



Numberless Word Problems: A Coaching Cycle in 2nd and 4th Grade

E.T. Walker (2018)

Some students are competent in decoding and solving mathematical story problems, but many are not. Numerous protocols exist as tools, leading students through steps such as underlining and circling important words and information. Questions are restated. Writing pertinent equations or drawing pictures are encouraged.

Call them word or story problems. My teachers often bemoaned the level of reading required, offering evidence that students could do the math as stand-alone computations. The words in the problem, they said, got in the way. What if the words in mathematical word problems were not the distraction? What if the numbers themselves got in the way of solving the problem?

During a Student-Centered Coaching cycle, teachers in second and fourth grade classes both agreed to experiment with removing numbers from word problems, engaging students in forming Notices and Wonders, and then slowly adding the numerical values back into the problems. The results were fascinating.

The second grade teacher chose to engage her entire class of 17 students in group discussions of the problems. The fourth grade teacher utilized a daily 20-minute, math intervention in which a small group of six students worked together.

Here is what they did:

1. Identified the Problem of Practice: Students are not consistently successful at decoding and solving math story problems.
2. Created two math story problems as a starting source of data. Problems were based on content already taught.
3. Students were given time to complete the problems and show any work. They were encouraged to include notices and wonders about the problems.
4. The teachers created a scoring protocol for the pre- and post-assessment problems. Each student received:
 - a. 1 point for each mathematical notice (up to 2 points)
 - b. 1 point for each mathematical wonder (up to 2 points)
 - c. 1 point the correct operation (1 point)
 - d. 1 point a correct answer (1 point)
5. Teachers developed instructional story problems, which began with no numbers and gradually added information back in. They constructed their own set of probing questions as guides for group discussions.

6. Teachers met with their respective students over 4 weeks to engage in the use of notices and wonders, and discussion of the story problems.
7. Students were post-assessed using the same problems as the pre-assessment. Student work was scored the same way as the pre-assessment.
8. The teachers compared the pre- and post-data and formed a conclusion about the process of using numberless word problems.

In the second grade classroom

The problem was projected to the class via the interactive white board. Below the question, the teacher recorded the notices and wonders of students.

Session 1

Rhianna and Cassy were waiting in line to buy ice cream. Rhianna said, "I should go first because I am older."

The class offered some non-math notices and wonders:

- What were they wearing?
- Are they sisters?
- Why are they eating ice cream?
- They are waiting in line.
- Rhianna wants to go first.

About half of the notices and wonders were math related.

- Rhianna is older.
- Cassy is younger.
- How much older is Rhianna?
- There are no numbers.
- How much are they going to pay for the ice cream.
- What is the question?

It was interesting that second grade students looked for a question to answer as part of the problem. The teacher offered students the opportunity to propose possible questions to finish the story.

Session 2

Rhianna and Cassy were waiting in line to buy ice cream. Rhianna said, "I should go first because I am older." How much older is Rhianna?

Several times during the remainder of the day, students were heard talking about the problem and discussing the context and information that was, and was not, provided. There was anticipation about what information would be added the next day.

For the next session, the teacher included a question at the end of the problem and asked for notices and wonders. She noted that students had little difficulty reading the words in the problem. Students again noticed the story had no numbers. The teacher responded by asking the students how numbers would help find a solution.

She was curious if the students really understood the context of the story, so she entered this information for the next session to see if it would cause some disequilibrium.

Session 3

Rhianna and Cassy were waiting in line to buy ice cream. Rhianna was 6 years old and Cassy was 9 years old. Rhianna said, "I should go first because I am older." How much older is Rhianna?

The class erupted into excited chatter as soon as the story problem was revealed and even before it was read out loud. A discussion about numbers and order related to age ensued. The students insisted the girls' ages should be reversed. The teacher complied and students were released to work on the answer to the problem in groups with the teacher circulating.

A similar slow introduction and discussion about each scenario was utilized for additional word problems.

In the fourth grade classroom

The fourth grade teacher chose to work with a group of six students who did very well in math computation but poorly in solving story problems. These students liked to be first finishing work and were frustrated at the time it took to read and decode word problems.

The fourth grade teacher followed a routine similar to the second grade teacher by initially presenting story problems with no numbers and no question. Her first goal was for students to understand the context through notices and wonders and discussion. The addition of numbers was delayed as long as possible. Here is her first problem.

Session 1

Javier, Anthony, and Jacob earned Dojo points today. They wanted their total points to be higher than their total points yesterday.

The students took time to write down their notices and wonders before sharing them. This allowed all to think about the problem without any voices being dominant. The fourth graders also were asked to suggest a question to place at the end of the story.

Session 2

Javier, Anthony, and Jacob earned Dojo points today. They wanted their total points to be higher than their total points yesterday. How many points would they need to earn today?

Students noticed that the question did not help them find an answer without numbers, but they were also able to articulate where quantities should be assigned in the story, discussed the relationship of those quantities to each other and what operations might help solve the problem.

Session 3

Javier, Anthony, and Jacob earned 25 Dojo points today. They wanted their total points today to be 15 times higher than their total points yesterday. How many points would they need to earn today?

An error by the teacher in the wording of this question was serendipitous. Notice that the additional quantity of points is written as *15 times higher* than the previous day, indicating a multiplicative relationship. The teacher's intention was for *15 more points*, indicating an additive change.

Without the previous exercises in writing notices and wonderings, it is likely the students would have felt uncomfortable questioning the implication of the words "*15 times higher*". A rousing discussion about the meaning of the words and the reality of such an increase ensued. In the end, the group agreed to change the wording to *15 more points*, and then proceeded to solve the problem. Multiple other story problems followed this same pattern of dissection and discussion over the course of four more weeks.

What impact did this student-centered coaching intervention have on student work? Both grade level groups significantly increased their use of notices and wonders. Several of the fourth graders made notices and wonderings on their state assessments. Most of the second grade students were able to identify mathematical notices and wonders in contrast to non-mathematical ones. They spontaneously wrote more notices and wonders when completing the post-assessment compared to the pre-assessment. The second grade teacher described her students as "putting themselves within the problem" with a curiosity about the characters and situation. The second-graders were more willing to discuss story problems with other students in both non-mathematical and mathematical contexts.

The fourth grade teacher observed that writing notices and wonders prompted students to slow down and think about the problems. When working on their own, some even covered the numbers in the word problem with their fingers. While errors in previous work was often by choosing addition as a default operation, fewer students chose an incorrect operation after the coaching cycle, and more were able to justify their answers.

Both teachers were pleased with this different way of engaging students in thinking through story or word problems. The positive changes from pre- to post-assessment results were strong enough to encourage the teachers to continue utilizing numberless word problems as a transition technique in the future. They shared their methods and findings at the 2019 AMTNYS conference.