# Metacognitive Prompts

**DESCRIPTION**: Professors can reinforce the critical metacognitive skill of "thinking with questioning" by encouraging students to self-question on their own. This process builds awareness about their learning. Strategic self-questioning is not necessarily innate and may need to be developed and refined. Teachers can provide a list of targeted questions designed to facilitate deeper metacognitive sensitivity by asking students to self-diagnose their grasp of difficult material in order to determine what they understand and to monitor where they are struggling.

**EXAMPLE #1**

### Comprehension questions
1. What is this material about?
2. What substantive principles/concepts/rules were articulated?
3. What are the important facts, characters, outcomes?

### Connection questions
1. How is this material similar/different from other material we read?
2. Where does it fall in the chronological sequence of material we have studied?
3. Does this material modify/change/reverse prior material?

### Strategy questions
1. What strategies were at play?
2. Why might those strategies have been used?
3. What result?
4. What should/could have been done to produce a better/different result?

### Metacognitive questions
1. Do I understand the material at this point?
2. Can I clearly articulate the relevant question/issue?
3. What other concepts might help me to understand?
4. Am I able to articulate what types of situations pose these substantive problems and why?
5. Am I able to identify the relevant substantive rules/concepts and why they are relevant?
6. Can I articulate the sequence of analytical steps to take in resolving an issue in this area?
7. If I am having trouble understanding, what else could I do, what sources might I consult?
8. Have I put in the necessary time for mastering this material?
9. What, if any, emotional reactions did I have to the material, and did that affect my ability to understand it? For example, did I give up because I was frustrated?

**EXAMPLE #2**

**Planning Questions:**
1. What is the problem?
2. What are we trying to do here?
3. What do we know about the problem so far?
4. What information is given to us?
5. How can this help us?
6. What is our plan?
7. Is there another way to do this?  What would happen if . . .?
8. What should we do next?

**Monitoring Questions:**
1. Are we using our plan or strategy?
2. Do we need a new plan?
3. Do we need a different strategy?
4. Has our goal changed?
5. What is our goal now?
6. Are we on the right track?
7. Are we getting closer to our goal?

**Evaluating Questions:**
1. What worked?
2. What didn't work?
3. What would we do differently next time?

**POTENTIAL BENEFITS**

1. Improved understanding of the material
2. Development of self-monitoring and evaluating of learning
3. Better quality of preparation for class discussion and later assessment

**POTENTIAL CHALLENGES**

1. Students must be reminded to review the questions and practice them regularly.
2. At outset, professor might want to monitor responses, as students aren't always able to answer accurately/honestly to self-diagnose.
3. It might distract some learners from understanding of the material.

**REFERENCES**

Kolencik, P. L., & Hillwig, S. A. (2011). *Encouraging metacognition: Supporting learners through metacognitive teaching strategies. (vol. 12)*  New York, NY: Peter Lang.

King, A. (1991). Effects of training in strategic questioning on children's problem-solving performance. *Journal of Educational Psychology*, *83*, 307-317.

## Metacognitive self-monitoring

DESCRIPTION: Students are prompted to make comments in the margins of their work (writing, computations, drawings) to document their thinking, to ask questions, to explain choices, both for their benefit during future reflection or revision and to benefit a future reader or evaluator.

**EXAMPLES**

1. Using comment features in a written document to insert comments that describe writing choices that the student was unsure about or additional ideas that did not get included.
2. Designating a space on a computational assignment (the right third of the page, for example) for writing questions that come up as a student is working through the problem.

**POTENTIAL BENEFITS**

1. Can provide students with an easy way to rework ideas and revisions.
2. Can provide a way for students and faculty (or peers) to have a dialogue about approaches or points of confusion in a way that does not require a face-to-face interaction.

**POTENTIAL CHALLENGES**

1. Requires a format for easy/natural collection of questions and comments.
2. Students may need training/reinforcement as to what is a substantive question or comment that is productive for them and not just a superficial response to fullfill the prompt.

**REFERENCES**

LaVaque-Manty, M., & Evans, E.M. (2013). Implementing metacognitive interventions in disciplinary writing classes. In M. Kaplan, N. Silver, D. Lavaque-Manty, & D. Meizlish (Eds.), *Using reflection and metacognition to improve student learning* (pp. 122-146). Sterling, VA: Stylus Publishing.

# Assessment wrappers

**DESCRIPTION**: Assessment wrappers ask students to reflect on their preparation, performance on the assessment, and how they plan to prepare for the next assessment.

