Where to Focus so Students Become College and Career Ready

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What should guide the content of math and numeracy instruction with seemingly competing priorities from federal and state legislation, research, adult education program demands, and from our learners? Do teachers focus on workplace skills, college-readiness skills, the College and Career Readiness Standards for Adult Education (CCR), or high stakes assessments? Considering the math levels of so many of our adult learners, I believe that teachers can focus on all of these competing demands at the same time, but only if they teach their students how to reason mathematically, and ensure that they have a solid conceptual foundation so that they can apply that knowledge and reasoning to any new situation that arises.

Unfortunately, teachers feel the need to swiftly get students to meet goals and expectations, whether it is passing the test, mastering a CCR Standard, or preparing for college or training. Teachers may hear that 'trig' is now on some of the high stakes assessments and suddenly they feel a need to teach their students some basic trigonometry procedures. Or, they notice that the CCR Math Standards at Level E include factoring of quadratic expressions, so they feel that they need to teach their students procedures associated with that content. Unfortunately, too many teachers feel like they don't have the time to give students the foundation that would allow their students to actually understand what is being taught. They may teach students procedures and tricks, hoping that they will retain those procedures long enough to at least pass the test.

However, without foundational understanding, students rarely remember those procedures. How many times have teachers shown students how to add fractions with unlike denominators, only to discover a few weeks later that students have already forgotten the procedure? Or, they watched students apply the procedure for adding fractions when faced with a proportion problem? As a result, teachers reteach the same procedures over and over again, rarely successfully getting their students to understand when to use those procedures. According to Givvin, Stigler, and Thompson (2011):

> Without conceptual supports and without a strong rote memory, the rules, procedures, and notations they had been taught started to degrade and get buggy over time. The process was exacerbated by an ever-increasing collection of disconnected facts to remember. With time, those facts became less accurately applied and even more disconnected from the problem solving situations in which

> they might have been used. The product of this series of events is a group of students whose concepts have atrophied and whose knowledge of rules and procedures has degraded. They also show a troubling lack of the disposition to figure things out, and very poor skills for doing so when they try. This leads them to call haphazardly upon procedures (or parts of procedures) and leaves them unbothered by inconsistencies in their solutions. (p. 5)

Although Givvin et al. (2011) were referring to students supposedly ready for developmental education classes, most practitioners would say that the description would readily apply to the vast majority of learners in their own adult education classes.

Teachers think that they don't have the time to spend on conceptual understanding of core concepts. But, perhaps teachers need to reconsider what it means to be college and career ready, and what it means to have a core set of skills that allow learners to meet the demands of both academic and life priorities. The National Center on Education and the Economy (NCEE) asked: *What does it really mean to be college and work ready?* They conducted a two-and-a-half year study to try to answer that question. What they discovered is most of the math that is required of students before beginning college courses and the math that most enables students to be successful in college courses is not high school mathematics, but middle school mathematics. Ratio, proportion, expressions and simple equations, and arithmetic were especially important (NCEE, 2013). In other words, if we could help our students develop strong math skills at levels A through C/D in the CCR, they would be well-prepared to tackle college level classes or even ready to succeed in training required at the workplace.

And, according to *Redefining College Readiness*, a report published by the Educational Policy Improvement Center (Conley, 2007), college success requires key cognitive strategies such as analysis, interpretation, precision and accuracy, problem solving, and reasoning. Students who are ready for college possess more than a formulaic understanding of mathematics. They are able to apply conceptual understandings in order to extract a problem from a context, use mathematics to solve the problem, and then interpret the solution back into the context. While these skills are specifically called out for college readiness, I doubt anyone would argue that they are not also critical for dealing with life issues and work situations. In other words, students need to have strong reasoning and problem-solving skills for success, not just know a bunch of procedures.

Perhaps it is not only that teachers claim that they don't have enough time to prepare their students for multiple goals. Maybe there is another issue involved. Certainly it is not a lack of commitment or caring on the part of our adult education teachers. However, so few have learned math conceptually themselves. It is rare to find a practitioner who not only understands the procedures herself, but also knows how to teach that understanding.

Compounding the problem, says Ma (1999), in the United States, it is widely accepted that elementary mathematics is "basic," superficial, and commonly understood… Elementary mathematics is not superficial at all, and anyone who teaches it has to study it hard in order to understand it in a comprehensive way" (p. 146). If teachers think that elementary and middle school math is "basic," it might explain why so little time is taken to ensure that our students (including our adult learners) really do understand what those elementary principles are.

Taking into account a widespread attitude that the "lower level" math is easy (and therefore able to be reviewed quickly) and the number of teachers with limited knowledge of how to teach math, adult education is hard-pressed to get students to reach any of the conflicting goals and expectations. However, if students had a strong foundation of math concepts, they would be able to transfer their understandings to the workplace, to tests, and to situations involving math in their lives. If they are only taught procedures, how will they ever know when to use them on the job or in a college class or on a test?

Teachers should ensure their students have a strong conceptual foundation before launching into "higher level" math. Too often, the students have incomplete mastery of "middle school" math and could use more than just a quick review. Teachers would do well to adopt strategies to strengthen foundational knowledge, such as probing number sense or asking students to predict what an answer will be BEFORE having them jump to the formal calculation. Students who learn to question the logic of their answers are more likely to intuit that the solution to a problem like 5/6 + 1/2 must be larger than 1, since 5/6 is greater than 1/2. In contrast, a student relying on an incorrectly internalized fraction addition procedure might arrive at an answer of 6/8 —an answer that would stand out as incorrect to a student with solid number sense.

