Feedback in the Mathematics Classroom

“Less teaching plus more feedback is the key to achieving greater learning.”

Grant Wiggins

According of John Hattie, feedback is one of the most powerful influences on improved academic achievement. In fact, after his synthesis of more than 900 meta-analyses, he found that feedback had one of the highest effects on student learning. This means that feedback can be one of our most effective instructional strategies for improving student performance because it has been shown to accelerate the rate of learning and amount of learning.

What is Feedback?

Feedback is the information we provide students about how they are performing relative to a goal. Feedback does not include judgments or evaluation, rather feedback tells our students what effects their actions have on their goals. Feedback clearly articulates for students what they understand and the areas where they still need to demonstrate proficiency, and guides them to use specific strategies for improvement.

According to author Dylan Wiliam, “Feedback involves a change of focus from what the teacher is putting into the process to what the learner is getting out of it.” Feedback should help the learner answer the following questions “Where am I headed? How am I doing? and Where do I go next?”

Teachers may choose to provide feedback on any of the following:

• The learner’s success with a task
  The teacher, using very clear criteria for success, helps the student to find places where errors have been made and to understand the steps to take to correct the errors. In these instances, teachers should ask themselves “Does the student’s work meet the criteria for success? What did the learner do well? Where did the learner go wrong? What other information will this learner need to reach success with the task?”

• The processes the learner is using
  The goal of feedback in this area is to promote students’ reflective thinking about their process. Students should be afforded the opportunity to self-correct their work. Students should be asking themselves “How did I get here and where am I going next?” Teachers can ask themselves “Where are the errors? Why were the errors made? What strategies did the student use? What is the students’ understanding of the content/skills/strategies related to the task?”

• The self-regulatory habits the learner is developing
  Feedback should challenge students to reflect on the metacognitive processes they used to learn the content. Teachers can ask students questions such as “What happened when you…? What still confuses you? What is still hard? How has your thinking changed during the task?”

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Feedback is also provided to the teacher by the student. When teachers listen to students and learn what they know, what they understand, where they are confused, where they have misconceptions, and when they are disengaged, amazing learning occurs for both teacher and student.

Tenets of Effective Feedback

Feedback is tied to a learning target and success criteria.
Before feedback is delivered, students should understand the learning target as well as the indicators for success with that target. As described in the “Learning Target” issue of *Making the Standards Come Alive*, learning targets are student-friendly statements of what students are expected to learn during the lesson. Learning targets also include the criteria for success, so students are able to measure how they are doing relative to their goal and envision what success looks like. When students can compare their work with a clearly understood criterion for success, they are more likely to accept and value the feedback the teacher provides. Students can answer the question “I’ll know I am successful when…” In fact, when students are able to make comparisons between their work and the indicators of success, they are actually generating their own feedback for learning.

Feedback is based on evidence.
When designing tasks, teachers need to ensure that the tasks they assign are aligned with the student learning targets. Feedback should be specific and based on observations of the students’ processes and work, not on inferences. In addition, feedback should be focused on the quality of the student work and not the learner themselves. It is the student work that is used to identify where improvements need to be made and how to go about making those improvements.

Feedback informs the student where they are relative to the criteria for success.
Using work samples at different levels of proficiency helps students to understand the criteria of quality work. In time, students become adept at recognizing errors in the work of others, and better at recognizing the strengths and areas of opportunity in their own work.

Feedback is actionable.
The most effective feedback is meaningful, specific, and useful. In other words, it provides information that allows the student to take action. It informs the student what needs to be done in the future and helps them to answer the question “What do I need to do more or less of next time based on this information?” Feedback should be focused and target one important thing that if changed would immediately yield noticeable improvement.

Feedback is comprehensible.
Feedback should engage and motivate students with their work, and be usable, and not overwhelming. By giving students time upfront to discuss what constitutes quality work, they are in a position to better understand and use feedback. When students are used to short, frequent conferences they have a greater awareness of the role that feedback plays in their learning.

To ensure the student has understood the feedback they’ve received, students should be asked to repeat back teacher comments in order to confirm that they know what to do next. After all, we want students to take an active part in monitoring and regulating their own learning.

Feedback is timely and ongoing.
In order to be effective, feedback needs to be delivered when the student is engaged in the work and when there is still time to make improvements. Once feedback is given, students need the immediate opportunity to use it. When feedback is provided during the learning, students make connections to their learning target and the indicators for success with that target.
Feedback in the Mathematics Classroom

Applying these tenets of high quality feedback in the mathematics classroom is critically important to our students’ success. Our feedback to students should not only promote their learning of the math content, but also strengthen their application of the mathematical practices. In order to learn and retain their mathematical understandings, students need to be engaged in the process of doing mathematics and receiving feedback on their experiences. Therefore, in addition to specific content and skills, feedback should focus on the Standards of Mathematical Practice which emphasize students’ ability to:

- Make sense of problems and persevere in solving them
- Reason abstractly and quantitatively
- Construct viable arguments and critique the reasoning of others
- Model with mathematics
- Use appropriate tools strategically
- Attend to precision
- Look for and make use of structure
- Look for and express regularity in repeated reasoning

When feedback is centered on the mathematical practices, students grow in the habits of mind needed to be mathematically proficient. Consider making observations of the students’ work and the processes they are using. For example, at the start of a conference, quickly research the work the student has done, including the strategies or processes they are using to solve problems. Make observations of what the student has done well, along with any areas of challenge or confusion. You might start the feedback discussion with:

- I’m noticing that you…
- I can see that…
- Based on my observations, you…
- It looks like…

With these openers, the feedback is tied to the students’ work and based on evidence, not in the learner.

