LOOK FOR in the CCSS Mathematics Classroom

TOOL
USER DOCUMENTATION

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LOOK FOR *in the CCSS Mathematics Classroom*

No evidence of GPSing by teacher, written word, or peer

No evidence of Cold Calling—instead, students are given study time

No evidence of the game—*Guess, What's in Your Teacher's Head*?

Evidence that assignments are given in writing—no matter how small—and remain visible for the duration of the assignment

Evidence that student reasoning is written down and posted for all to see with the students' names attached

Evidence that other students are called on to read and critique their peers' reasoning

Evidence that students are given feedback designed to move their learning forward

Evidence that students are activated as instructional resources for each other—look for the special impact of grouping students with common issues together

Evidence that assignments that depend on reasoning and communication are given: all students have the opportunity to critique the reasoning of others

Evidence that early finishers are given worthwhile extensions designed to move their learning forward

Evidence that students are given the opportunity to learn *when* to use a particular skill as well as *how* to use it

Evidence that the teacher works directly with a struggling student to turn him or her into an expert on something, no matter how small

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What to look for in the CCSS mathematics classroom

This *Look For* tool is designed for teachers and administrators to use as teachers grapple with the complexity of transitioning their teaching toward a classroom practice that better provides opportunities for students to learn the mathematics specified by the common core. The intent is that teachers use this tool as a support as they move away from some deeply ingrained practices, and that administrators use this tool as they carry out observations of teaching practice.

What is GPSing, and why should mathematics teachers avoid it?

When I talk about GPSing students in a mathematics class I am describing our tendency to tell students—step-by-step—how to arrive at the answer to a mathematics problem, just as a GPS device in a car tells us—step-by-step—how to arrive at some destination.

I coined this metaphor as a tool to aid teachers (professional learning facilitators, professors, or parents) to reflect upon their teaching. A GPS device is usually convenient in helping us get to our destination—we key in an address and the step-by-step

instructions guide us to it, often painlessly, passively, and without struggle. If for some reason, we fail to follow a given instruction, the GPS will usually provide additional step-by-step instructions that will guide us to self-correct and arrive back on a productive route.

I noticed that when I used a GPS device to guide me to some destination, I usually arrived at my destination having learned little about my journey and with no overview of my entire route. I also noticed that I had a tendency to become dependent upon my GPS and that this led to a lot of trouble when, for some reason, my GPS malfunctioned and did not guide me to my desired destination. My dependency kept me from learning the kinds of things that would have enabled me to repeat the journey without a GPS: figuring out the reverse journey, finding shortcuts, planning analogous journeys, explaining my route to a friend, or even self-correcting when I ran into trouble. In short, all the benefits and learning that came from studying the route beforehand, downloading a map, and planning out a possible route were traded away for the convenience of my GPS.

In the same way, when we give students step-by-step instructions that will enable them to arrive at the answer to a math problem, we are trading away their opportunity to learn mathematics. These step-by-step instructions usually create a dependency on the teacher that robs students of the opportunity to learn how to develop their own solution path that will lead them to the answer to the problem. In turn, students' dependency on step-by-step instructions robs them of the opportunity to learn the underlying mathematics that they need to learn in order to become college ready. In fact, it prevents students from building the understanding that they need to build in order to learn the mathematics that they need to learn. The CCSS outlines the shortcomings for students:

Students who lack understanding of a topic may rely on procedures too heavily… may be less likely to

- consider analogous problems,

- represent problems coherently,
- justify conclusions,
- apply the mathematics to practical situations,
- use technology mindfully to work with the mathematics,
- explain the mathematics accurately to other students,
- step back for an overview, or
- deviate from a known procedure to find a shortcut.

In short, a lack of understanding effectively prevents a student from engaging in the mathematical practices. (CCSS page 8)

When students are provided with step-by-step instructions that are designed to guide them to an answer, we say that they have been GPSed. Instead of GPSing students, the CCSS calls on us to provide students with the opportunity to learn how to develop solution paths through worthwhile mathematics problems and arrive at the correct answers.

There are many ways in which students can be “GPSed” in a math class; the three most important are:

- GPS by Teachers: The teacher tells the students what to do, step-by-step.
- GPS by Text: The assignment is written in such a way as to break a multi-step problem down into discrete steps and provide step-by step instructions.
- GPS by Peer: Students are grouped heterogeneously so that students who are perceived as not struggling tell students who are perceived as struggling what to do, step-by-step.

In each of these cases, the student who really needs the opportunity to learn is deprived of the opportunity to develop a solution path, and instead becomes dependent on his/her teacher, text, or peers to dictate a solution path that will lead him or her to the answer.

In order to learn mathematics and emerge as college ready, students need to be given the chance to develop solution paths to worthwhile problems by grappling with complexity. If the student is just doing what the teacher says, or imitating the teacher, then the student will be robbed of the opportunity to learn.

What is Cold Calling, and why should mathematics teachers avoid it?

Cold calling is asking students to respond to a question without giving them time to think, to study, or to make sense of the situation. If our questions are worth asking, then our students need to have time to think about how they might respond to them.

