Reflection and Metacognition Series

PART 1: Reflecting on Teaching Practice

"Make time for reflection." It sounds simple enough, but how often do we stop to make time for reflection on teaching practices? Many instructors do it automatically while in the midst of teaching; however, transforming potentially-passing thoughts into concrete plans for change requires further intention. And if reflection is important for instructors, might it also be important for students? Schraw, Crippin, and Hartley (2006) found that engaging in reflection helped increase students' critical thinking ability.

This series on Reflection and Metacognition looks at the implications for both instructors (part 1) and students (part 2). We begin with discussing the merits of engaging in reflecting about teaching.

What is reflective practice?
Since the beginning of the 20th century, scholars such as John Dewey, acknowledged reflection as an important element of effective teaching; it was from that continuing conversation that the term "reflective practitioner" emerged (Schon, 1987). Generally, a reflective practitioner is someone who actively engages in thinking about teaching with the express intent that reflections about those experiences inform future practice. More recent scholarship suggests that "...reflection [is] a process in which a person tries to make sense of something while acting on it at the same time" (Bishop-Clarke & Dietz-Uhler, 2012). As instructors, we reflect when we think about what we are doing, are willing to learn, and are open to change.

What are the benefits of reflection?
Reflective practice is central to articulating student outcomes, considering new pedagogical perspectives, and engaging learners in a number of learning environments (in-person, hybrid, online). Reflection offers a chance to (re)explore our beliefs about learning and our teaching, many of which have become so deeply-seeded as to become "automatic."

Brookfield (2017) suggests there are a number of reasons reflection on teaching can benefit educators, such as: developing a rationale for practice, taking informed actions, keeping instructors engaged in the teaching process, and establishing trust with students. With regard to trust, Brookfield posits that intentionally disclosing the pedagogical decisions you have made during the design of the course/lesson/unit is an opportunity to build trust with students and show them that your plans are made to benefit their learning. In other words: A reflective instructor is more able to communicate the "how" and "why" of course design and delivery to students.

What is the process of reflection?
The process is one in which we challenge our assumptions through reflection. According to Brookfield, "Critically reflective teaching happens when we build into our practice the habit of constantly trying to identify, and check, the assumptions that inform our actions as teachers (p. 5)." Brookfield further describes four lenses through which we might introspectively examine our teaching: through the eyes of our students, through our colleagues' perceptions, through our personal experiences, and through theory and research.

Considering ourselves through the lens of our students, increases our awareness in the ways we interact with our students. This may help us interrogate the common assumptions we have, predicated on our own learning, that may or may not be true for our student learners. This lens may inform how we see the disparity between our intentions and actual perceptions. Hearing and integrating this type of feedback can only increase our impact on learning. As but one example of a tangible way to reflect on our practice through the lens of students, Brookfield advocates for use of a Critical Incident Questionnaire (CIQ) as a tool. He argues that it can be quick to implement and particularly insightful. Since these questions ask students to reflect on their own learning, it also can serve as a reflective tool for our students. (For more details of the CIQ, see part 2 in this series.)

Additionally, opening ourselves to our colleagues' interpretations may also shed new light on our practice. Engaging in open discussions with colleagues who share many of the same professional experiences can add nuance to our way of thinking, while also providing us with credible alternate perspectives. Considering our own experiences as learners (i.e., what makes us engage when in learning contexts, what motivates us to participate, what makes for effective group interaction) might also inform ways to change practice in order to increase student engagement in our own classes. Finally, existing research and literature on learning and teaching may illuminate our experiences or catalyze fresh new ideas. Taken together, and when examining our practice consistently and with a regularity, we engage in critical reflection.

Why reflect on paper?
Writing by hand has been demonstrated to stimulate the brain differently than writing on the keyboard. Researchers contend that transforming the spoken word into the written word activates cognitive processes that lead to learning and change. Mueller & Openheimer (2014) found that college students who hand wrote notes (rather than typing on a laptop) performed better on tests of conceptual knowledge.

How do I get started?
There are both formal and informal processes on the continuum of reflective practice. You could simply start by thinking of responses to the following questions:

- What worked well in my instruction? Who will I share this news with?
- What needs work? Who can help me think through this?
- What will I do differently? How will I know it is working?

For a more structured approach, scholars suggest a three-phased reflective process: Pre-planning, Planning, and Post-Planning (detailed below).

