



TESOL Connections

Keeping English language professionals connected

Reading and Writing in STEM

by [Emily A. Thrush](#), [Teresa Dalle](#), and [Angela Thevenot](#)

The implementation of the Common Core State Standards (2010) in the United States has resulted in a shift from teaching discrete facts to focusing on the ability to read, comprehend, analyze, and apply information. With that shift has come a greatly increased emphasis on literacy skills across all subjects in the curriculum.

This article summarizes various means of integrating literacy skills in science, technology, engineering, and mathematics (STEM) classes and presented in professional development workshops. Development of literacy skills is particularly important for ELLs, who benefit from the interactive nature of the suggested activities, whether they are interacting with each other or native speakers. ELLs benefit from hands-on activities, cooperative learning, and literacy activities that stress fluency as well as accuracy.

Reading in STEM Classes

Content-area teachers are increasingly being held responsible for literacy development as students are being asked to read and write informational texts that can prove to be very challenging, especially at the fourth-grade level and up.

According to Chall, Jacobs, and Baldwin (1990), fourth grade is where many students start to fall behind. Why? Whereas texts in K–3 classes are often narrative, content-area textbooks in fourth grade exhibit the features of informational texts, including

- complicated syntax,
- less textual or language support (paraphrasing),
- longer sentence length,
- use of terms specific to content areas, and
- use of terms that carry different meanings in different contexts (e.g., *table*, *tie*, *pressure*).

Strategies for Teaching Reading

To help students approach complex texts, here are two very effective strategies:

- **Language Experience Approach activities:** Students experience something before they read and write about it. For example, students can go outside to look at leaves that have fallen before reading about the characteristics of deciduous trees (McCloskey & Davidson, 1989).
- **From graphics to text and back again:** Introducing a topic with a chart, graph, or other visual helps to set the scene and to remind students of what they already know about the topic (background knowledge). Then, as students read the text, or after reading it, they can create their own graphics to consolidate the knowledge.

Activities for Reading

Strip Story

1. Copy a short reading from the textbook or other materials and cut the text into individual sentences.
2. Each group of students gets one copy of the sentence strips to put in order.
3. One person from each group visits the other groups, reports back, and can revise his or her group's order.
4. Ask students to read the text, describe how they decided the order, and tell what contextual clues they used.

This activity results in students reading the text several times as they attempt to solve the puzzle. Comprehension checks after this exercise have shown high retention of the information. This activity requires some reading ability, and is best for students with emerging literacy. It can also be done with pictures, with students describing the sequence orally.

Jigsaw Reading

1. Cut a longer text into chunks of several paragraphs.
2. Give one section of the reading to students in "expert" groups of four or five. The members of the group discuss the reading to make sure they understand it.
3. Students number off from 1 to 4 or 5. All 1s get together, all 2s, and so on. Each new group should have one person from each of the "expert" groups.
4. Students in their new groups explain the main points from the section of the text that they read.
5. Afterward, students write or present orally a summary of the reading.

Teaching each other promotes more processing and memory of the information. For students with emerging literacy skills, the strips consist of one sentence, and can be accompanied by pictures.

Activities for Vocabulary Building

Bingo

1. Ask students to draw a grid, usually five by five.
2. Provide a list of words to write in the spaces and have students place the words randomly.
3. Read definitions while students mark off the appropriate words on their grids.

This is basically the same as having students match words with their definitions, but much more fun!

Four Square

1. Students draw a four-square grid on a piece of paper, as shown in Figure 1.

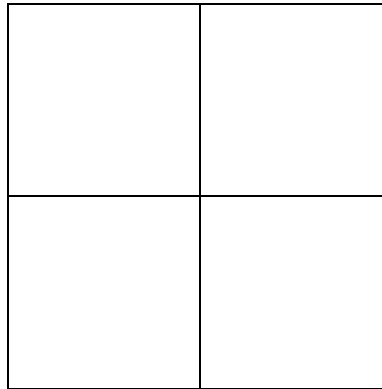


Figure 1. Four Square grid.

2. Have students write a vocabulary word in the upper left quadrant, one word for each group. Then, have them write their own definition for the word in the upper right quadrant, draw a picture in the lower left, and write a sentence containing the word in the lower right. Students who are in the preemergent stage can be assigned to draw the picture, while more advanced students write the sentences.
3. Students can work together to fill their grids, show and explain their Four Squares in groups or with the class, or keep a file of their squares.
4. Four Squares can be used in gallery walks. Draw grids on large sheets on the wall. Have groups choose a vocabulary word to write on their assigned Four Square. The groups rotate to the right and write the definition for the word written on that sheet. They rotate again and add a picture to the next square, and finally create a sentence for the next. Afterward, the students circulate to see what their classmates added to the squares.

