able to evaluate the effectiveness of strategies and then implement the best plan of action to learn.

Learners with Strong Metacognitive Skills

- Know the limits of their own memory for a task
- Do frequent self-assessments of their knowledge to ensure they know how well they are learning
- Self-monitor success
- Use a variety of strategies to learn depending on content
- Undertake careful rehearsal of a skill to gain confidence and competence
- Plan effectively at many levels and see the big picture of learning
- Elicit help where required

> *There is a need to teach for metacognitive knowledge explicitly …. we are continually surprised at the number of students who come to [university] having very little metacognitive knowledge; knowledge about different strategies, different cognitive tasks, and particularly accurate knowledge about themselves.*
> *Pintrich, 2002*

The following ten metacognitive teaching strategies come from a few sources that were used including: Promoting Student Metacognition (K. Tanner, 2012), Creating Self-Regulated Learners: Strategies to Strengthen Students' Self-Awareness and Learning Skills (L. Nilson, 2013), Metacognition (Putting Metacognition into Practice) website by Nancy Chick, Centre for Teaching Assistant Director (Vanderbilt University), Classroom Assessment Techniques (by T. Angelo and P Cross, 1993), Centre for Research on Learning and Instruction (University of Edinburgh) and Peter Arthur, Former Director, Centre for Teaching and Learning, University of British Columbia Okanagan.

1. Metacognitive Awareness Inventory

NOTE: Locate 2 separate documents: MAI – Modified Metacognitive Awareness Inventory and MAI Scoring Guide

There are two processes that are part of learning. Most often learners of all ages are unaware of what the processes are and what is required to improve them. Our job is to help them learn about learning.

1. **Knowledge of Cognition** (Declarative, Procedural, and Conditional)
    a. **Awareness** of **factors** that influence your own learning
    b. **Knowing** a collection of **strategies** to use for learning
    c. **Choosing** the appropriate strategy for the specific learning situation
2. **Regulation of Cognition**
    a. **Setting goals** and planning
    b. **Monitoring** and controlling learning
    c. **Evaluating** own regulation (assessing if the strategy is working or not, adjusting and trying something new)

In 1994, Schraw and Dennison created the Metacognitive Awareness Inventory (MAI) specifically for adult learners to bring awareness of metacognitive knowledge and metacognitive regulation (which they referred to "Knowledge of Cognition Factor" and "Regulation of Cognition Factor" respectively). The MAI consists of 52 questions that cover these two components of cognition. Through their research they found that there was strong support for both factors in how one learns. They also determined that both areas (Knowledge and Regulation) were very much related as had been suggested by previous researchers.

Recent research has uncovered a significant correlation between the MAI and some measures of academic achievement (e.g., GPA, end of course grades etc.) When looking at undergraduate students and graduate students (younger adults and older adults) it was found that they do not differ in their mean scores on the 'Knowledge of Cognition' areas (similar for both groups), but they do differ in terms of their regulation strategies and skills.

This result is because 'Knowledge of Cognition' is easily acquired early on and doesn't really change or can be improved upon. Whereas 'Regulation of Cognition' strategies are not that easy to acquire and most often students won't improve over time in their 'regulation scores' – because they need to learn the strategies and have chances to practice in and out of classroom experiences. Students need instructors to help them build their strategies around regulation of learning – they are not learned on their own.

How to Use the Metacognitive Awareness Inventory (MAI) with Students

1. Copy the 52-statement double-side MAI Modified Awareness Inventory and give to students to complete either as homework or in class. Tell them to consider a range of learning experiences when they are choosing their responses (not just one learning experience or class).
2. After complete, give them the second handout (double-sided scoring guide) to score themselves.
3. Indicate that the total numbers/score aren't good or bad – there is no labelling or putting value on the results. It is more about where they could improve, become more aware etc.
4. Discuss with students. Discuss how they can improve their knowledge and regulation. Have them share with their peers. Discuss how to enhance their knowledge and regulation.