Phase	Description	Points of Reflection
Pre-planning	Thinking about previous experiences that inform the current teaching goal(s) (successes, lessons learned).	What assumptions or dispositions do you have about your class? What do you want learning to look like in your classroom?
Planning	Transforming thinking into action by designing (in some cases pilot testing) and implementing a teaching plan.	What strategies will help you accomplish this vision? What data will you gather to determine the effectiveness of your planning?
Post-planning	Reviewing the plans and the data you have to understand the effectiveness of your planning and to inform future plans.	What ideas, patterns, themes emerged from your data? What would you like to do differently next time?

While these are accessible and informal points of entry, the most systematized and formal process of reflection leads to the Scholarship of Teaching and Learning (SoTL). More specifically, SoTL is a structured and formal process of reflecting that entails questioning, hypothesizing, collecting empirical data, analyzing, and reporting (Bishop-Clark & Dietz-Uhler, 2012).

There are other ways to conceptualize reflection. Appendix 1 provides more examples to further reflect on your teaching at different stages of the instructional process.

Extend reflective practice to other areas of professional practice?
While reflecting on our teaching is the focus of this part, as professionals, we are not limited to reflecting on teaching alone. The practice of reflection can be extended to other areas of our professional lives. Although embedded in our research, we may already have informal systems for reflecting about our reading and our writing. What about reflecting on our mentoring: How do I ask clarifying questions of my mentee? Consult with them? Collaborate with them? Coach them? How do I strike a balance amongst

these behaviors? When attending talks, lectures, or conferences: What did I observe that particularly engaged me intellectually or emotionally? How do I reproduce both types of behaviors in my own class? Reflecting on all dimensions of our professional lives can contribute to deeper introspection and integration, thus improving outcomes and holistic well-being.

Additional Readings & Resources

- McDrury, J., & Alterio, M. (2003). Learning Through Storytelling in Higher Education: Using Reflection and Experience to Improve Learning. Sterling, VA: Taylor & Francis.
- Newton, J., Ginsburg, J., Rehner, J., Rogers, P., Sbrizzi, S. & Spencer, J. (Eds.) (2001). Voices from the Classroom: Reflections on Teaching and Learning in Higher Education. Toronto, ON: Garamond Press.
- Ovens, P., Wells, F., Wallis, P., & Hawkins, C. (2011). Developing Inquiry for Learning: Reflection, Collaboration and Assessment in Higher Education. New York: Routledge.

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PART 2: Integrating Reflection for Students

What is metacognition?
Simply put, metacognition is "thinking about thinking." Complex and multi-dimensional, scholars posit that metacognition is comprised of two main components: the knowledge and regulation of cognition (Metgzer et al., 2018; Schraw et al., 2006). Having awareness of how one learns, one's strengths and deficits, and the benefits of situational learning strategies contribute to "knowledge" about cognition. While regulation of cognition consists of actively engaging in one's own learning process through planning, monitoring, reflecting, and strategizing (Metzger et al, 2018; Schraw & Dennison, 1994; Tanner, 2012). This is a type of intentional learning that interacts with active inquiry, whereby students both reflect on and direct their learning (National Research Council, 2000).

Why does metacognition matter?
Research has identified student metacognition as a significant mechanism for producing positive learning outcomes (Millis, 2016; Wang et al., 1990). As Ambrose et al. assert (2010), self-directed learners can evaluate their knowledge and skill in the context of a learning task, prescribe a path to accomplish it, and monitor and adjust as needed along the way.

Indeed, undergraduate courses more traditionally focus on disciplinary content exclusively, instead of incorporating the practice of metacognitive skills into culture, instruction, or activities. Still, scholars find that embedding these pedagogical skills within instructional practice that connects disciplinary learning to metacognitive practice produces more proficient content-area learning (Metgzer et al., 2018; Kuiper & Pesut, 2004).

