10 Ways to Imbed ELA Skills into the Math Curriculum

Margaret Golden

ABSTRACT

The author describes 10 classroom activities that are designed to promote reading comprehension and organizational skills in the context of solving math problems. These lessons help students to clarify the information within math problems, identify what operations are necessary, and express their solutions more accurately and precisely. A bibliography of recommended stories with math themes is included.

AUTHOR BIOGRAPHY

Margaret Golden, a National Board Certified teacher, has 15 years experience in primary education and has been teaching classroom methods at the State University of New York at Oneonta for the last 4 years. She is presently working on an Ed.D. at SUNY Binghamton. As a New York State Math Mentor, she is interested in how teachers teach math so that students may learn math in a conceptual way.

Introduction

Eight year-old Brian can solve arithmetic problems in his head faster than most of his teachers. He's swift, he's accurate, and he's confident. Last year he failed the New York State Math Assessment. How can this be? There is a considerable amount of reading and writing required on this state test. Students need to put their reasoning into words and explain the process. Brian struggles with the English Language Arts (ELA) skills necessary in order for him to tell what he knows about mathematics.

There are many students, like Brian, who excel in mathematical thinking, but who are unsuccessful on the New York State Math Assessment. For these students the problem is not math ability, but rather a lack of reading comprehension and writing expression. This same group of students does not succeed on the ELA Assessment. By designing lessons that ask students to listen, read, and write in math class, teachers can teach and practice ELA skills that will benefit students in both math and ELA classes. Researcher Daniela O'Neill, professor of psychology at the University of Waterloo in Ontario, found a link to narrative skills and math ability (Tenenbaum, 2004). She found that young children with strong language ability scored well on math tests. I am suggesting that by strengthening this link, teachers can help students increase skills in both areas.

The classroom suggestions in this article are designed to help students with weaknesses in one academic area, by using their abilities in the other area to enhance

understanding in both. In addition, if these students are taking assessments in math and English Language Arts, the exercises in this article may help increase both test scores.

Suggestions

1: Analyze Story Problems for Story Elements.

Story problems, also known as word problems or extended tasks, are a focus of the New York State Mathematics exam at all levels. Most of these math story problems are only a few sentences long, which make them perfect for identifying story elements. Identifying story elements is a skill traditionally taught in ELA classes. By providing students with a method for identifying the story elements, students may ultimately achieve the necessary comprehension of the math story problems used on the assessment exam.

To use this protocol, teachers begin the lesson by reviewing the elements of a story: character (who), setting (where and when), plot (what), and theme (why or so what). The teacher can have the students read the story problem, or the problem can be read aloud. When the story is read aloud, the students are also practicing listening skills. (See suggestion #2.) Students can use the same graphic organizers they use in their ELA classes to record the story elements. As they are identifying the story elements, students will improve comprehension necessary to solve the problem. In **figure 1**, the setting is not important for solving the problem. It is helpful for students to see that all details provided are not always necessary for a story to make sense. Likewise, some stories have information that enhances the story, but is unnecessary for understanding the main ideas.

2: Read Story Problems Aloud.

When students hear their teachers read aloud, the teachers are modeling "what good oral reading is" (Tierney & Readence, 2005, p. 32). Reading aloud to students can be part of a math class. Math story problems can be read aloud by the teacher as students listen without the story in front of them. In ELA classes, teachers read aloud selections similar in length to the stories on the listening section of the ELA assessments. Compared to the story selection on the ELA exam, the story problems in math class are much shorter. These stories are often only a few sentences long. Therefore, math story problems can provide important practice for students who are struggling to identify story elements by making the process of taking notes of important details easier. Listening to, rather than reading, a math story problem is critical practice for students as it provides practice in listening closely and taking notes quickly while someone else is talking. The methods used to teach note taking should be similar to the techniques learned in ELA class. Students can use graphic organizers, draw pictures or identify and write key words and phrases.

Figure 1

This question is from the New York State Testing Program: Introduction to the Grades 3–8 Testing Program in English Language Arts and Mathematics: Appendix B: Sample Mathematics Questions. (New York State Education Department).

