Ditch the CUBES When Solving Word Problems!

Sandi Berg

No, I'm not referring to manipulatives when I say ditch the CUBES when solving word problems. Full disclosure: in the past, I probably fell into the CUBES supporter bunch. I've learned a lot over the past few years and now focus on other ways of teaching students how to solve word problems.

First of all, some of you may be asking, "What is CUBES?" CUBES is an acronym that you may have seen posted in math classrooms throughout the years. The acronym may take a slightly different form, but they all get to the same basic idea: when solving a word problem, use CUBES

1. **C**ircle all key numbers.
2. **U**nderline the question.
3. **B**ox any key words.
4. **E**liminate unnecessary information.
5. **S**olve and check.

Rather than telling you why I no longer use this, let's just jump right in and try an example. As you look at each stage (before skipping ahead to the next image), ask yourself "What's the answer?"

You see the following word problem that makes no sense to you ...

[redacted]

so you faithfully follow the steps ...

Step 1: Circle all key numbers.

89 [redacted] 12 [redacted]

What's your gut instinct for the answer?

Step 2: Underline the question:

89 [redacted] 12 [redacted] How many tables are needed in total?

Do you feel pretty confident about that gut instinct?

Step 3: Underline the key words:

89 [redacted] 12 [redacted] How many tables are needed in total?

Still feeling pretty confident?

This is where most students stop when they don't know how to solve a word problem. What answer do you think comes to mind?

Let's look at the full question. Were you right?

89 people have been invited to a banquet. The caterer is arranging tables. Each table can seat 12 people. How many tables are needed in total?

What operation is used in this question?

Did you know that most students who aren't sure what to do when solving a word problem will take all of the numbers they see and just add them?

Do you have a math word wall? Have you taught students to identify key words? What have they learned *in total* means?

Let's try another example:

[redacted]

Let's start with that key word: *in total.*

> [redacted] in total?

Circle all the numbers:

> [redacted] four [redacted] 5 [redacted]
> 23 [redacted]
> [redacted] 5 [redacted] in total?

What do you think the answer is?

Are you trying not to add? But if it's not adding, then what is it?

Let's look at the question:

> [redacted] four [redacted] 5 [redacted]
> 23 [redacted] how many
> grade 5 students are there in total?

Whoa ... did that 5 just get removed from the calculations? Oops! How many students might be thrown off by that?

Let's look at the full question:

> If there are four grade 5 classrooms with 23 students in each class, how many grade 5 students are there in total?

What operation is used in this question? Were there any other key words that students might have identified? Would they have helped or hindered their understanding?

Let's look at another example:

> [redacted]

Here are the numbers:

> 15 [redacted]
> [redacted] 4 [redacted]

Here's the question:

> 15 [redacted]
> [redacted] 4 [redacted]
> children are there in total?

What are you going to do with the information?

> 15 [redacted]
> [redacted] 4 [redacted]
> children are there in total?

Again, let's look at the full question. Does identifying key words help here?

> 15 children were playing on the playground when 4 had to go home. Now have many children are there in total?

You probably guessed it ... here comes another example.

> [redacted]

Let's pull those numbers out.

> [redacted] 2 [redacted] 213
> [redacted] 68
> [redacted]

What's the question?

> [redacted] 2 [redacted] 213
> [redacted] 68
> [redacted] How many animals do all the
> zoos have in total?

What's the full set of information?

> A city has 2 zoos. One zoo has 213 animals and the second zoo has 68 animals. How many animals do all the zoos have in total?

So, what's the commonality in these four questions? They all focus on the key word *in total*, which is typically taught as "addition," but every question actually addresses a different operation and some have extraneous numbers. Following CUBES (or most of the other acronyms) fails you if you don't actually make sense of the word problem.

Here's a word problem for you to try: There are 125 sheep and 5 dogs in a flock. How old is the shepherd? I'll wait while you figure it out.

Did that seem like a silly question to you? Obviously, you can't figure it out.

Robert Kaplinsky (http://robertkaplinsky.com) asks 32 students to respond to this question. How many do you think agree with you and how many do you think attempted to solve it? Once you've made your prediction, watch the video.

Were you surprised? Why did so few students make sense of this problem? How do we help students dig deeper into the word problem rather than relying on following steps like CUBES?

Brian Bushart (https://bstockus.wordpress.com) introduced me to numberless word problems (https://bstockus.wordpress.com/numberless-word-problems/) and I fell in love.

As always, let's begin with an example.

> There are some mice on the field. Some more mice come.
> 1. What do you notice?
> 2. What do you know to be true?
> 3. What do you think to be true?

Take some time to think about the three questions in relation to the two statements above them.

I have used this example in many of my workshops, and I'm always fascinated by the discourse that occurs. If the participants/students have never experienced a numberless word problem before, they might experience confusion—there are no numbers! They sometimes start by retelling me the information that's on the board. I have had to prompt them to think about what "numbers" are in the question. What words might imply numbers? They will focus on the word *some*. What does *some* mean? This is where it gets interesting. In my experience, most will say "More than one," but some will disagree and state that it means at least three. Why three? They claim that if the writer meant two, then they would have said *couple*. We often spend quite a bit of time talking about the differences between *couple*, *some* and other examples they might bring up. It's really very interesting. I'll then ask the question: If *some* means *more than one*, what do we know?