2. Pre-Assessment of Content

Finding out what students already know about a topic can help students begin to think about how learning works.

Here is one way to conduct a pre-assessment (or a student self-assessment) of new content.

1. Create a few key questions about the content/topic. Give the questions to students a week or two prior to when the topic will be discussed in class.

   Questions should focus on asking students what they know already about the topic, possible identification of any misconceptions they have about the topic, challenges or successes they have had with the topic, exploration into past experiences or applications of the content/topic.

   These questions may be in the form of a homework assignment, an in-class poll, a short reflective writing piece done in class and handed in etc.

2. Have the students individually hand in their responses anonymously. Skim through the answers after class. Possibly categorize/summarize all responses by themes.
3. Share responses with students the next class either verbally or a summary of themes.
4. Have a discussion with students about how these questions can help them in thoughtful planning of how they might approach a new idea or topic or how they will approach course content and associated studying/learning strategies.

3. Approaches to Learning Chart

NOTE: Locate separate document called "Approaches to Learning Activity – Chart"

Students aren't going to learn how to be good learners unless we engage them in activities and discussions about how they perceive themselves as learners – and to see what approaches ARE working and what approaches are NOT working for their learning. We also need to engage them in discussions about different/new approaches to learning that align with the structures and expectations of post-secondary learning. Some approaches to learning worked well for high school content or with ways that learning was structured in their previous schools – but now won't work for post-secondary.

In the chart, there are 21 statements you could give to students to start them thinking about how they think about how they learn. Ideally, we hope to have students utilizing deeper and more long-term learning approaches rather than surface or short-term approaches. Strategic approaches are somewhere in between the two but don't really result in longer term and meaningful learning.

All items are to be responded by choosing from "strongly agree", "somewhat agree", "somewhat disagree" or "strongly disagree". Students complete in class or for homework

These items come from ASSIST (Approaches and Study Skills Inventory for Students) designed to evaluate university students' conceptualizations of learning, approaches to studying and preferences for different instructional methods (Centre for Research on Learning and Instruction, University of Edinburgh). The ASSIST tool identifies three main approaches to studying: deep, strategic and surface/shallow.

- **Deep Approaches to Learning:** Students examine the significance of what they are learning, try to make sense of it, connect and think more elaborately and holistically about the topic. They develop their own understandings of new knowledge from integrating it into their existing knowledge structures and critically analyze the new information coming in. Students tend to read beyond the course expectations, have a high motivation to learn and make use of evidence, inquiry, and evaluation skills throughout their studying. This approach usually results in greater success with retaining information and recalling it easier.

- **Strategic Approaches to Learning:** Students organize their learning with the intention to achieve high scores/grades or other positive outcomes. Learners organize their time and distribute their effort to the greatest effect. They seek out previous exams and assignments to predict questions. Strategic learners use both shallow/surface and deep strategies depending on what is being learned or what time they have available. Strategic learning works best when it is more closely aligned with deep approaches.

- **Shallow or Surface Approaches to Learning:** Students focus on discrete details and pieces of information that they feel is important to learn. There is an emphasis on memorizing these pieces of information that falsely gives the learner a sense of comprehension of the whole picture. The learning approach is narrow as they concentrate on details (definitions, key words, theories, etc.). Students focus on reproducing unconnected facts that they think will help them in a test or exam. Students focus on "what do I need to pass the test". Learning is superficial and does not promote real understanding.

Once students complete the checklist you could put a few of these statements on a slide or on the whiteboard and ask if anyone uses that technique and why. Engage in a discussion before you tell them the answers for each "Approach". Once the chart is complete and some discussion has occurred, share with the students the THREE approaches to learning. Share a brief definition of each as above. Ask the students to identify the "approach" for each collection of statements and have them fill in the type of approach used.

Answers: Surface, Strategic and Deep as below.