Sam and Jenna have been saving pennies. Sam has 232 pennies, and Jenna has 151 pennies. How many more pennies does Sam have than Jenna?

A 71
B 81
C 121
D 181

Elements of a Story

Characters: who?	Sam and Jenna
Setting: where?	Not important
when?	Not important
Plot: What?	Jenna and Sam have been saving pennies. Sam has 232. Jenna has 151. How many more does Sam have? We need to compare the number of pennies that Sam and Jenna have.
Theme: Why or So What?	Subtract to find the difference. 232 -151 81

3: Have Students Paraphrase Story Problems.

In order to do well on the ELA assessments, students need to know how to paraphrase. Since the math story problems are short, they are ideal practice for paraphrasing. Paraphrasing will also help students solve a math story problem, because students will learn to focus on the nature of the problem rather than on just the numbers in the story. (See **figure 2**.) "RROARR" is a graphic organizer written using an acronym that shows the necessary steps to solve story problems. RROARR is one form a graphic organizer might take.

- RR = Read and Restate
- O = Organize (Decide on the strategy & the operation
- A = Answer (Do the necessary calculations to find the answer.)

- RR = Reread and Rethink

The first step is "Read and Restate." Students paraphrase the story problem. By putting the math story problems in their own words, students are practicing the necessary ELA skill of paraphrasing, a vital step in comprehending the math story problem. (See **figure 3**.)

Figure 2
RROARR to Solve Problems

R & R: Read and Restate
O: Organize. What strategy will you use to solve the problem? Circle One: Draw a Picture — Use Objects, Act It Out Find a Pattern — Make a Table Work Backwards — Guess and Check Make an Organized List or Table — Write an Equation Use Logical Reasoning — Solve a Simpler Problem Choose an Operation: Addition — Subtraction Multiplication — Division
A: Answer the Problem
R & R: Reread and Rework Read again. Highlight the key words in the problem. Make sure your calculations are correct.

Figure 3

RROARR to Solve Problems

The following question is from the New York State Testing Program: Mathematics: Book 2: The Sample Test: 2005: Grade 4: Question #32. (New York State Education Department)

Ronald's apartment building has 17 apartments on each floor. There are 6 floors in the building. What is the total number of apartments in Ronald's apartment building?

R & R: Read and Restate Ronald lives in an apartment building. This apartment building has 6 floors with 17 apartments on each floor.
O: Organize. What strategy will you use to solve the problem? Circle One: Draw a Picture — Use Objects, Act It Out Find a Pattern — Make a Table Work Backwards — Guess and Check Make an Organized List or Table — Write an Equation Use Logical Reasoning — Solve a Simpler Problem Choose an Operation: Addition — Subtraction Multiplication — Division
A: Answer the Problem Prototype of student work shows a drawing with calculations.
R & R: Reread and Rework Read again. Highlight the key words in the problem. Make sure your calculations are correct.

4: Ask Students to Tell, Rather Than Show or Write, Their Explanations.

The math assessment requires students to write their reasoning and their process "in words." Since writing takes more time for most elementary students, a student can get more practice putting these thoughts into words by speaking rather than writing. Speaking well is often a precursor to writing well. As students work, the teacher can mingle with the students. The teacher should ask individual students to explain what they are doing and why. The teacher should know, in advance, what a good answer sounds like. A good answer has details and precise, mathematical vocabulary. A good answer

can explain the process with accurate detail and / or show understanding of the concept. A teacher should continue to talk to the students until each student's explanation is acceptable. Teachers should use a combination of modeling and questioning to help a student attain an acceptable answer.

Teachers need to ask students challenging questions. Challenging questions require logical explanations and precise details. Questions that are asked in math class cannot be just about calculations. Requiring students to explain the process and explain the logic that was used to reach calculated answers is critical. Teachers need to challenge other students to agree or disagree with the student explanations given. When teachers write challenging questions, they may refer to Bloom's Taxonomy so that questions involve learning domains beyond the knowledge and comprehension levels (Dalton & Smith, 1986). "How is this process similar to what we did earlier?" "Do you see another solution to this problem?" "Which solution is better? Why?" These questions are samples of what could be challenging questions.