What are some ways that teachers can begin to teach more conceptually so that their students can at least develop some solid skills at the elementary and middle school level while developing mathematical reasoning at the same time? Here is a sampling of ideas, which are based loosely on the CCR Math Standards:

- Introduce the concept of the benchmark ½ (along with its equivalents .50 and 50%) to students who are at Level A. Knowing ½ is more important than knowing how to do long division.
- Build on those benchmarks very slowly —still at Level A, ensuring that students really do understand. Have them apply those benchmarks to data where they can begin to reason critically about simple data representations (beginning with two categories and building to three or four).
- Teach estimation strategies early on and expect students to use them in everything they do, not just when it's covered in a particular chapter of the book.
- Begin to introduce the concept of proportional reasoning early on by having students build in/out tables as a way to work on basic multiplication facts. Encourage them to discover patterns in the multiplication tables so they begin to see the relationship between different rows in the tables (i.e., 2 to 3, 4 to 6, etc.). Build on the in/out tables by having them begin to create graphs of those patterns. This anticipates the introduction of linear functions (which is middle school level math).
- At Level A, introduce the basic properties of operations and hammer those ideas home as students move from whole numbers to fractions. After all, the properties work just as well for fractions as they do for whole numbers and abstract algebra.
- At all levels, teach conceptually by helping students visualize what is happening. Often seeing a visual representation helps students to understand (and trust) a particular procedure that they have been taught.
- At all levels, ask students to reason about their answers. Don't listen for the right answer and then move on. Ask students—whether their answer is right or wrong—to explain their thinking. This will go a long way in helping them develop critical reasoning skills.

If teachers focused on these ideas, they would be preparing their students for all of the goals and expectations placed on them. Teachers who not just teach procedures but also conceptual understanding give students a foundation from which to add new knowledge. Students can make connections among math content. For example, if students can understand the idea that the area is the product of two numbers, then they can use that same understanding to visualize why two fractions multiplied together have a product less than either of the two fractions; and, they can use that same understanding to multiply binomials. Teachers then don't have to teach mnemonics such as FOIL (first, outer, inner, last) because students can apply knowledge built from whole numbers. Even if teachers do not get to the topic of binomials, students can use their foundational knowledge for new, more advanced topics. After all, math is not a series of disconnected topics but rather a coherent body of knowledge made up of interconnected concepts.

Teachers who contextualize number and operation sense are already giving students opportunities to practice using skills in the workplace, community, and home. Students might not know specific content needed for work, but students with the ability to apply their learning in different contexts will be able to use their math skills and reasoning in different work environments.

Those teachers who struggle to see how to teach math more conceptually and with more real-life applications should use any available opportunities to further develop their own teaching skills. Most of us were taught in very decontextualized, procedural-based classrooms. Therefore, teachers tend to teach as they were taught. And, if a teacher has spent most of her career in education, it is sometimes difficult to find examples of how to contextualize math lessons.

What can a teacher do to begin her own journey of learning how to teach math to ensure students succeed? Here are some questions teachers should ask themselves:

- *Do I try to provide students with real-life examples but can only seem to think of my own personal experiences in the kitchen?* Seek out opportunities to engage in workplace education and training environments. Minimally, it might be helpful for a teacher to observe how math is applied in an I-BEST or other integrated education and training initiative. Or, even better, to seize the challenge to co-teach in such an environment. Also, take time to have conversations with students about the kinds of jobs they now hold (or would like to) and where they use math within those contexts.
- *Do I tend to look for short workshops that will provide me with tricks on how to teach 'higher level math'?* If so, look for professional development offerings that include opportunities to explore math content in more depth to allow you as a teacher to become a learner for a while. Those quick tricks do not help the teacher, much less her students, develop understanding. And, without the understanding, math will continue to be a set of disconnected procedures to memorize.
- *Do I use the same scope and sequence that I used five years ago? Ten? Is it based on how I learned math – whole numbers first, then fractions operations (all of them in one unit), decimals, ratios, geometry, etc.?* If so, then you might want to explore the College and Career Readiness Standards in more detail to see how the domains (such as operations and algebraic thinking, measurement and data, geometry, and number sense) are integrated. Algebraic

thinking begins at level A and fractions also begin at Level A (under geometry where students visualize benchmark fractions). When designing lessons in number and operation, think about how and where someone might use a skill.

The real question we need to consider is not how to address competing priorities but rather how to help teachers develop their own understanding so that they can prepare their students for success, no matter what the goal or expectation. ❖

Donna Curry is an educator, curriculum developer, and professional development specialist with over 25 years of experience in adult education. For the past 20 years, she has focused on math standards development at the national and state levels. She has also worked on the National Science Foundation EMPower project and served as co-director for the NSF Teachers Investigating Adult Numeracy (TIAN) project. She co-developed and implemented the Adult Numeracy Initiative (ANI) project and Adults Reaching Algebra Readiness (AR)2. Most recently, she serves as director of the MA SABES PD Center for Mathematics and Adult Numeracy at TERC.

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