Teachers: How to Help Stu

by Catheryne Draper

Comments from students like "Oh, I see" are like music to many math teachers. Besides using models such as algebra tiles and place value blocks, patty paper and counting sticks, what else can help students to see the math relationships and patterns? This is a good question with a not-so-simple answer. We know that constructivism encourages students to build their own knowledge base and we also recognize that tactile materials help students move math models so as to view relationships in their own way. Too often these are not enough to get some students to understand the math so what else can we do?

Maybe asking students to classify, sort and organize information may help. The process of classifying requires that the student make some decisions about the information. Even if the decision is simplistic, the student is creating a mental place for the information to be "stored" or, in brain language, generating a memory path. Of course we want a high level of sophistication for these memory paths but we must start small if the students are not used to being asked to sort and re-sort.

Replacing the typical instruction of how to "do" a problem with a classification or re-organizing type of presentation sounds simple but the implementation isn't. Very often, this change of focus requires an equivalent change in our view of the way math was and has always been taught - in other words, how we were taught.

If instruction the way it has "always been" worked well then we would not have a nation filled with math phobics and repeater classes, therefore let us consider another option. Let the students start doing some of the work by classifying and organizing and reorganizing, the information.

What can this classification and organization focus look like? First, it starts with the kinds of questions that teachers ask. At the very least, stop using questions that ask for an "answer." Instead, ask questions that seek several options for responses so that students start thinking about relationships and stop looking for one right answer. The more students participate by thinking about the math relationships, the better and more efficient their mental pathways get. This effort to change is not easy for those of us who have been conditioned by right answer mathematics but it is very worthwhile.

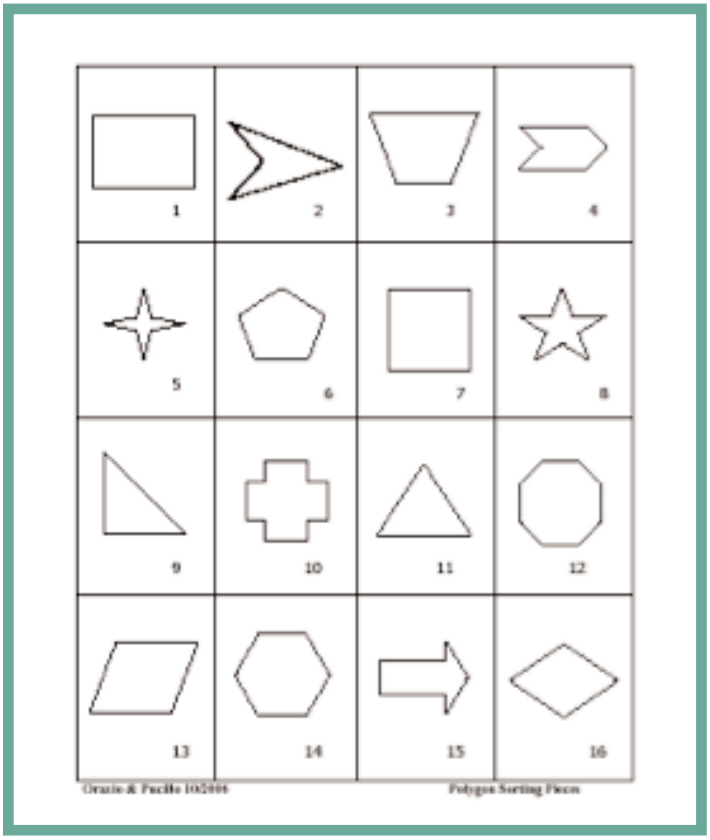
If students have models then they can either individually or in a small group try some options by moving the models before responding; if students do not have models then they really should be in a cooperative group so that they can talk about what these options could be before announcing them to the class. Students need to be trained that it is OK to have an opinion in a math class and that the "right answer" is not always the goal. An accurate calculation is always the desired result but we teachers are not getting the best results from just asking for "right answers." The good news is that this measure of our US status has been changing since the TIMMS results were published in 2003!