It is also essential to listen to the answers the students give with a focus on use of precise, mathematical vocabulary. If we average the number of words a student must learn over the course of his or her first 13 years of school, the number is about 70 new words per week (Tompkins & Blanchfield, 2004). For students to learn this many words, they must use them in context, multiple times. As math lesson plans are written, teachers should think about the vocabulary they want to target. Teachers should use these words in their questions and get students to use the targeted vocabulary in their answers. Targeted vocabulary can be displayed and recorded on a "word wall" or in individual glossaries or dictionaries. Just like in ELA class, the teacher needs to identify the words the students need to know. The teacher can also help the students use these words in proper context.

Students can also play "Teacher / Student." In teams, one student can act as the teacher. The other student should take the role of a younger student. The "teacher" is then required to explain, using appropriate, specific vocabulary, the process and concept being taught to the younger 'student.'

5: Write Stories Using Math Data.

When students study graphing, a teacher can also have them write stories about the graph. The graph in **figure 4** shows how much time Krista volunteered over the course of 6 weeks. Students need to read the graph and write a story that fits the data shown in the graph. Brian, mentioned in the introduction, wrote that Krista volunteered for two hours during both week one and week two. Then Krista went on vacation. She returned to her volunteer job the fifth week, but needed to make up the hours missed. She continued to make up the missed hours during the sixth week. His was only one possible plot that would fit the information given in the graph. When students write stories about the information given to them in graphs, the student practices the math skill of reading the graph for pertinent information and interpreting that information. The student also practices the ELA skills needed to write a story. Both math and ELA skills are practiced.

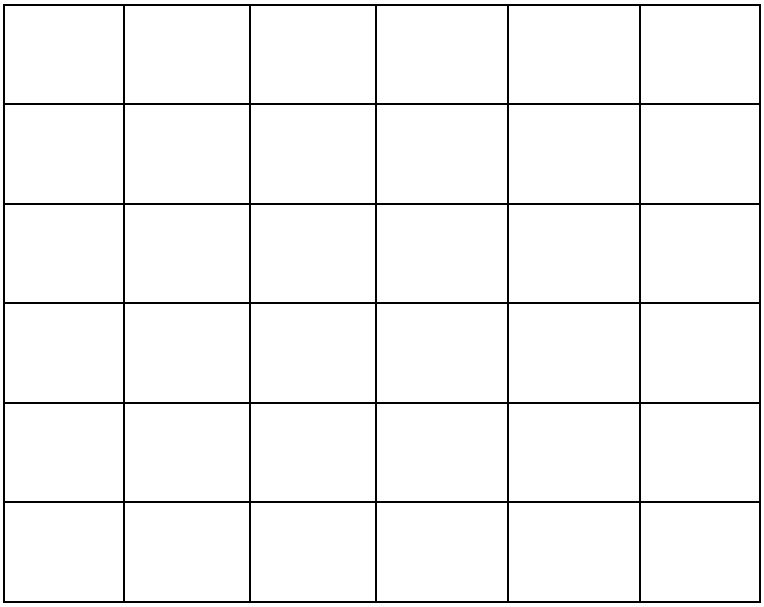
Figure 4
Krista Volunteers
Story / Graph Challenge

Fact: Graphs give readers information that can tell stories.
Task: Read the graph and write a story based on the information.
Standards for a Job Well Done:

- Story is based on the information from the graph.
- Story is interesting.
- Story includes a beginning, middle and end.
- Story includes the four literary elements: character, setting plot and theme.
- All conventions of writing are correct (spelling, grammar, punctuation).
- All work is neat.

Time Krista Volunteered

Numbers and labels on the graph need to be included.



6: Make Graphs from Stories.