Writing in STEM Classes

Constructed-response tests put a new emphasis on writing fluency—the ability to get ideas down quickly.

The kinds of writing frequently performed in STEM classes include

- quick writes, often on content-related topics to activate background knowledge;
- responses to questions to review material;
- journal writing for reflection;
- reports, such as lab reports or research reports;
- process writing on an experiment;
- technical descriptions of tools, machines, or processes;
- explanations of processes;
- instructions;
- problem-solution papers; and
- explanations of graphs, charts, and tables.

Activities for Teaching Writing

Power Writing

1. Give students an important vocabulary term or question that has already been addressed in the class.
2. Instruct them to write as much as they can for 60 seconds, usually in a dedicated writer's notebook. For students with limited literacy, this writing can be in the form of words rather than complete sentences.
3. At the end, have them count their overall number of words and tally it.
4. Have students repeat this procedure two more times, with a new related vocabulary word or question each time.
5. For each session, they graph the highest number of words they wrote in any 1-minute period. Have students set goals for the number of words they will write next time.
6. Periodically, have them choose a previously written entry to revise and extend into a more formal explanatory or argumentative piece, which can be a homework exercise.

In Power Writing, a fluency exercise, it is not necessary to correct errors or grade rough drafts. Correcting errors in student writing has been shown to have very little effect on student learning (Ferris, 2006).

Reverse Word Problems

Students often have difficulty knowing how to approach word problems. The technique in this activity has students writing problems to match solutions.

1. Give students some numerical information, such as an equation like $12x + 8 = 32$. You might also give students a hint for a context to put the problem in or give an example.
2. The students then write a math problem, such as "Mary babysits for her neighbor and makes \$12 an hour. One day last week, she earned an extra \$8.00 because she also agreed to walk the dog twice that week. How many hours did she actually babysit?"

3. If students are given different equations, after writing the word problems, they can exchange with another student and attempt to solve that student's problem, first by coming up with the equation, and then solving it.
4. Students with limited literacy can be given a framework to be filled in, such as "Mary babysits _____ hours," or the steps in the problem can be shown in pictures.

Writing Instructions

1. Students work in pairs to build something with Legos or other building materials. (See Figure 2 for examples of structures students have built.)
2. The pairs write instructions for building the structure they just created.
3. They take the structures apart and exchange the building materials and instructions with another pair (it helps to have the materials in plastic zip bags). The students can take a picture of their structures before they disassemble them.
4. The groups now attempt to follow their classmates' instructions to rebuild the structure. When they are done, the original group can see if their instructions were clear.



Figure 2. Example student structures.

This exercise is remarkably effective in showing students how difficult it is to write clear instructions. It also gives students immediate feedback that they can't dispute—either the other students could follow their instructions or they couldn't. With young students or those with limited literacy, the larger blocks can be used to create very simple designs. The teacher can model the language needed, such as "Put the red block on the white block" and practice the language with the students before they engage in the activity.

Writing Product Descriptions

This activity is adapted from Dalle and Thrush, 2014.

1. Give an object to pairs of students—simple kitchen devices like can openers work well for this.
2. Tell them that they are the Research and Development Department for their company, and they have just invented this new device. They now have to write a technical

description for the manufacturing department. They should include measurements, materials, and information on operation.

3. Circulate during this exercise so students do not lapse into marketing language: “It’s the amazing, fantastic can opening device that will solve your problems!” They have to really think about their audience and purpose in this exercise.
4. For students with limited literacy, simple objects such as a ruler can be used, with a framework to be filled in with the dimensions, materials, and so on.

Teachers from the workshops who implemented some or all of the activities in this article reported that the activities increased interaction and enthusiasm among their students. The highest rated activities, which teachers felt would prove useful to other STEM teachers, were the Power Writing, the Four Square vocabulary activity, and the Reverse Word Problem exercise. Many teachers reported being particularly at a loss at how to include ELLS in class activities, and found these activities to be most useful in building language skills for that population. When these activities were presented at local and national TESOL conferences, the feedback from teachers, often sent to us weeks after the presentation, indicated that they found these activities useful in ESL classes to support the mainstream classroom teachers.

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