Surface Approach to Learning Questions

1. I find I must concentrate on just memorizing a good deal of what I have to learn.
2. I am not really sure what's important in lectures, so I try to get down all I can.
3. I tend to read very little beyond what is actually required to pass.
4. I concentrate on learning just those bits of information that I have to know to pass.
5. I like to be told precisely what to do in essays or other assignments.
6. I often seem to panic if I get behind in my work.
7. Often, I find myself wondering whether the work I am doing here is really worthwhile.

Strategic Approach to Learning Questions

1. I think I am quite systematic and organized when it comes to studying for exams.
2. I am pretty good at getting down to work whenever I need to.
3. I organize my study time carefully to make the best use of it.
4. Before starting work on an assignment or exam question, I think first how best to tackle it.
5. I look carefully at my instructor's comments on course work to see how to get higher marks the next time.
6. I put a lot of effort into studying because I am determined to do well.
7. When I have finished a piece of work, I check it through to see if it really meets requirements.

Deep Approach to Learning Questions

1. When I am reading I stop from time to time to reflect on what I am trying to learn from it.
2. When I am working on a new topic, I try to see in my own mind how all the ideas fit together.
3. Often, I find myself questioning things I hear in lectures or read in books.
4. Some of the ideas I come across on the course I find really gripping.
5. I usually set out to understand for myself the meaning of what we have to learn.
6. I like to play around with ideas of my own even if they don't get me far.
7. It is important for me to be able to follow the argument, or to see the reason behind things.

4. Think Alouds for Metacognition

As the instructor, you are an expert in your field. It can be almost impossible to remember a time when you did not think 'the way you currently do about your discipline'. At one time you were confused or unsure about studying your discipline. If you can offer students examples of your own self-reflective examples of your own transition into thinking like an expert in your discipline, this can help students improve their own metacognition. As researchers and reflective practitioners we are thinking metacognitively all the time (thinking about your own questions, how your thinking has evolved, how you incorporate new knowledge into your practice etc.)

Anytime you can talk out loud ('think aloud') about how you view a document or a picture or think about a book, or share your thinking processes with students you are helping them become more metacognitive in their own approaches to the subject.

Once you have modelled for them how you would solve a problem or interpret a piece of writing, have students work in pairs to talk out loud as to how they are thinking about an assignment piece of homework or an assignment.

1. One student talks out loud while the partner records what they are saying. Encourage them to share the strategy they are going to use to complete the homework or do the assignment. The partner also guides them to think through all the steps.
2. Students switch roles and do the same for each other.
3. Now students have thought out the process for completing the assignment or homework, received some feedback from their partner and possibly have a plan written down as to how they are going to undertake the task. Debrief briefly with class as to lessons learned etc.

"[I]t is terribly important that in explicit and concerted ways we make students aware of themselves as learners.

We must regularly ask, not only 'What are you learning?' but 'How are you learning?'

We must confront them with the effectiveness (more often ineffectiveness) of their approaches.

We must offer alternatives and then challenge students to test the efficacy of those approaches."