In math class, students often gather data and are asked to organize the information into graphs and / or charts. Students can also gather data directly from non-fiction writing. "Children need to be introduced to the different purposes of writing," (Stead, 2005, p. 31). Non-fiction is often a neglected genre (Stead, 2005, p. 33). Providing

students with non-fiction writing which can be deconstructed using graphs or charts benefits both ELA and mathematics skills. Students are given exposure to the genre, and they are given an activity that requires comprehension of the selection. In fact, it is the activity of making a graph or chart that enhances comprehension of the non-fiction selection.

As shown in **figure 5**, students read a story about the population decline of African elephants. The information in the paragraph is perfect for the creation of a line graph. Students have to read closely for meaning and accuracy. After the line graph is completed, the students can decide which is the most effective way to present the information: graph or paragraph. This type of lesson can be duplicated with other types of graphs.

Figure 5

African Elephants

Problem: Did you know that African elephants are disappearing at an alarming rate? These beautiful, majestic animals are endangered.

Task: Read the paragraph below. Use the information in the paragraph to make a graph.
Evidence of a Job Well Done:

- Choice of graph (line graph, bar graph, pie graph, pictograph) makes sense.
- Graph has all required parts: title, title of axes, even intervals starting with zero, correctly plotted data, key (if necessary).
- A ruler is used to graph data.
- All data are accurate.

Decide:

- Is the number of African elephants increasing or decreasing?
- The rate at which the elephants are dying is decreasing. Give three reasons that may be responsible for the decrease.
- Can you predict how many African elephants will still be in the wild in 2006? Defend your answer.
- Is the information presented in the graph or in the paragraph more powerful? Defend your answer.
- Which is more precise: graph or paragraph? Defend your answer.
- Which is easier to understand: graph or paragraph? Defend your answer.

African elephants are endangered mammals that live in herds. They are hunted for their beautiful ivory tusks. In 2000, there were 45,000 African elephants still living in the wild. The next year, this number had decreased by 4,000 elephants. The number of elephants still living in the wild, in 2002, was 38,000. Unfortunately, the trend continued. In 2003, the herd was further reduced by 5,000 elephants. In the next two consecutive years, the herds decreased by 2,000 elephants, each year.

7: Ask Students to Explain, Orally or Written, Why Certain Mathematical Solutions are Illogical.

When students are asked to explain an incorrect mathematical solution they are given a chance to express logical reasoning. Developing the ability to clearly express ideas verbally will enhance their ELA skills. In **figure 6**, students are asked to read a pie graph that is divided incorrectly. Students need to know how different percentages of a pie graph look. ELA skills are also enhanced when students take this knowledge and express it in words. For example, when expressing logical reasoning, students are encouraged to express themselves rationally and precisely, which enhances their writing skills. In figure 6, there are many ways to discuss the inaccuracies of the graph. Two sections are labeled 25%, yet they are not the same size on the graph. One section of the pie graph is labeled 50%, yet it is smaller than a section labeled 35%. As students practice what they need to say about the graph, they are thinking about number sense, the mathematics of percentages, and logical thinking. By talking and writing about these ideas, students are practicing the ELA skills they will need for the math assessment.

8: Use Venn Diagrams to Compare and Contrast.

Venn diagrams are often used in both math and ELA classes in order to compare and contrast information. In ELA classes, the Venn diagram is used as a graphic organizer for students to organize their ideas before a paragraph is written or as a way to organize information from a reading. In math class, Venn diagrams are used more like a graph rather than a graphic organizer. Students put numbers in the graph rather than words. The Venn diagrams show relationships between sets of numbers. Math teachers, like their ELA counterparts, can also ask their students to write about the sameness and differences in sets of numbers. Using **figure 7**, students analyze these sets of numbers to find similarities and differences, and then they write about their findings. It is not enough to just put the numbers in the right place within the Venn diagram; students have to write paragraphs (or essays) defending why they separated the numbers as they did.

9: Use Literature in Math Class.