Before students can feel secure enough to contribute to a discussion or answer a question they need to be able to study the question or assignment, have the opportunity to discuss with a partner—in short they need study time.

What is the game, *Guess What’s in Your Teacher’s Head?*, and why should mathematics teachers avoid it?

We often ask students questions and then fish for a particular answer—when we do this we are engaging in the game called *Guess what’s in your teacher’s*

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head?" We do this when we want to elicit evidence from students that they have learned what we have taught them. The least useful versions of this game result when we fish for a particular piece of vocabulary.

Here is an example of the game, *Guess what's in your teacher's head?*

> A teacher writes the following on the board:
>
> 8/12, 6/9, 10/15
>
> Through conversation at least some students notice that these fractions all represent 2/3.
>
> Then the teacher asks, "What do we call this?

In this class the students provide a number of answers—fractions, equivalent fractions, ratios—that appear "right enough" to me, but none are the word that the teacher is looking for. Students continue with other offerings—equation, function, similar —words that appear "not at all right" to me. As I observe, I wonder if the teacher is hoping to elicit something as specific as—*equivalent ratios* or *constant ratios*— from his students. But when the teacher says, "Let me give you a hint—it begins with *p,"* I realize that I too am "not at all right." I realize that I must stop grappling with the mathematics, and instead try to figure out the word that the teacher is hoping to hear from his students. I fail. When the teacher shares the word, I remember that I was never any good at this game.

Asking questions is a worthwhile learning tool, but fishing for a particular word or phrase is not. Instead of fishing for a particular answer, a teacher might ask students, "What comes to mind when you see 8/12, 6/9, 10/15" and then quickly jot down the student insights, organizing them in a fashion that will give him some formative information as to how he might adapt future instruction.

It is important to avoid playing this game with students because it distracts their energy and attention away from the real mathematical work that will help students learn, and instead focuses their attention on wild or random guess of the word that they think the teacher wants to hear.

Evidence that assignments are given in writing—no matter how small—and remain visible for the duration of the assignment

When teachers provide written records of their questions or assignments, students can revisit these as often as they need in an attempt to figure out what it is that the teacher is asking them to do. Sometimes, it is difficult for students to understand what a teacher is asking of them when the instructions are provided verbally. The written record allows students to re-read their teachers' instructions time and time again, and so the written document provides an important *scaffold* for students. Moreover, if some forget what they were asked to do they can look at the written record and get back on track. With the questions or assignments written and visible, students with stronger language skills can be asked to read these instructions aloud, paraphrase these, and even translate them into their own language. Finally, written instructions provide an important scaffold to the cognitive demand of the question or assignment.

Evidence that student reasoning is written down and posted for all to see with the students' names attached

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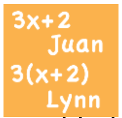

By writing up what students say—for all to see—we represent in a written form what the student has uttered verbally. In turn, this written record calls for some form of re-voicing of the student's utterance. This is helpful for students, who might be struggling with English, because they can refer back to information provided by their peers and learn how others verbalize information. This also ensures that student comments are represented in multiple ways:

- Verbal utterance
- Re-voice by teacher or peer
- Written documentation of student's initial utterance with his or her name attached

When these utterances are recorded and kept visible for the duration of the lesson, they will be available to the teacher and she/he will be able to reference them as the lesson moves forward. For example, I was recently in a classroom where students were ordering fractions and Milton, a student, said the following:

Milton; I think that 8/10 is smaller than 3/4 because 8/10 is two away from a whole but 3/4 is only 1 away from a whole.

It was clear that all of the other students, with one exception, agreed with this erroneous statement. The teacher wrote Milton's comment on chart paper and invited all students to prove or refute the belief that 8/10 was smaller than 3/4.

When Christopher argued that 8/10 was bigger than 3/4 the teacher wrote up his explanation as follows:

Christopher: I think that 8/10 is bigger than 3/4 because 8/10 is equivalent to 4/5.

The teacher kept this running record of all of the students' comments and brought them into the students' focus as the lesson progressed. Thus, the teacher provided an important scaffold for students because she made the cognitive demand of the lesson accessible.

Evidence that other students are called on to read and critique their peers' reasoning

With Milton's and Christopher's arguments recorded for all to see, the teacher could call on other students to say why Christopher's argument helped prove that that 8/10 is bigger than 3/4. If these important student-generated statements had not been recorded it would have been hard for anyone —even the teacher—to keep track of what was said and work with what was said in a way that would support students' reasoning as the lesson progressed.

Also, when it became clear that almost the entire class agreed with Milton, the teacher saw that she had surfaced a common misunderstanding that was not going to be easily dislodged. Thus it was important for student learning that, when the entire class had changed its mind and agreed with Christopher that 8/10 was indeed bigger than 3/4, the teacher explicitly revisited Milton's explanation.

When the teacher records what each student says in a written form, the teacher is actually creating a "map" of student reasoning. For students, this map scaffolds the cognitive demand of a whole class discussion and allows them to build on and revise earlier statements. Thus, students have access to mathematics and are supported in critiquing the reasoning of others.