At the K-3 level, students should be asked about patterns so that they can classify by number totals in the addition or multiplication tables instead of being subjected to timed tables testing. All question stems need to encourage students to rely on themselves for appropriate responses rather than on the teacher or the book. Yes, answers are in the back of the book and 5 x 4 will always be 20 but skills such as problem solving or classifying are far more important. As an example, the number 20 can be a category that contains expressions such as 2 x 10, 1 x 20 as well as 5 x 4, plus the addition expressions such as 15 + 5, 10 + 10, 14 + 6 and all the rest of the related addition problems. We cannot forget the 40 ÷ 2 and 100 ÷ 5 options for expressing 20 when the time comes for division calculations. The idea of classifying and sorting is related but not limited to the familiar fact families. The objective is to allow students to develop a sense of internal self assessment for what makes sense about learning by employing classification skills and that getting "right answers" is really more about calculation than about the burden of rightness.

Instead of repeating what the K-3 grades presented for students who did not understand the material, let us try encouraging students at grade 4-6 levels to sort and classify as is illustrated in the work that Leominster teachers have been doing over the past few decades. An example of a classification Sort is represented on the right page. Others that have been developed by and for teachers are available for download at http://www.leominster.mec.edu/pro-dev.htm. This fraction, decimal, percent Sort illustrates how using the same symbolic notations and changing only the presentation into a classifying or matching activity can be achieved.

How to question students and steer them in the direction toward seeing their own way for learning mathematics has been given increased emphasis for the past several years. The National Council of Teachers of Mathematics publication Principles and Standards for School Mathematics has provided many options for question stems in both the 1989 and the 2000 publications. Some of the better classification stems are: "How else could you organize?", "What is similar about?", "What is different about?"

udents "See" Mathematics



Middle schools and high schools are not exempt from the benefits of classification, organization and categorizing through what could feel like to students to be a learning maze of algebra and geometry topics. Far too often our students get to high school without "the basics" and then are left adrift or worse, required to rote memorize yet again what they didn't remember from what they memorized earlier. I have seen the miracle of the staying power that the process of classifying does for students, especially the students who didn't understand the original presentations. It works for several reasons, only one of which is that the other techniques didn't work and don't make sense to students. You can classify anything if you have enough information.

The Algebra Game program is an example of having enough information to classify. The program has a total of 22 decks separated into four Topics - Linear, Quadratic, Conic and Trig. A total of 48 examples of linear equations is available to classify by slope, by y-intercepts or by equation depending on the specific mats provided. The same is true for quadratics, conics and trig just using different applicable characteristics of these equations. Instead of slopes, the Trig Set has amplitude cards that have a similar impact as slope cards do for Linear Graphs. Students have enough examples with which to sort, classify, categorize and organize their way to seeing as many relationships and connections as they can.

A friend of mine recently reminded me of what I had said several years ago - "kids who are visual learners just process differently, they think about things in a way that is so different from others." At the time I was becoming more aware of the myriad of ways that students "see" not just with their eyes. I am still awed at the sheer magnitude of different ways that students "see" mathematics, only some of which are measured with visual instruments. Since knowing all of the ways for all kids to see is not a "countable set" then maybe it is more efficient for us teachers to steer them with classification questions so that they can "see" what they need to see on their own terms in order to understand.

Resources:

- The Algebra Game: Linear Graphs, Quadratic Equations, Conic Sections, and Trig Functions, © 1989, 1997, 2005, 2007 http://www.mathstudio.com and click on the appropriate icons.
- Leominster Public Schools, Leominster, MA, Available for download at website address: http://www.leominster.mec.edu/prodev.htm and click on "Sorts".
- Principles and Standards for School Mathematics, NCTM, © 2000, Reston, VA http://www.nctm.org
- Lampert, Magdalene, and Paul Cobb. "Communications and Language.". A Research Companion to Principles and Standards for School Mathematics, NCTM, © 2003, Reston, VA http://www.nctm.org

Catheryne Draper started The Math Studio 25 years ago because she wanted to focus on the tactile and visual pedagogy for teaching mathematics to all grade levels. She had already been a high school math teacher, a district and state supervisor, a math editor, and a consultant for math education professional development. Since opening the doors of The Math Studio, she has welcomed the opportunity to teach all grade levels from Kindergarten through college plus serving as a math coach, professional development trainer, materials development, and assessment item writer.