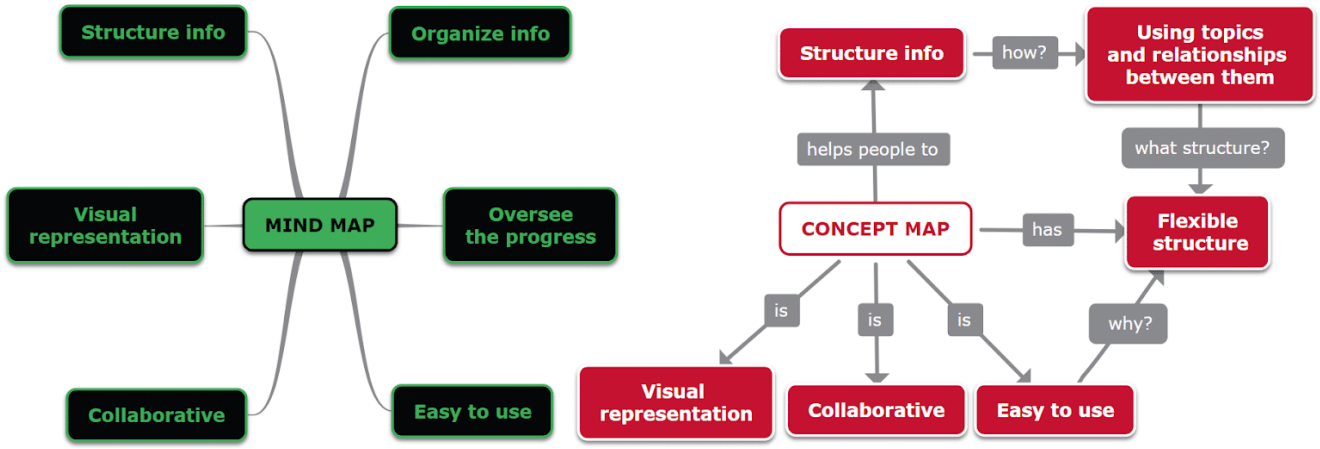
(Weimer, 2012)

5. Concept Mapping and Visual Study Tools

Concept maps were originally developed to enhance meaningful learning in the sciences. A concept map is a way of representing relationships between ideas, images, or words now used throughout many disciplines.

Concept maps are a way to develop logical thinking and study skills by revealing connections to the big ideas or the key concepts you are trying to teach. Concept maps will also help students see how individual ideas relate to the larger whole or the bigger picture.

DIFFERENCE COMPARED TO MIND MAPS: Concept maps connects ideas or concepts – whereas "mind maps" are usually just focused on one idea or topic. See diagram below from Zen Flowchart website.



Learning benefits can be derived from instructor-led or student-constructed concept maps of the connections and key ideas from a course or class. A powerful metacognitive activity, students still need to be taught how to create.

It is best that the instructor demonstrates how to design a concept map first - before students are asked to do the same. For example, show students how the course readings, videos, assignments, and activities are connected to the course learning outcomes and other courses in their program area.

Design a brief or detailed concept map of the course or sub-components of the course and share with students. Later in the course students can form small groups and build a concept map as a review activity before a mid-term or to review a portion of the course. Students build individual concept maps as homework, or they can create one in class as a group. They then share with each other explaining the interrelationships between each component.

TIP: Ask the students to draw all the 'cross-links' and label them as they see the components connecting fully or partially. This is the essence of a concept map – understanding the relationships between each item.