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Evidence that students are given feedback designed to move their learning forward

Feedback can be effective when it causes students to think more deeply about the mathematics that they are learning. Let's go back to the case where most of the students in the 5th grade class believed that 3/4 was greater than 8/10. The teacher's challenge here was that, although Christopher *could* generate equivalent fractions, he did not use this skill to straightforwardly order the fractions. In other words, he did not generate equivalent fractions with common denominators and so justify that 8/10 was indeed bigger. When Christopher showed that 8/10 was equivalent to 4/5, the teacher grabbed this opportunity to give students feedback that would cause them to think more deeply about their common misconception that 3/4 was bigger than 8/10 because 3/4 was only 1 piece away from a whole. The teacher asked students if they would compare 4/5 and 3/4 rather than 8/10 and 3/4, and such feedback gave students reason to pause and realize the need to rethink their mathematics.

Feedback is powerful when it is used to inject conflict into student reasoning.

Evidence that students are activated as instructional resources for each other—look for the special impact of grouping students with common issues together

Activating students as instructional resources for each other is something that goes beyond group work or collaborative learning—it really refers to the grouping of students that fosters each student's opportunity to grapple with complexity. Grouping students together that are struggling with a common issue can have the impact of allowing all learners wrap their arms around the problem and resolve the issue. For example, when students were attempting to show that ¾ was bigger than 8/10, it was important that all students were given the opportunity to take a position and justify it—no student had to go along with another because student because they happened to be working with the student that was "good at math."

Evidence that assignments that depend on reasoning and communication are given: all students have the opportunity to critique the reasoning of others

There is a growing evidence that attempts to make math easy for struggling students actually makes it harder for struggling students to learn math. In other words, evidence suggests that while remediation does not work, acceleration does work. If some students can rip through classroom assignments without a struggle, then this shows that these students are being robbed of the opportunity to learn. By the same token if some students are so stumped by the assignment that they cannot make any meaning out of it, then they are too being robbed of the opportunity to learn. The classroom is a place for learning and research shows that students cannot learn unless they are engaged in a productive struggle with mathematics.

Evidence that early finishers are given worthwhile extensions designed to move their learning forward

Not all students learn math at the same rate. When some students finish early—they must be assigned an extension that is going to cause them to think more deeply about the mathematics that they are studying. Recently I was in a 5th grade class where some students finished their work earlier than most. The teacher was not at all daunted, and pulled out a Magic Square with Fractions and offered it to the

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early finishers. The early finishers appeared to be having so much fun with the Magic Square with Fractions that they motivated other students to focus and wrap up their assignment.

Evidence that students are given the opportunity to learn *when* to use a particular skill as well as *how* to use it

One of the most striking concerns of most educators is the difficultly that students have in learning when to use a particular skill or how to use a particular skill to show, justify, or prove something. When Milton and another 18 of his classmates all decided that 3/4 was bigger than 8/10, they had an awful lot of trouble convincing their teacher than they were correct. These students believed that they could prove their point by drawing diagrams. It soon became clear that they could not, in part because they could not use an understanding of fractions to make accurate diagrams. Christopher, on the other hand, did not use equivalent fractions to convince his peers that 8/10 was bigger than 3/4 because he did not generate equivalent fractions that had common denominators. Our challenge becomes that of figuring out how to teach students how to reason with the procedures and skills that they have in their toolkits.

Recently I visited a Grade 4 class where the students could add and subtract multi-digit numbers, but did not know when to add or subtract. I posted a word problem and asked students to figure out how to get started. I asked if students had any questions—one student asked: Do we add or subtract? I said that was what they had to figure out. After a short time working on the problem, one student asked if I wanted them to do the problem in a different way. I was delighted and noticed that she had added correctly to give the correct answer—when I asked the student to explain her two solution paths—she said. *In this I added and then in this I subtracted*. I asked why she had subtracted? She said this: *I subtracted because you said that I could do it in a different way.*

Evidence that the teacher works directly with a struggling student to turn him or her into an expert on something, no matter how small

Recently I was in a Grade 7 math class where students were engaged in the **Whole class Interactive Discussion** component of the Shell Center's Formative Assessment lesson, *Proportion and Non-Proportion Situation*. The prompt was straightforward:

> 10 ounces of cheese costs $2.40   Ross wants to buy ___ ounces of cheese.
> Ross will have to pay $ ___

Students had to fill the blanks using easy numbers and then fill the blanks using hard numbers. The teacher worked with her most struggling student, Maribel, with the goal of making Maribel an expert. The teacher then asked Maribel if she could call on her when she was collecting student solutions. Maribel agreed. When Maribel participated, she was barely audible and the teacher repeated what Maribel had said and wrote it on the board. The teacher then asked the class: Who agrees with Maribel? All students raised their hands. Even though it was clear that all students agreed with Maribel, the teacher asked: Who disagrees with Maribel? No students disagreed with Maribel. The whole purpose of this type of tactic is to create opportunities for struggling students to experience themselves as competent learners.