**EXAMPLES**

1.  Exam wrappers ask three types of question after graded exams are returned:
    1.  How did you prepare for this exam?
    2.  What errors did you make on the exam?
    3.  What might you do differently to prepare for the next exam?

    These questions are answered either in class or as a homework assignment right after the exam is returned. These responses are then returned to students about a week before the next exam to remind them of their plans to adjust studying to improve performance.

2.  Homework wrappers have been used in which students are to assess their understanding of a concept or their skills in an area before completing homework. After the homework is completed, students are asked again to assess their understanding and/or skills. Then, they are asked to plan next steps for continued learning in this area.

**POTENTIAL BENEFITS**

1.  Ideally, assessments are one stage in the learning process, not an end point. Assessment wrappers foster self-reflection and monitoring of one's understanding and skills**.**
2.  They are quick and adaptable activities that can be added to a range of classes.

**POTENTIAL CHALLENGES**

1.  Poor self-reflection skills may make it difficult to identify and learn from mistakes or implement suggested changes.
2.  They are additional work for students and faculty.

**RESOURCES**

Lovett, M.C. (2013). Make exams worth more than the grade: Using exam wrappers to promote metacognition. In M. Kaplan, N. Silver, D. Lavaque–Manty, & D. Meizlish (Eds.), *Using reflection and metacognition to improve student learning* (pp. 18-41). Sterling, VA: Stylus Publishing.

Some sample exam and homework wrappers:
https://www.cmu.edu/teaching/designteach/teach/examwrappers/

# Write, Respond, Revise (WRR)

**DESCRIPTION:**
A WRR prompt is a prompt that asks students to write about a concept or procedure;  this initial articulation  can be in the form of a description, or question-asking, or a narrative.  The student's written work must receive a response.  This response can take the form of written or oral feedback. This feedback can be in the form of asking further questions, requiring further clarification, answering a question, or simply going over the solution or concept in class.   The student should revisit their written work and revise it integrating the feedback received in the student's own words. Further questions can be articulated at the revision step, if necessary. The revision step can be repeated.

**EXAMPLES:**
For a class in the Humanities:
In two-three sentences, explain Kant's categorical imperative in a way that would be understandable to a bright and curious 10-year-old.  Read what you've written.  Was there anything that you found difficult to explain?  Was there anything that you found confusing?  Can you put into words this confusion or difficulty in the form of a question?
After input:  Revisit your description of Kant's categorical imperative and your own questions. What do you understand now that you didn't understand before? (How, in other words, has your understanding changed?)   Revise /rewrite your initial explanation of the categorical imperative with reference to what you understand now.

For a class in STEM:
In two-three sentences, explain equilibrium both conceptually and mathematically to a peer who is having trouble understanding equilibrium. Read what you've written.  Was there anything that you found difficult to explain?  Was there anything that you found confusing?  Can you put into words this confusion or difficulty in the form of a question?
After input:  Revisit your description of equilibrium and your own questions.  What do you understand now that you didn't understand before? (How, in other words, has your understanding changed?)   Revise/rewrite your initial explanation of equilibrium with reference to what you understand now.

**POTENTIAL BENEFITS**

In general, WRR prompts require students to write down "what they understand about 'x', and to write down what they don't understand about x'."  The student then receives feedback.  On the basis of this feedback, students revisit their initial answer or question and revise it in writing.   In this way, they create a de-facto "log" or written record of their own understanding that can provide instructors (and the student) with a more detailed sense of the latter's understanding of a particular concept or procedure.

**POTENTIAL CHALLENGES**

1. Students may need coaxing to describe their thinking process in writing.  They might say "I don't know what to write." In such cases, encourage freewriting or brainstorming about a concept or question.
2. Their written response requires feedback either from peers or the instructor.  The former can take up class-time; the latter can add to the professor's workload.

**RESOURCES**

Berkenkotter, C. (2000). Writing and problem solving. In Toby Fulwiler & Art Young (Eds.), *Language connections: Writing and reading across the curriculum (*pp. 33-44). Fort Collins, CO: WAC Clearinghouse Landmark Publications in Writing Studies.

Emig, J. (1977). Writing as a mode of learning. *College Composition and Communication,* 28*:* 122-128.

Flower, L. & Hayes, J.R. (1981). "A Cognitive Process Theory of Writing." *College Composition and Communication* 32.4 : 365-87. Web.

Hacker, D.J. Keener, M.C. & Kircher, J.C. ( 2009) Writing is applied metacognition. In D.J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.). *Handbook of Metacognition in Education* (pp. 154-172). New York: Routledge.

Hand, B. Lang, O.E. & Bruxvoort, C. (2006) Using writing-to-learn strategies to improve year 11 students' understandings of stoichiometry. *International Journal of Science and Mathematics Education. 5,* 125-143.