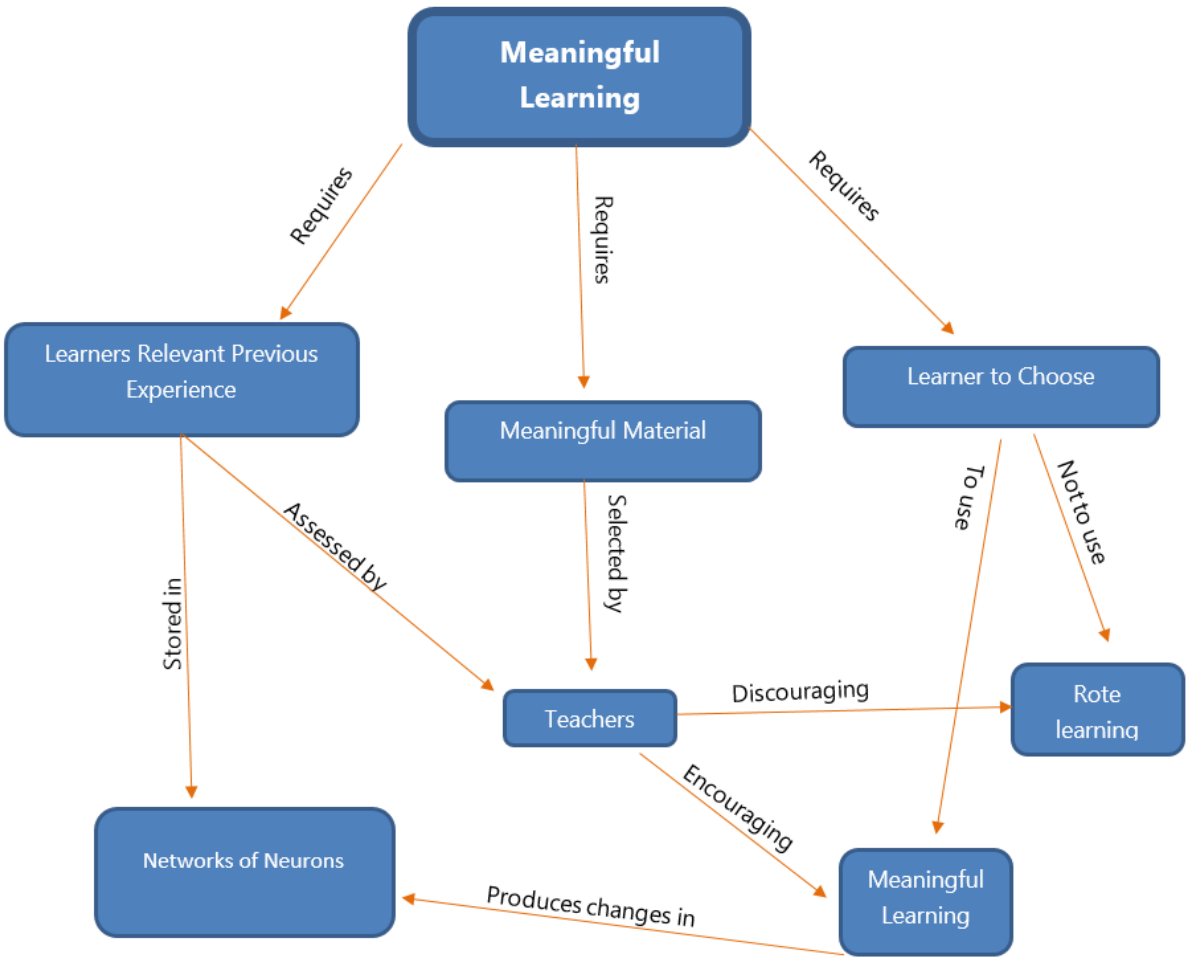
How to Create a Concept Map

Every concept map responds to a **focus question**, and a good focus question can lead to a much richer concept map – and subsequently richer learning experience to advance metacognitive skills.

When learning to construct concept maps, learners tend to deviate from the focus question and build a concept map that may be related to the domain, but which does not answer the question. It is often stated that the first step to learning about something is to **ask the right questions**. Steps to create a concept map are:

1) Construct a Focus Question
2) Identify the Key concepts
   - Some people rank the concepts by importance as it may help with the construction of the map
   - This also helps the map maker sort the ideas and if they see no relevant connection, they do not have to include the concept
3) Construct a Map
   - If this is the first time you are doing one – do it as a group first
   - You can use partially completed version with students to help them initially build

Example Concept Map: Based on Novak's concept map of meaningful learning



6. Classroom Assessment Tools

There are many short activities you can do during class time that will help promote metacognitive thinking in your students.

Sometimes these little activities are called "Classroom Assessment Tools – CATS" (term coined by Angelo and Cross).

Here is a sampling of a few tools to consider. They often take a few minutes to do and are easy to implement.

CATs give students and faculty immediate feedback on learning.