How to integrate student metacognition into practice
Metacognition, both language and habit, can become normative discourse in the classroom (Tanner, 2012; Pintrich 2002). Talking both *about* the strategies and *when* to apply them can demonstrate the value you place on these processes. When instructors give students permission to "be confused" and create a classroom culture where students can seek this missing clarity, student comfort level and willingness to trust the learning process increases (Tanner, 2012). Perhaps most importantly, students need not only *hear* instructors' explanations of the strategies, but they must *observe* them in practice, by either instructor or other students (Nilson, 2013). Metacognitive modeling by the instructor relies on their own self-reflective thinking. Instructors can explicitly show students how they (as experts) think procedurally (Tanner, 2012), whether it be solving a problem, engaging in reading of text, or organizing and studying for an exam. These concrete examples illuminate for students not only *what* is important to think about, but also *how* those with more experience do so. Finally, once students have observed, as with any new learning, they need opportunities to practice the metacognition and to receive meaningful feedback (Millis, 2016).

Next, embedding questions within regularly graded course material can help students see both the value and impact of "thinking about their thinking." Adapted from Tanner (2012), the series of tables below, organized along two dimensions, include sample questions that promote student metacognition. First, questions within each table correspond to the timing of the question: Before Implementation, During Implementation, or After Implementation.

Second, the tables include:

- questions that can be asked regarding individual Class Sessions (table 1),
- Active Learning Tasks or Homework (table 2),
- Quizzes or Exams (table 3),
- Overall Course (table 4).

Table 1: *Class Sessions*

Before	During	After
What are the goals of the class session going to be? What do you already know about this topic? How could you best prepare for the class session? Where should you sit and what should you be doing (or not doing) to best support my learning during class? What questions do you already have about this topic that you want to find out more about?	What insights am you having as you experience this class session? What confusions? What questions are arising for me during the class session? Are you writing them down somewhere? Do you find this interesting? Why or why not? How could you make this material personally relevant? Can you distinguish important information from details? If not, how will you figure this out?	What was today's class session about? What did you hear today that is in conflict with my prior understanding? How did the ideas of today's class session relate to previous class sessions? What did you find most interesting about class today?

Table 2: *Active-learning task and/or Homework*

Before	During	After
What is the instructor's goal in having me do this task? What are all the things you need to do to successfully accomplish this task? What resources do you need to complete the task? How will you make sure you have them? How much time do you need to complete the task? If you have done something like this before, how could you do a better job this time?	What strategies am you using that are working well or not working well to help me learn? What other resources could you be using to complete this task? What action should you take to get these? What is most challenging for me about this task? Most confusing? What could you do differently mid-assignment to address these challenges and confusions?	To what extent did you successfully accomplish the goals of the task? To what extent did you use resources available to me? If you were the instructor, what would you identify as strengths of my work and flaws in my work? When you do an assignment or task like this again, what do you want to remember to do differently? What worked well for me that you should use next time?

Table 3: *Quiz or Exam*

Before	During	After
What strategies will you use to study (e.g., study groups, problem sets, evaluating text figures, challenging myself with practice quizzes, and/or going to office hours and review sessions)? How much time do you plan on studying? Over what period of time and for how long each time you sit down do you need to study?	To what extent am you being systematic in my studying of all the material for the exam? To what extent am you taking advantage of all the learning supports available to me? Are you struggling with my motivation to study? If so, do you remember why you am taking this course?	What about my exam preparation worked well that you should remember to do next time? What did not work so well that you should not do next time or that you should change? What questions did you not answer correctly? Why? How did my answer compare with the suggested correct answer?

Which aspects of the course material should you spend more or less time on, based on my current understanding?	Which of my confusions have you clarified? How were you able to get them clarified? Which confusions remain and how am you going to get them clarified?	What questions did you not answer correctly? Why? What confusions do you have that you still need to clarify?

Table 4: *Overall Course*

Before	During	After
Why is it important to learn the material in this course? How does success in this course relate to my career goals? How am you going to actively monitor my learning in this course? What do you most want to learn in this course? What do you want to be able to do by the end of this course?	In what ways is the teaching in this course supportive of my learning? How could you maximize this? In what ways is the teaching in this course not supportive of my learning? How could you compensate for or change this? How interested am in in this course? How confident am you in my learning? What could you do to increase my interest and confidence?	What will you still remember 5 years from now that you learned in this course? What advice would you give a friend about how to learn the most in this course? If you were to teach this course, how would you change it? What have you learned about how you learn in this course that you could use in my future courses? In my career?

Beyond the questioning to promote metacognition, another effective way to incorporate is to implement activities and/or assignments explicitly geared toward metacognition. Part 3 of this series describes many concrete examples, ranging from those which can be accomplished in minutes to more comprehensive and sustained routines.