There are many engaging, interesting, and informative children's books that can enhance math understanding. There are many fiction books that have strong math content. Taking time in math class to read these books to students can enhance both their ELA skills and their math skills. Most teachers recognize the benefit of reading aloud to their students. Teachers model the skills that good readers use when they read. By using a combination of modeling and questioning, teachers show students the important role prediction plays in comprehension. Teachers also help students paraphrase, and teachers show students how to make connections to prior knowledge and experience. Teachers do all this to enhance comprehension and to model how good readers read. The same guided reading techniques that teachers use in ELA class can enhance the skills and concepts learned in math class. Students will benefit because they will practice skills necessary to be good readers, and they will be reading about math concepts. **Figure 8** is a list of some of the many books suitable for an elementary math classroom. This list is a combination

of fiction and non-fiction. The list includes topics from each of the five New York State content standards.

Figure 6
Pie Graph Challenge

Fact: Pie graphs can be a useful way to understand percentage.

Problem: Many people do not know how to read or make accurate pie graphs.

Challenge:

1. Study the pie graph below.
2. With your partner, make a list of any errors you find.
3. Using the data, construct an accurate pie graph. Be ready to tell how you decided the size of each piece.

Fourth Graders Favorite Lunches

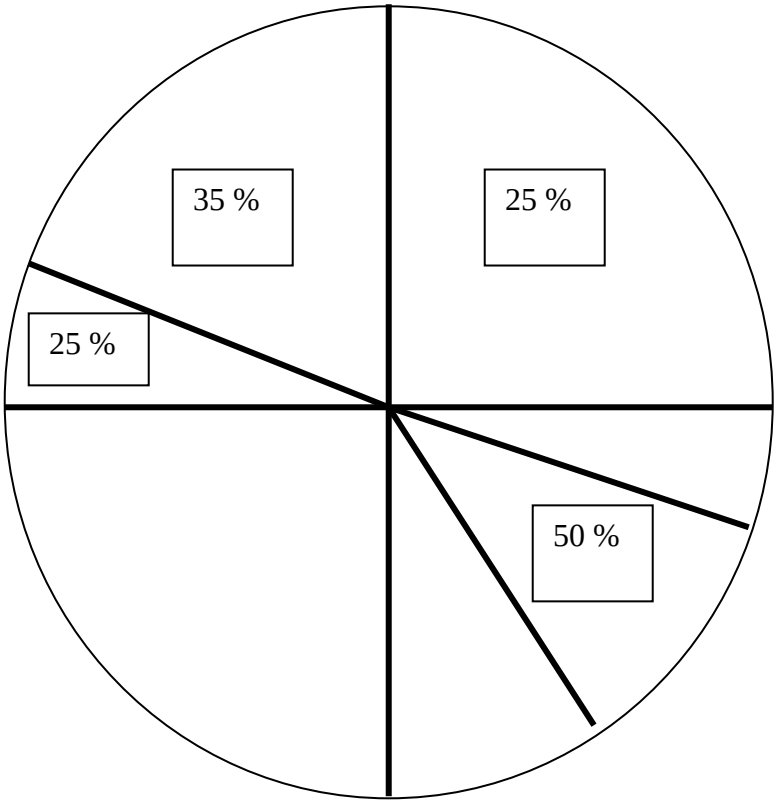


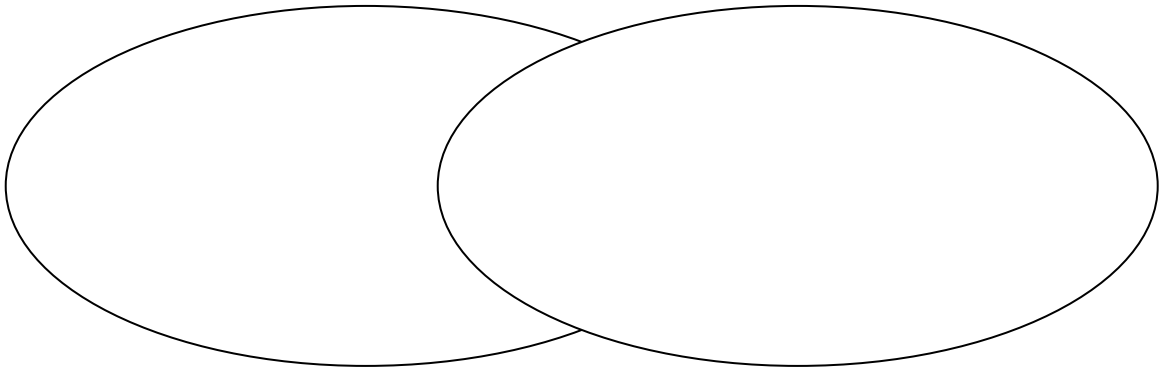
Figure 7

Compare and Contrast

How are these two tables the same and how are they different? Record your ideas in the Venn Diagram.

Table A:	IN	3	4	5	6	7
	OUT	6	7	8	9	10
Table B:	IN	6	8	10	4	2
	OUT	9	11	13	7	5

Venn diagram needs to be completed.



In your math journal, write a paragraph describing the similarities of the two groups of numbers.
In your math journal, write a paragraph describing the differences of the two groups of numbers.

Figure 8

Math Bibliography

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Aker, Suzanne. What Comes in 2's, 3's, & 4's?
Axelrod, Amy. Pigs on a Blanket
Axelrod, Amy. Pigs Will be Pigs
Ayres, Becky Hickox. Matryoshka
Burns, Marilyn. The Greedy Triangle
Friedman, Aileen. The King's Commissioners
Friedman, Aileen. A Cloak for the Dreamer
Geringer, Laura. A Three Day Hat
Greene, Rhonda Gowler. When a Line Bends…A Shape Begins
Kate, Marilyn. A Day with No Math
Leedy, Loreen. 2x2 = Boo!