Assessment Method	Description	How To Use
Ticket-Out-The-Door	During the last few minutes of class, students write a response to a question or two about class concepts or a question or two about how the learning experience was for them etc. Hand in as exiting the class.	Review/read all before next class and use to clarify, correct or elaborate more for students.
One Minute Paper	During the last few minutes of class, students write response to "Most important thing I learned today" and "What I understood the least today".	Review/read all before next class and use to clarify, correct or elaborate more for students.
Muddiest Point	Similar to One-Minute Paper – but only ask students to describe what they didn't understand during class and what they think might help them understand better.	Same as One-Minute Paper but if many students have same problem, reteach concept another way.
Student-Generated Test Questions	Divide the class into groups and assign each group a topic on which they are to each write a question and answer.	Use as many of the questions as possible on next test.
Memory Matrix	Students fill in cells of a two-dimensional diagram with instructor-provided labels such as a comparison chart outlining similarities and differences in two columns against a variety of concepts in the discipline.	Tally the number of correct and incorrect responses. Look for patterns amongst the incorrect responses. Address in class.
K-W-L Chart	Label three charts K (What I KNOW Already), W (What I WANT to Know) and L (What I have LEARNED). Complete the first two before a unit/topic and the last one at end.	Discuss with students – their perceptions of what they thought they knew, what they have come to know etc.
Directed Paraphrasing	Ask students to write a layperson's "translation" of something they have just learned (geared for a non-expert audience) to assess their ability to comprehend/transfer concepts.	Categorize student responses according to characteristics you feel are important. Address in class.

One Sentence Summary	Students summarize knowledge of a topic by constructing a single sentence to cover the core concept. The purpose is to require students to select only the defining features of an idea.	Evaluate the quality of each summary in brief fashion. Note if students have identified the core concepts of the class topic. Share with students.
Think-Pair-Share	Give the class a question. Allow everyone to think on own for a few minutes jotting down some thoughts. Then ask students to pair up with a peer and discuss thoughts for another few minutes. Can do groups of 4 as well. Ask to share with whole class.	Use when you want to have a better discussion by a greater number of students. By thinking alone first and with small groups of peers, shared responses should be richer and more varied.
Application Cards	After teaching a theory, principle or procedure, ask students to write down at least one real-world application for what they have just learned to determine if they can see the transfer of their recent learning.	Quickly read through once and categorize them according to quality. Pick out a broad range of examples to share with the class the next day.
Classroom Opinion Polls	Using 'clickers', or online polling questions, ask students a variety of questions about a topic and seek their anonymous opinion,	Often polling devices can present immediate results back to the class to provide discussion and next steps.
Weekly Report	Written by students each week in which they address three questions: What did I learn this week? What questions remain unclear? And What questions would you ask your students if you were the instructor to find out if they understood the material?	Read at end of each week, categorize responses and share with class. Follow up on unclear questions with class or small group of students.
ConcepTests	Instructor presents one or more questions during class involving key concepts, along with several possible answers (multiple choice). Students indicate (by show of hands, or poll/clicker voting) which answer they think is correct. If most of the class has not identified correct answer, students are given a short time to persuade their neighbor(s) that their answer is correct. The question is asked a second time to gauge class mastery.	Often lasts a few minutes but uncovers misunderstandings, and great conversation amongst students. Share answer after second voting session to see how the class responses changed or didn't change.
Instructor Meetings	Instructor meets informally with students either in class or after class to answer questions, inquire about conceptual understanding or provide feedback on student learning.	Design specific questions to help guide the meeting and address concepts and understandings you want to know more about.

7. Metacognitive Note Taking Skills

NOTE: Locate separate document called "Metacognitive Note Taking Template"

Students don't know how to take good notes during class to aid in their learning. Provide students with guidance and models about how to take good notes. Here is a suggestion for a format you can replicate or draw on the board and discuss with students.

Beginning of Class (Plan and Connect)

In this section, encourage students to prepare their notes in an organized fashion. Stop the class and have them complete the connections questions in their notes. This will help them start thinking about how this class fits in with what they already know or want to know more about.