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PART 3: Activities to Promote Reflection for Students

Just as instructors can reflect on teaching practice, students can also grow from reflecting on their learning. The more that students know about their own learning, the better they are able to match learning strategies to contexts, and the more they are able to regulate it for success. Instructors can also systematically integrate metacognitive exercise into already established instructional activities and assessments, as opposed to prompting students with isolated or scattered questions for reflection.

This part describes some tangible and engaging examples of integrated reflection to promote student learning.

- For routinized *quick* reflection in commonly used activities, or as described by Millis (2016), "action-oriented opportunities," see Tables 1a – 1c
- For more *complex* sustained models that can be maximized as structured, routinized, integrated, and institutionalized regular parts of the course, opportunities for reflection:
    - Before teaching a unit (Table 2)
    - While teaching a unit (Table 3)
    - After teaching a unit (Table 4)

It is worth remembering that reflective exercise is like any other; the more it is practiced, the stronger the students' metacognition becomes and the greater the benefits, to not only their learning, but also to instructors' practice.

Quick Activities

Table 1a: *The Minute Paper*

What is it?	What are some sample prompts?
This is a brief reflective activity to be used in the concluding minutes of class. Instructors give students 2-3 minutes to write on an index card their responses to the posted prompt/s. This guides students in reflecting on their understanding of a finite amount of material, such as a single lecture or class (Millis, 2016; Tanner, 2013).	What was the most important thing you learned during this session? What important questions remain unanswered? How did what you learned today apply to lab/section?

Table 1b: *The Muddiest Point*

What is it?	What are some sample prompts?
Instructors use this at the closing of class (2-3 minutes). Asking students to reflect on the day's class not only engages them in their own metacognition, but also establishes a tone that confusion is a part of learning. Also, this aggregated feedback from students can help the instructor plan their next class session with the explicit goal of clearing up the confusion or can be shared with TA's to integrate into their planning for discussion sections or labs (Tanner, 2012).	What was most confusing to me about the material we explored in class today? What was one point today that is not clear to you?

Table 1c: *Support a Statement*

What is it?	What are some sample prompts?
Instructors provide students with a general statement from lectures, readings, or informed	Who makes these claims?

experts. They then ask students to justify support, rather than just citing it. This simple adaptation requires students to think at a different level, reflecting on what they either do or do not know (Millis, 2016).	Are they a credible source? Why or why not? What evidence is (or arguments are) used to support these claims?

More Complex Activities

Table 2: *Before Teaching a Unit*

What is it?	What are some sample prompts?
Knowledge Surveys Instructors use these before beginning the unit as a metacognitive instrument for students. Instead of an actual pre-test of content knowledge, they gauge students' perceptions of their knowledge of topics without having to "prove" it. Students reflect on their confidence in their ability to answer given questions or perform skills (Millis, 2016). (Additionally, the same survey can be given at multiple points in the class and/or the end to measure what students learned or what skills they acquired.)	Provide students with a series of 3 responses and prompt them to mark one for each substantive question/problem. • Mark 1 if you are fairly certain you can answer question or perform skill indicated • Mark 2 if you know at least 50% of the answer or if you know exactly where to find the information to answer it • Mark 3 if you don't know how to answer the question or perform the skill

Table 3: *While Teaching a Unit*

What is it?	What are some sample prompts?
Clickers (Personal Response Systems) These have become increasingly prevalent in classes to check for student understanding. Instructors pose questions, usually with multiple-choice options. Students are given a few moments to think and arrive at their answers or to solve a problem. Instructors are able to assess how well students demonstrate an understanding. This type of learning activity can also be combined with pair or group discussion. Once students have reflected and answered independently, instructors can direct them discuss the same questions in groups and to once again respond to the question after collaboration. Research has shown that the peer interactions are the mechanism for learning and metacognition. To see a demonstration of this type of activity in a live classroom, watch this brief clip of Harvard professor, Eric Mazur, leverage the impact of clickers (Millis, 2016).	Share how you thought about what the question was asking. Share the process you used to arrive at an answer you wanted to choose. What was your main reason for choosing your answer, and what were the main reasons you did not choose the others? How did your ideas compare with your neighbor's ideas? What was most confusing to you about this question? How confident are you in your answer? Why? What else would you need to know to increase your confidence?
Learning Log/Reflective Journal This can be a more formal way for students to reflect and can be integrated into other activities such as active learning tasks, homework assignments, or exam preparation. With regular reflecting and writing about their learning, students are better able to see patterns and to diagnose their own strengths and weaknesses. Instructors can then coach them in prescribing solutions and monitoring their own learning. This helps students to take responsibility and to become independent and self-directed. This strategy for requiring metacognition is appropriate across levels and within varied contexts of	**Applied to Active Learning Tasks or Homework Assignments** Pose three questions that you had about the concepts you explored in your assignment that you still cannot answer. What enabled you to learn the most in this assignment? How was the way you approached completing this assignment different compared with the last time we had an assignment like this?