Leedy, Loreen. Mission: Addition
Leedy, Loreen. Fraction Action
Leedy, Loreen. Measure Penny
Lewis, Paul Owens. P. Bear's New Year's Party!
McGrath, Barbara Barbieri. More M & M's Math
Neuschwander, Cindy. Amanda Bean's Amazing Dream
Nolan, Helen. How Much, How Many, How Far, How Heavy, How Long How Tall is 1000?
Pallotta, Jerry. The Hershey Milk Chocolate Fractions Book
Payne, Emmy. Katy No Pocket
Pinczes, Elinor. A Remainder of One
Pinczes, Elinor. One Hundred Hungry Ants
Schuett, Stacey. Somewhere in the World Right Now
Terban, Marvin. Too Hot to Hoot
Viorst, Judith. Alexander, Who Used to be Rich Last Sunday
Zimelman, Nathan. How the Second Grade Got 8205.50 to Visit the Statue of Liberty

10: Use Your Favorite Graphic Organizer for Math Story Problems.

Many elementary teachers use graphic organizers in their ELA classes in order to help students understand what they read or put thoughts in order as preparation for writing. "Graphic organizers help students organize and summarize information," (Cunningham & Allington, 2003, p. 88). Graphic organizers can take the shape of webs, feature matrices, and data charts. The same graphic organizers can be used in math class. Students can be asked to fill in graphic organizers for the math story problems they read. The graphic organizer in **figure 9** was used in an ELA class to help students record information they read in a story. The same graphic organizer can be used to analyze math story problems. Using the graphic organizers with the math story problem gives

students a method to practice finding who, what, when, where, why, and so what. The task in math class may be easier than the same task in an ELA class because the math story problems are often quite short. There is less to read to find the required information. This is excellent practice for all students, and it also helps students with ELA deficits to understand the math problem they are trying to solve. Using the same graphic organizer in math class that was used in ELA class may help some students make connections that what is taught in one class should carry over to the other.

Conclusion

Embedding ELA skills in math lessons can boost students' ability to express themselves more precisely and accurately. Eight-year-old Brian, who was mentioned in the introduction, will benefit in both his ELA class and his math class when the skills required in ELA are taught in math. This may help Brian, and other students like him, listen, speak and write more effectively and increase their test scores.

Figure 9

W/H Chart

Who?
What?
When?
Where?
Why?
How?

References

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