Date: Course Name: Class Learning Outcomes:

Connections Questions

- What do I already know about this topic?
- How do I feel about this topic? (excited, anxious, curious, nervous)
- How does this topic relate to something I already know?
- What questions do I have already about this topic?

Middle of Class (Monitoring Learning)

In this section, encourage students to create 2 columns in their notes. In the left column ask students to record insights, 'ah-ha' moments, questions students have about the content, connections they are making to other classes/topics, and also any feelings or thoughts they have about the class. In the right column they take traditional notes on what is being presented. Encourage students to refrain from writing everything. Write key concepts and headings on the board and indicate to students when you are shifting to a new section or concept.

Learning Insights	**Class Notes**

End of Class (Reflecting on Learning)

Near the end of class, ask students to draw a line below their notes and write a summary of the whole class. Just a few sentences are enough to get students thinking about the key learning that has just happened. Encourage them to describe the key learning of the whole class in a few points.

You can also write a few prompts on the board to help students with their summary note (e.g., what were the most important ideas from today's class? what did I find most interesting in class today? how did today's content relate to another class?)

8. Reflective Writing

Reflective writing helps students make connections between what they are learning in their homework/class content and how they are integrating the content into their current learning structures.

Writing helps students observe themselves before, during and after their reading, watching and listening experience.

Reflective writing can also take the form of jotting down their affective and other personal reactions to learning the material.

The most popular reflective writing activity is the "minute paper" whereby you have students respond to prompts that ask them to think about their experiences with the homework, class activities or recent learning experiences in your class.

Here are some sample prompts to use for your reflective writing activities:

- The most important part of the reading, video or class is….
- The most useful or valuable thing(s) I learned today was….
- The most surprising or unexpected idea I encountered was…
- The ideas that stand out the most in my mind are….
- This helped or hindered my understanding of the reading, video or class ….
- Two ideas that I have found confusing are….
- "I learned a lot doing this assignment". I agree (or disagree) because….
- The advice I'd give myself based on what I know now and if I were starting this assignment over again would be….
- If I were to paraphrase what we have learned today for a high school student it would look like this….
- What I have learned today, I am able to connect to other courses in this way…

9. Wrappers

NOTE: Locate separate documents called Assignment Wrapper – Long/Short, Cognitive Wrappers

A quick and easy tool for monitoring and evaluating metacognitive activity. A wrapper is an activity that surrounds pre-existing learning or assessment tasks and fosters students' metacognition. You can build a self-monitoring wrapper around any pre-existing part of a course (lecture, homework, or test)

Why Wrappers Work

- Time efficient
- Students are doing the task anyway
- Only add a few minutes to a task
- Metacognition practice is built in to the that task
- Students are self-monitoring in context
- Feedback on accuracy can be built in
- Feedback is immediate

- Support can gradually be faded out
  - in just 3 lessons most students are successful on their own
- Minor Interventions can significantly change behavior

Course/Lesson Wrapper

1. **Before Lesson Begins:** Indicate to students that in the last minutes of class they will be asked to consider the 3 key ideas from the class. Give the students a few tips on how to actively listen, make effective class notes and engage with the content and activities (e.g., while listening, think of questions they have about topic, provide headings on board for students to organize notes, ask students to summarize and repeat back key content to peers in activities etc.).

2. **Near End of Lesson:** 10 -15 minutes before class ends, ask students to write 3 key ideas from the class. Students do individually (on own paper, on a stickie note they paste on board) or do in small groups (on chart paper, on white/blackboard) and share (individual volunteers, reps from small groups, teacher summarizing themes from notes on board).

3. **Teacher** gives his/her list of 3 key ideas for students to self-check. Students record the differences between their responses and the teacher's.

4. **Debrief:** Have a brief discussion around similarities/differences between students' and teacher's 3 key ideas. Summarize class.

