



by Joshua Zucker

Be Less



A butterfly that has just completed its metamorphosis must struggle very hard to emerge from its chrysalis. And there is an important reason for this natural struggle. Fighting to get out is a key exercise that strengthens the butterfly's new wings enough to fly. In fact, if someone were to attempt help the butterfly out of its cocoon, bypassing the uncomfortable but essential struggle, its wings would remain soft and weak and it would never fly. Similarly, as teachers, we all want to help our students, but, at times, being too helpful is precisely what hurts them most. Here's why we must try to

Helpful

At their worst, too-helpful teachers replace problem solving with guessing. Students offer some possible answers and then, once the teacher tells them which one is correct, the students write that down and go on to the next problem. They're learning that having the right answer is what matters, and becoming dependent on the teacher to tell them when they have it.

It can even be too helpful when the teacher offers a suggestion like, "Try the distributive property." The teacher feels helpful, the student feels helped, and everyone feels happy, until the next problem comes, and the next, and the student still doesn't know how to start without the teacher pointing in the right direction. "This is much easier to avoid when you can escape the culture of 'how' and 'what' questions and move toward 'why' and 'what if,'" research mathematician James Tanton said.

Of course, at the other extreme, there are teachers who simply lecture and then leave the students to do the work all on their own, without any help. These teachers probably need to learn how to be more helpful. But then, that sort of teacher probably isn't reading this newsletter! For most of us, the much bigger danger is giving in to the temptation to be more helpful rather than making the students think as much as possible for themselves.

The Search for Perplexity

Stanford University's Dan Meyer has a well-known blog, "dy/dan," with the motto, "less helpful." What does this mean, and why is it a good thing?

To be less helpful sounds like bad advice on the surface, and maybe that's why it turns out to actually be good advice: it makes you stop and think. Dan Meyer points in the direction of "perplexity," which is the feeling of puzzlement that makes you want to work something out (as opposed to confusion, which is when you feel like you have no tools at all to figure out what to do next). We want to be less helpful, not unhelpful, so it's important to give students the strategies to deal with their situation while making sure that they have real work to do. For example, rather than telling them, "Try the distributive property," we could ask them, "What form would you like this expression to have?" and make a connection to the very general strategy of wishful thinking.

To be the least helpful of all, we can indeed leave the student or the Circle to solve the problems, but we can also have them create the questions. "It takes only a few minutes to let them form their own questions," says Tatiana Shubin of San Jose State University. "This is an area where mathematicians can really contribute to a MTC. When circlers form their own questions, mathematicians are in a position to see whether they are leading toward something deep and interesting."

A Productive Classroom

Alan Schoenfeld of UC Berkeley calls a classroom in which the teacher is not too helpful a "productive classroom," and points out that being less helpful means placing more of a cognitive demand on the students. Students may fight back if they're not accustomed to this, and press the teacher toward being more helpful, and possibly too helpful, but it's quite clear that this natural reaction leads to less learning. Schoenfeld has done substantial work on this question in collaboration with Bob Floden at Michigan State University and others and ended up with five key questions and a rubric to evaluate how successful the classroom environment is in producing mathematical thinking by the students.



- **Mathematical content:** Is it all skills and procedures, or is there significant attention to concepts and connections? This ties in well with the mathematical practice standards of the Common Core State Standards.
- **Cognitive demand:** Is there “productive struggle” or “perplexity” on the part of the students, or are things broken down into steps so small that the students never have the opportunity to make an effort?
- **Access:** Is everyone involved, or could only a few students participate while others spectate?
- **Agency:** Is the teacher the authority, the source of information, and the judge of quality, or are students also involved in explaining their thinking and responding to other students’ ideas?
- **Assessment:** Is there continuous use of student reasoning to advance the discussion and sometimes alter its path, or is the feedback limited to a correction when there is an error? Or, even worse, is student reasoning not elicited at all?

In the worst case, classrooms fail to meet any of these goals. Paul Zeitz at the University of San Francisco calls this the “foie gras method.” “That’s when we stuff the subject with material and then test how well they can excrete it at a scheduled time,” Zeitz said. “We’re trying to avoid the stuffing and regurgitating. We want to teach people to be brave, to engage with hard questions, and to be willing to flail around.” In Zeitz’s book, “The Art and Craft of Problem Solving,” one section leads with the epigram “The explorer is the person who is lost.” Zeitz explains, “We want to teach people to be happy to be lost.”

Creating Mathematics For Themselves

Math Teachers’ Circles help us learn to enjoy being lost. Our sessions focus on mathematical content, concepts, and connections. We emphasize perplexity, giving problems that are challenging enough to eliminate boredom and accessible enough to avoid frustration. We wait, giving time to think, so that every participant can get involved and they can respond to each other. “The participants need to feel like they create the mathematics for themselves,” Tanton said. “We set the stage, and while we may enjoy performing, it has to be their experience.” We come prepared with more material than we could possibly use in a session so that we can move flexibly in the direction that the participants choose. We show our love for the

mathematics, but for participants to fully appreciate the beauty of it, they must find it for themselves.

We’ve always known that a problem-solving focus with rich mathematical content does us no good if it’s the mathematician or teacher doing all the solving with the participants as spectators. In MTCs, we refer to “session leaders” rather than “presenters” or “lecturers,” to make the role more clear. We emphasize that they should be sure to give the participants time to think. Now we can add a reminder for session leaders: Be less helpful! Create a cognitively demanding classroom! Allow your students to fight their own way out! It is only then that they will be able to fly. 🦋

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Tips to Remember

- **Give students/participants enough time to think and deduce.** Don’t give away too much too soon.
- **Let participants generate the questions.** This creates engagement in, and ownership of, the investigations that follow.
- **Encourage perplexity.** Give problems that are challenging enough to eliminate boredom, yet accessible enough to avoid frustration.
- **Be prepared to only get through a fraction of your material.** Let the participants’ interests and questions dictate the direction the session goes.
- **Focus on more general strategies.** Give non-specific hints rather than giving answers away.

Links and Resources

[dy/dan](#). Dan Meyer’s mathematics blog.

[Floden-Schoenfeld Algebra Teaching Study](#).

[The Art and Craft of Problem Solving](#). Paul Zeitz.

For links to these resources and more, visit us online at <http://mathteacherscircle.org/resources/sessionmaterials.html>.