How technology can help develop academic language for Common Core math success

GUEST COLUMN | by Barbara Freeman

In 2008, the creator of the evidence-based HELP Math program, Dr. Barbara Freeman (that’s me), and the chief researcher, Dr. Lindy Crawford, wrote, “If a student cannot understand what is being said in math class, then it is difficult to move beyond the language to master math content and skills – no matter how gifted the student may actually be.” Academic language is the language of schooling, and it is the language through which school subjects are taught and assessed. In no place is this clearer than in the Common Core State Standards (CCSS), which give equal weight to both sets of standards: Mathematical Content and Mathematical Practice, and by doing so, emphasize the importance of language to content learning.

Students missing the academic language and relevant vocabulary to understand math content at grade-level find themselves at a severe disadvantage. Words are portals to a concept. To properly explain mathematics content, teachers are required to use technical language and teach their students to read, write, and speak in a specialized context. Textbooks—whether physical or digital—are also supposed to illuminate the technical language of math. Language may be viewed as both a means and an end: a means to construct meaning, participate in mathematical problem-solving, and communicate ideas. The end outcomes are the ability to think critically and increased math achievement. While the number of CCSS math standards is fewer, students are expected to have a deeper conceptual understanding and be able to construct viable arguments and explain their mathematical reasoning. Since the new assessments align closely with the CCSS, when the new Smarter Balanced assessment consortium and Partnership for Assessment of Readiness for College and Careers (PARCC) assessments are released in 2014-2015, students will be tested on these broader competencies.

Marzano and Pickering (2005) maintained that systematic instruction of key academic terms is essential, and that students receiving systematic vocabulary instruction are better able to read and understand new academic content by 33% more than those who do not receive
similar instruction. Many math terms are technical and new to learners (e.g., coefficient, tessellation), so are the symbols (e.g., > greater than, ∑ summation); others are deceptively familiar and have multiple meanings (e.g., scale, value), with the mathematical definitions being considerably more precise than their everyday meaning (Freeman & Crawford, 2008). Math content is typically taught and assessed using grammatical constructions (e.g., simplify the equation), cause-and-effect (e.g., if not x, then y) and metaphoric language (e.g., the size of a number is like a string) (Freeman, 2012).

Academic language includes vocabulary but is comprised of much more. Schleppegrell (2006) reminds us that in a school context, the language students need to make sense of is often abstract, technical, and information-dense. It is vastly different than language used in social conversation and situations. Mastery of academic language is not an easy task for any student. It is especially difficult for English language learners, students with learning disabilities and children who grow up in poverty. In these circumstances, the students may be missing the essential background knowledge, of which language is an essential part, to make sense of new information. The WIDA Consortium (http://www.wida.us/standards/eld.aspx) has excellent tools that describe the features of academic language and demonstrate ways of developing students’ language abilities within sample units (also see Marzano & Pickering, 2005).

Math lends itself beautifully to teaching and learning in a digital environment. To address the issue of teaching academic vocabulary, some publishers provide a dictionary alongside their instructional content that sometimes includes a read aloud feature; others provide supplemental worksheets or lists with definitions for words found within a particular lesson or unit. While such provisions represent a step in the right direction, this approach contrasts with HELP Math, which was designed from its inception with the dual objective of developing students’ math content knowledge and skills and improving students’ overall English literacy and comprehension.

Math concepts and academic language are concurrently developed throughout the instruction and interactivity – on every page – by synchronizing audio, video, text, and interactivity to create a visual connection between words, symbols, and meaning (e.g., corresponding vocabulary and pictures flash in sync with audio).

Thus, language is not treated as an add-on to the HELP Math intervention, but rather academic language and academic vocabulary are interwoven into the core of the instruction and the enabling learning environment. Given the fundamental shift in learning outcomes as represented by the CCSS and the new assessments, we expect that, in time, most publishers will need to move in this same direction.

The following is a list of a few of the research-based techniques embedded into the HELP Math learning environment and content. Some of these strategies are also found in various other digital math programs, games, and content:

- Visually representing math concepts/skills through pictures, diagrams, and graphs.
- Explicitly modeling and/or simulating math concepts/skills, with guided interactive practice, using virtual manipulatives and interactivities.
- Pre-teaching essential, high frequency vocabulary in context of the lesson’s content.
- Repeating key vocabulary in varied contexts, providing plenty of concrete examples.
- Factoring language load into the content delivery through scaffolding.
- Employing appropriate speech, sentence structure, paraphrasing, and pacing.
- Describing academic tasks, with attention paid to explaining academic language.
- Using curriculum mapping to organize and monitor students’ learning.

Not only can technology be used to exploit the visual and graphical richness of math content, but it can also be used to help students visualize connections between mathematical language, data, symbols, and models, which are essential to developing mathematical understanding and the academic language needed for math success.

---

References


---

Dr. Barbara Freeman is President and COO at Digital Directions International, a socially responsible, educational technology publisher of K-12 digital curricula and assessments in mathematics. Their evidence-based HELP Math program and the Math Learning Companion were created from her research. She is relentlessly committed to closing the achievement gap and believes resources must be accessible, addressing the specific learning needs of all underserved populations — and she’s dedicated to developing innovative digital programs and instructional tools to do just that. Visit [http://helpprogram.net](http://helpprogram.net)