Homework Wrapper

1. Instructor creates self-assessment questions that focus on skills students should be monitoring

2. Students answer questions just before homework is given out

3. Complete homework as usual

4. After homework, answer similar self-assessment questions and draw their own conclusions

Example
Pre Self-assessment: "This homework is about vector arithmetic… How easily can you solve problems that involve vector subtraction? How confident are you in being successful with the homework?"
Post Self-assessment: "Now that you have completed this homework, how easily can you solve problems around this topic? How confident are you in being successful with future homework around this topic or a test question?"

Exam/Test Wrapper

Most times, instructors hand back exams (tests, quizzes, mid-terms) and focus the discussion on the exam questions, the areas where students did well or poorly and rarely engage students in a learning experience around how they prepared, studied or strategies they used in taking the test. An exam wrapper is often a handout with a series of questions students answer and then discuss typically after the exam is marked and returned.

A process might be:

1. Students utilize normal test taking strategies to prepare and take the exam.
2. The exam is marked and returned. Students complete the exam wrapper questions either in class or online within a course management system. (Instructors can either make this for no marks or award points for completion).
3. The instructor collects the exam wrappers and reviews student comments. This allows the instructor to assess student behavior patterns and determine whether additional teaching resources are required to support student learning.
4. The exam wrapper is returned to students within a week or two before the next exam. Students review their comments and then can follow their own advice for improved study skills.

Possible Questions for Exam Wrappers

Preparation for Exam

1. How did you prepare for the exam? Explain your process.
2. What resources did you use in preparing for taking the exam?
3. How does your exam preparation compare to three other peers in the class (ask them)

Planning

1. What strategies did you use for studying (e.g., study groups, online practice quizzes, office hours with instructor, review sessions, peer teaching etc.)?
2. How much time did you study (and how long over what time period)?
3. What aspects of the course did you spend more time on (or less time on) based on your current understanding.
4. What percentage of your exam preparation time was spent on these activities? (re-reading the textbook section(s)___?; reviewing your own notes (daily)___?, reviewing your own notes (sporadically)____?; reviewing PowerPoint presentations from lecture ____?; generating your own exam questions and answering them____?; studying in groups_____?; other strategies____?

Performance

1. How did your actual grade on this exam compare with the grade you expected? How do you explain the difference, if any?
2. How do you feel about your exam grade (happy, surprised, disappointed)?
3. Examine the items on which you lost points and look for patterns. Were you careless or did you run out of time?

Next Steps

1. What are you going to do differently for your next exam?
2. What might be your goal (e.g., certain percentage)?
3. What study strategies are you going to use next time to enable you to get that score?

10. Retrospective Post-Assessment

Near the end of a topic or end of the course, ask students to reflect (retrospectively) about what they thought about a topic or concept before the course and what they think about it now.

Learning is about change and this activity asks students to reflect on the changes in their knowledge, skills and attitudes and put that into perspective for moving forward.

This activity engages students in a mechanism to train students to 'self-question', "*How has my thinking changed (or not changed) over time?*"

1. Some instructors record the thoughts of students at the beginning of the course and keep those responses until the end of the course – and revisit those responses. Alternatively, after learning has taken place (after a class or near end of a course) ask students to recall how they were thinking about the topic prior to the course learning activities and compare that with how they are thinking about the same topic now.
2. Possibly write two prompts on the board to help students: "Before this course I thought X was…." and "Now I think X is…." OR ask them to write three ways in which their thinking has changed over time (a few classes or the course).
3. Ask students to complete this task on their own on a piece of paper.
4. During the last class, have a discussion with students as to how much 'change' has occurred in their learning. Students could also discuss their responses in small groups and share a summary with the class.

Metacognition: *Purposefully thinking about one's own thinking strategies – when students are able to "learn to think" and "think to learn"*

Three critical steps to teaching metacognition:

1. Teaching students that their **ability to learn is mutable**
2. Teaching **planning and goal-setting**
3. Giving **students ample opportunities** to practice monitoring their learning and adapting as necessary