Negretti, R. (2012). Metacognition in student academic writing: A longitudinal study of metacognitive awareness and its relation to task perception, self-regulation, and evaluation of performance. *Written Communication, 29*, 142-179.

Porter, M.K, & Masingila, J.O. (2000). Examining the effects of writing on conceptual and procedural knowledge in calculus. *Educational Studies in Mathematics*. *42*, 165-177.

Prain, V. (2006). Learning from writing in secondary science: Some theoretical and practical implications. *International Journal of Science Education*, *28(2):* 179–201.

## Muddiest Point

**DESCRIPTION**: The Muddiest Point is a formative assessment technique instructors can use to determine what students do not understand. It can be extended to ask students to reflect more deeply by suggesting ways they could support their own learning.

**EXAMPLES**
In its simplest form, students are asked to write a sentence or two about the "muddiest point" of the class session - that is, what was *least* clear to them. For example:

> Please write a few sentences in response to the following prompt:
> What was the muddiest point of the class session for you? That is, what was *least* clear to you?

This requires students to reflect on what they have learned and provides instructors with rapid feedback regarding the class session. If multiple students report struggling with the same idea, the instructor could choose to review material or have students engage with material again in another way.

An extension of the muddiest point is to use a series of short prompts:
1. What is your strongest point of understanding regarding (insert your topic/concept here)?
2. What is your weakest point of understanding regarding (insert your topic/concept here)?
3. What will help you strengthen your understanding of this topic?

**POTENTIAL BENEFITS**

Instructors can rapidly review short student responses and make adjustments accordingly. Students reflect on their learning and suggest strategies for improving learning.

**POTENTIAL CHALLENGES**

The exercise can potentially be discouraging to students due to its emphasis on something negative (i.e., a focus on what they do not understand).

**RESOURCES**

Angelo, TA & KP Cross (1993). *Classroom assessment techniques*. (2nd Ed.) San Francisco: Jossey-Bass.

http://cpree.uw.edu/scc1-your-own-understanding/

**RESOURCES FOR USE OF METACOGNITIVE ACTIVITIES IN THE CLASSROOM**

<u>Some websites</u>
CPREE - Consortium to Promote Reflection in Engineering Education
http://cpree.uw.edu/
A useful list of in-class metacognitive activities in a range of science disciplines, including examples and tips for successful implementation.

http://wpacouncil.org/metacognitive-development
Information on incorporating metacognition in composition classes

https://cft.vanderbilt.edu/guides-sub-pages/metacognition/
Information, links, activities, and research references, from Vanderbilt's Center on Teaching

<u>Recommended reading</u>
Alleva, P. & Gundlach, J. (2016). Learning intentionally and the metacognitive task. *Journal of Legal Education*, *65*, pp. 710-743.

Bangert-Drowns, R. L., Hurley, M. M., & Wilkinson, B. (2004). The effects of school-based writing-to-learn interventions on academic achievement: A meta-analysis. *Review of Educational Research*, *74*(1), 29-58.

Bransford, J. D., Brown, A., & Cocking, R. (1999). *How people learn: Mind, brain, experience, and school*. Washington, DC: National Research Council.

Brown, A. L. (1987). Metacognition, executive control, self-regulation, and other more mysterious mechanisms. In F. Weinert & R. Kluwe (Eds.), *Metacognition, motivation, and understanding* (pp. 65-116). Mahwah, NJ: Erlbaum.

Dunlosky, J., & Metcalfe, J. (2008). *Metacognition*. Sage Publications.

Flavell, J. H. (1976). Metacognitive aspects of problem solving. *The nature of intelligence*, *12*, 231-235.

Kaplan, M., Silver, N., Lavaque-Manty, D., & Meizlish, D. (Eds.) (2013). *Using reflection and metacognition to improve student learning*. Sterling, VA: Stylus Publishing.

Kolencik, P. L., & Hillwig, S. A. (2011). *Encouraging metacognition: Supporting learners through metacognitive teaching strategies. (vol. 12)*  New York, NY: Peter Lang.

McCabe, J. (2011). Metacognitive awareness of learning strategies in undergraduates. *Memory & Cognition*, *39*(3), 462-476.

Pintrich, P. R. (2002). The role of metacognitive knowledge in learning, teaching, and assessing. *Theory into Practice*, *41*(4), 219-225.

Young, A., & Fry, J. D. (2008). Metacognitive awareness and academic achievement in college students. *Journal of the Scholarship of Teaching and Learning*, *8*(2), 1-10.