Students will have time to talk about that. They'll naturally start to think about the question, "How many mice are on the field now?" Invariably, I'll hear the answer *three*, but then they'll discuss how *more than one* plus *more than one* has to be more than three. They'll share their reasoning. I'll follow up this question with "If *some* means *more than two*, what do we know?"

After we have fully dissected this question, I will replace one word:

> There are seven mice on the field. Some more mice come.
> 1. What do you notice?
> 2. What do you know to be true?
> 3. What do you think to be true?

We'll discuss what's changed and how that changes the rest of the information we talked about. After a full discussion, I adjust the question again:

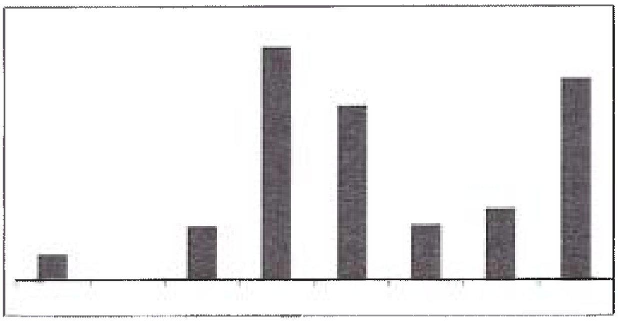
> There are seven mice on the field. Four more mice come.
> 1. What do you notice?
> 2. What do you know to be true?
> 3. What do you think the question is going to be?
> 4. Solve that question.

At this stage, students solve the question.

Questions like this are easy to create. Just pull out a question that you would give them anyway and replace the numbers with generic words like *some*, *many* and so forth (check out #numberlesswp on Twitter).

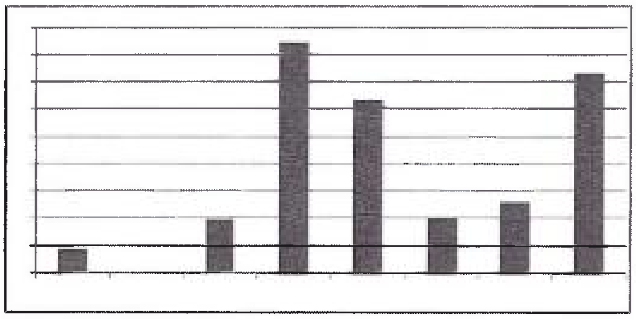
Caution! This is great at the beginning of a class, but do *not* spend an entire class talking about addition and then pull out this question. Why? If we do 40 minutes of addition questions and then have a word problem, students will just assume that it's addition. The thinking stops, and they revert to running a procedure rather than delving into the meaning behind the words.

Can you run a numberless word problem in other formats? Absolutely! Let's look at a numberless graph. I know it might be tempting to peek ahead to the upcoming graphs, but try to see what information you can figure out just by asking yourself the same three questions as in the previous section.

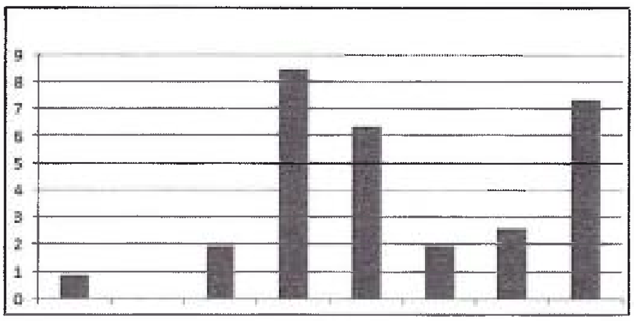


Did you see that there is one empty spot? Did you wonder if it was *zero* or if it was left out on purpose? Did you notice the third and the sixth were the same or about the same. That the fourth is the most and the first is the least? The fifth is about triple the third? And so on.

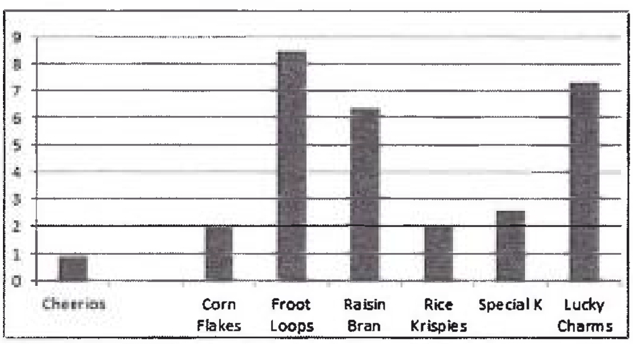
Let's add some more information. Does this help narrow down some of your statements from above?



Let's add a scale. This might help.