disciplines (Tanner, 2012; Barkley, 2010; Weimer, 2002).	What advice would you give yourself based on what you know now if you were starting this assignment all over again? **Applied to Preparation for Exam or Quiz** How do you plan on preparing for the upcoming exam? Why? What resources are available to support you? How will you make sure to use these? How does your strategy for exam preparation compare with at least three colleagues in your lab section? (go ask) What concepts have been most clear? What concepts have you found most confusing so far? Given that, how should you spend your study time in preparing for the exam? Based on your performance on the last exam, write a letter to yourself with advice about preparing for the upcoming exam.

Table 4: ***After Teaching a Unit***

What is it?	What are some sample prompts?
Critical Incident Questionnaire (CIQ) This metacognitive tool, administered in regular intervals, asks students to respond to the same five questions pertaining to critical moments or actions in learning. Patterns and trends emerge from results and can be addressed either explicitly or implicitly by the instructor. CIQs can be kept anonymous, if desired. Through implementation of CIQs, students become more aware and are encouraged to take a more active role in influencing class climate for their own learning. Collecting data on class environment helps instructors to understand their students' learning processes and adjust to maximize learning (Barkley, 2010; Metzger et al., 2018; Brookfield, 2005; Weimer, 2002).	At what moment in class or while doing your homework this week were you most engaged as a learner? At what moment were you most distracted as a learner? What action did anyone in class take this week that you found most affirming or helpful? What action did anyone take this week that you found most puzzling or confusing? What surprised you most about class this week?
SMASH Inventory paired with Exam Wrappers/Post-test Analysis *Part 1:* This two-step process begins once students complete an exam, but before they submit it. Instructors ask students to reflect and provide written analysis around a series of questions about their study strategies and effort. Metzger et al. (2018) designed a variation of this method by creating a 25-item instrument (SMASH Inventory Instrument) that more formally guides students to consistently practice self-reflection in conjunction with performance.	Predict your exam score. What supports this prediction? Rate your effort in studying for the exam on a scale of 1 (lowest) to 10 (highest) List the specific learning strategies you used to study for the exam (e.g., used flash cards to memorize definitions, rewrote/reviewed lecture notes, created outlines from readings, etc.) Identify what you found easiest and most difficult about the exam and why Adapted from SMASH Inventory Instrument: • The concepts on this assessment were difficult for me. (reflective thinking)

	• The concepts in this course have been difficult for me. (reflective thinking) • I use different study strategies for concepts that I find to be more difficult. (reflective thinking) • The strategies that I used to prepare for this exam worked well, and I will use them again next time. (systematic study habits) • I am confident in my ability to learn this material. (meta-emotional)
Part 2: Once exams are graded and returned, students are then asked to write about their emotional response, compare results to predictions, and engage in test item-analysis. Some refer to this as a post-assessment Writing, Reflection, and Planning (WRaP). Taken together, these become a metacognitive mechanism for both students and instructors to gain insight into the learning process. This can illuminate associations between preparation and results. It may also help students to see disparities between their perception and actual performance. Instructors might use results as a mechanism for early identification of gaps in understanding and intervention. (Barkley, 2010; Metzger et al., 2018; Millis, 2016; Weimer, 2002)	Did you earn the score you hoped on this exam? Explain. Do you plan to adjust your study habits based on this? If yes, how? Review the items you answered incorrectly. Do you notice any patterns in what you missed? Explain. Make corrections to the missed items. Provide the correct answer, explain why this is correct, and indicate the source for the correct information (e.g., readings, lectures, assignments) Please provide feedback on how I can help you prepare better next time. How can your peers help you prepare?

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