Developing Language Skills in Mathematics

As you learned in the first module of this course, literacy has several key components. In the last module, we looked primarily at how comprehending texts and understanding text structure lay the foundation for critical thinking and learning, or formulating, new knowledge. In this reading, you will discover how language skills contribute to students’ literacy.

Common Core State Standards: Language

According to the Common Core State Standards (CCSS), mastery of language includes three domains:

- **An understanding of the conventions of standard English:**
  - standard grammar and usage in reading and speaking
  - standard usage of capitalization, punctuation, and spelling

- **The knowledge of language:**
  - the way language works in varying contexts
  - language choices that effect style and meaning

- **The acquisition and use of vocabulary:**
  - the use of context clues, word parts, or references to determine what unknown or multiple-meaning words mean
  - figurative language, relationships between words, and nuance
  - academic words and phrases, including the knowledge to find the meaning independently

The CCSS provide standards that break down the three domains so that throughout the K–12 years students develop increasing proficiency in language skills and
thereby improve their ability to express themselves through language by the time they graduate from high school. According to the CCSS Initiative document (2010), “The inclusion of language standards in their own strand should not be taken as an indication that skills related to conventions, effective language use, and vocabulary are unimportant to reading, writing, speaking, and listening; indeed, they are inseparable from such contexts” (p. 25).

Developing Vocabulary

Vocabulary development has always been an important educational goal. But the CCSS views vocabulary a little bit differently. As shown in the video, “SHIFT 6: Academic Vocabulary,” the CCSS considers three tiers of vocabulary:

- **Tier 1**: Basic vocabulary and words commonly used by students
- **Tier 2**: High-frequency and multiple-meaning words; useful words found across a wide range of domains
- **Tier 3**: Domain- or context-specific words

Although the Common Core State Standards recognize the importance of all three tiers, they put special emphasis on Tier 2 words because they are powerfully useful, often containing nuance and insight into an author’s purpose and meaning. In other words, Tier 2 vocabulary is essential for understanding Tier 3 key terms.

How do students develop vocabulary—and what is the role of CCSS in helping them do so? According to the Common Core State Standards Initiative website, the standards “expect that students will grow their vocabulary through a mix of conversations, direct instruction, and reading. The standards will help students determine word meanings, appreciate nuances of words, and steadily expand their repertoire of words and phrases” (CCSSI, 2011).
Strategies for Language in Math

The emphasis of the CCSS is to always begin with a text. Keep this in mind as you consider how to develop students’ language skills in a math classroom. In *Teaching Reading in Mathematics* (2002), Mary Lee Barton and Clare Heidema explain four unique challenges:

1. “conceptual density of a mathematics text
2. complex overlap between mathematics vocabulary and the vocabulary used in ‘ordinary’ English
3. varied use and a large number of mathematics symbols and graphics
4. a need to understand concepts embedded within other concepts” (p. 13).

The authors go on to explain that teachers may be tempted to “use informal terminology in place of the more formal mathematics terminology in a text” or to “eliminate the use of mathematics text except for the examples and exercises they contain” (Barton and Heidema, 2002, p. 18). But neither of these options helps to develop true literacy in math. Instead:

“Beginning in the middle grades, students should understand the role of mathematical definitions and should use them in mathematical work. Doing so should become pervasive in high school. However, it is important to avoid a premature rush to impose formal mathematical language; students need to develop an appreciation of the need for precise definitions and for the communicate power of conventional mathematical terms by first communicating in their own words. Allowing students to grapple with their ideas and develop their own informal means of expressing them can be an effective way to foster engagement and ownership” (p. 18).

Barton and Heidema (2002) lay out some guidelines for language (particularly vocabulary) development strategies:

- Provide students with explanations of symbols.
• Have students practice reading, constructing, and analyzing charts and graphics such as those in newspapers or other “real-life” texts.

• Teach students to use and create graphic organizers to “manipulate new ideas, to see how these ideas are related to what they already know, and to integrate their new learning into existing schema or revise that schema to reflect new understanding” (pp. 19-20).

Here are several specific approaches that might help you address language standards in your classroom.

**Concept Mapping**

Through concept mapping, students learn the meaning of key concepts. A concept definition map, for example, is a graphic organizer that allows students to describe what a concept is, compare the concept, describe what it is like, and give examples of it.

Either individually, in small groups, or as a class, students fill out the concept definition map around a specific term, such as *fraction*. The teacher explains that a definition should answer the questions:

• What is it? Does it fit into a larger category?
• What can it be compared to? Contrasted with?
• What is it like? What characteristics does it have?
• What are some examples of it?

After students have completed the concept definition map, they use the information to write a complete definition.

Here’s an example of a concept definition map:
**Verbal and Visual Word Association (VVWA)**

The VVWA is a graphic organizer that helps students create personal and visual associations with a new term, reinforcing the visual nature of math. As part of the process, the teacher selects an appropriate term.
Students create their own graphic organizers that look like the following:

<table>
<thead>
<tr>
<th>Word</th>
<th>Visual Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td>Personal Association or Characteristic</td>
</tr>
</tbody>
</table>

Students write the term in the “word” box. Then they write the definition or get the definition from the teacher and write it in the “definition” box. Next, they create some visual representation in the “visual representation” box. Finally, they make a personal association, example, or characteristic and put that in the final box.

For example, if the term is “acute triangle” and the definition is “a triangle with all angles less than 90 degrees,” the visual representation will be a picture of an acute triangle, and the personal association might be a picture of a piece of pizza. In the next reading, we will discuss the listening and speaking standards which support the student who is literate in all subject areas.