Be sure to ask high quality questions to probe student thinking and promote reflection. In their book *Engage in the Mathematical Practices: Strategies to Build Numeracy and Literacy with K-5 Learners*, authors Kit Norris and Sarah Schuhl identify two different types of probing questions. The first are assessing questions, or those that scaffold instruction for students who are stuck. The second are advancing questions that further learning for students who are ready to move beyond the standard. Some of the questions they suggest are:

### Assessing Questions to Use When Student is Stuck

- How can you use a tool to make sense of the problem?
- What else can you try?
- What do you notice in the problem?
- What do you wonder about the problem?
- What is the problem asking?
- What do the numbers represent in the problem?
- What do you need to know?
- What strategies might you consider using?
- How will you know if your strategy works?
- How will you show your thinking?
- What could help you?
- How is this problem like problems you have solved before?
- Where have you solved a problem like this before?
- Can you solve it in a different way?

### Advancing Questions to Use When Student is Ready to Move Beyond the Standards

- How can you represent this problem in a different way?
- Can you create a word problem to match the equation ____________?
- Can you create a word problem using ____________ that has an answer of ____________?
- How is ________ like ________? How is ________ different from ________?
- What are you wondering about?
- How can you represent this situation with numbers and symbols?
It is really helpful to identify an “anchor problem and solution” that exemplifies the work you are expecting students to do. Students will do best when they know exactly what is expected of them. This can be done through rubrics, checklists, and other scoring tools; it can also be done by giving the students an annotated example of the work you are asking them to do. Feedback then can be in direct alignment with the demonstrated criteria for success with the task. Providing an “anchor problem” not only lifts the quality of student work, but also provides guidance about what to do next.

It is important that students do not see the teacher is not the only source of feedback in the math classroom. Providing opportunities for students to engage in dialogue with their peers helps to clarify their thinking and reflect on their work. For example, one partner may ask “Why are you choosing to solve the problem in this way?” Students can also ask their peers questions such as “Why?” or “What do you mean?” and “Can you explain that in another way?” as they look to clarify their own understanding. Finally, when talking with a partner, students have the chance to listen to and reflect on the mathematical arguments of their classmates.

Taking time to analyze and discuss errors in a student’s mathematical work can not only increase student engagement, but promote students’ conceptual understanding. One way to leverage errors is to design mathematical tasks that are likely to expose students’ misconceptions. While students are working, observe how they are approaching tasks and the errors they are making, then gather examples to use in a class discussion. Have the class publicly analyze and discuss these flawed solutions.

Strategically project anonymous work samples that include flawed thinking, then lead the class through a discussion. For instance you might ask questions like “What process did each student use? What do you notice about each solution? How are the solutions similar or different from each other? How is this work similar or different from problems like this that we have solved before? Is there a solution that is complete and correct? If so, which one and why?” Once the error is found, students can work in partners to correct the solution and justify their thinking. When re-convening the students it is important to solidify the mathematical points made during the discussion. Not only will discussions of students’ errors clarify each student’s understanding, but it will build a culture of risk taking and a recognition that we can all learn from our mistakes.

Norris and Schuhl also suggest using a consistent sequence of questions with students when they are problem solving. When consistently using these questions, the students begin to ask themselves the same questions as independent problem solvers. Students’ answers to each question clarify their thinking, assist with a plan for problem solving, and help them to check for the reasonableness of their answer. A suggested sequence of questions is:

1st What is the problem asking?
2nd How will I solve it?
3rd Is this strategy working?
4th Does my answer make sense?

When effectively used, feedback provides students with accurate information about what they understand and can do, as well as areas where they still need to build proficiency. In the mathematics classroom, quality questioning is at the heart of effective feedback. Students should be clarifying their understanding, evaluating their work, finding errors, making corrections, and applying their learning to different problems.

When students are able to make comparisons between their work and the criteria for success, they are actually identifying for themselves what is working and what is not, as well as the steps they need to take for improvement. The goal of our standards is to produce students who are college and career ready, and feedback is one of our most powerful tools to help them get there.
Resources and References

www.justaskpublications.com/just-ask-resource-center/e-newsletters/msca/
learningtargets/


www.engageny.org/resource/released-2017-3-8-ela-and-mathematics-state-test-questions
This link features released questions from 2017 grades 3-8 New York State Assessments in English Language Arts and Mathematics. There are annotated anchor problems for math that are effective to use with students when comparing student work to indicators for success.

www.teachingchannel.org/videos/math-test-grading-tips
This video, targeted to mathematics in grades 6-12, illustrates the strategy of highlighting mistakes in lieu of assigning grades. Through the use of this strategy, students are learning from their mistakes and strengthening their math understanding rather than focusing on the “grade