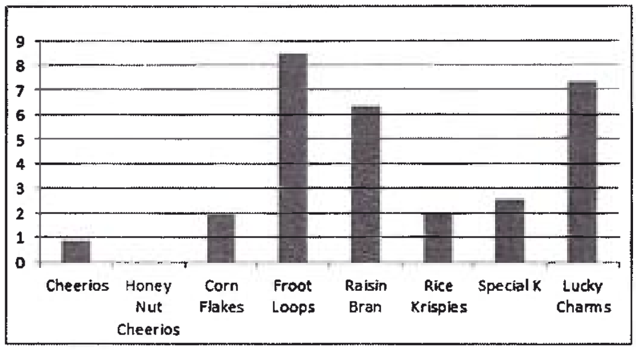


Let's add some more information.

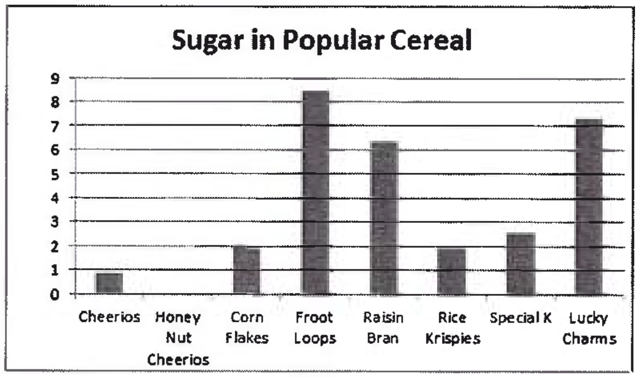


I wonder what they are comparing. Obviously cereals, but what about these cereals specifically? I wonder what the missing cereal is. Choose one.

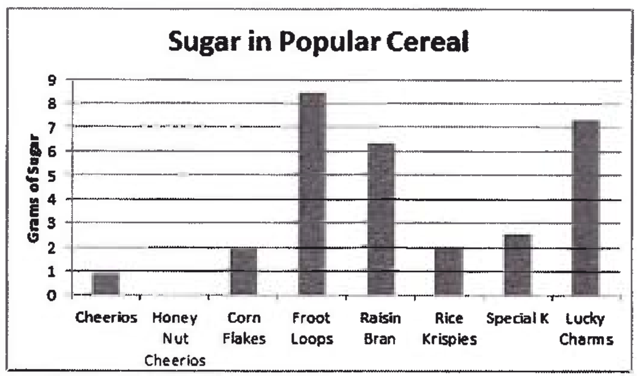
The next graph will tell you the missing cereal, but we'll come back to the one you chose in a bit.



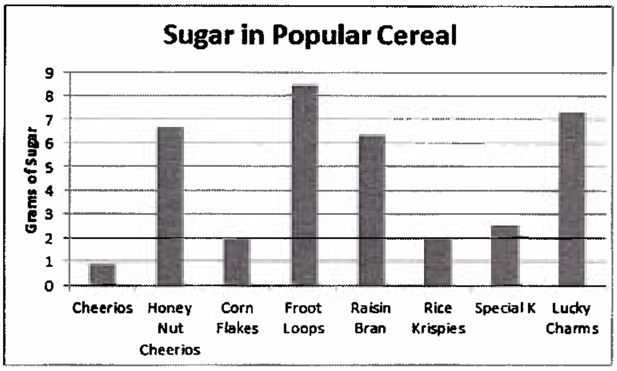
I wonder what they are actually comparing. What will help us determine this? Let's check out the title of this graph.



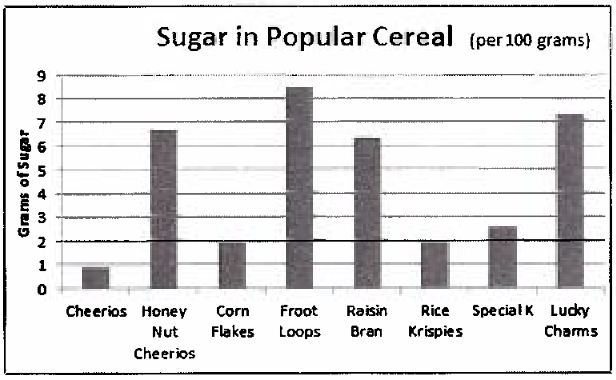
What do those numbers on the left represent?



I wonder where the Honey Nut Cheerios will fit. Make a prediction.



Have we made any assumptions? How did you visualize the amount of cereal? Did you think about it in terms of 1 cup or 0.5 cups? Did you think about it in weight? Will this make a difference?



How does this change our thoughts? Is 100g of Cheerios the same volume as 100g of Lucky Charms?

Let's return to the cereal you thought belonged in the empty spot. What would it look like if it was added to this graph? Find out!

Why is working with numberless word problems and numberless graphs a powerful activity? Once students have spent time making sense of a problem without numbers, when they get to a question they are not sure how to solve, they will slow down and think more deeply about the information provided. They won't just take the numbers, throw in an operation and "solve" the question.

Question for Reflection

How do you think your students would do in the "How old is the shepherd" problem? Try it in your class and see how they do. Are you surprised by their responses?

Activity to Try

There are many words and phrases, like *in total*, that have many mathematical meanings depending on the context of the problem. Try to create four word problems that each use that word or phrase but use a different operation, like my examples above.

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