Dr. Seuss Comes to Middle School Math Class

by Carrie DeFrancisco

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Last year Carrie DeFrancisco wanted to celebrate Dr. Seuss' birthday with her sixth-, seventh-, and eighth-grade students. The students were studying simplifying and evaluating expressions and solving one- and two-step equations. Carrie centered activities on the Dr. Seuss classic Green Eggs and Ham.

"As you know, today our school is celebrating Dr. Seuss' birthday. I know that in language arts, Mrs. Mayeur read to you several Dr. Seuss classics, one of them being *Green Eggs and Ham.* Today, we will be ordering, eating, and working at one of Dr. Seuss' favorite restaurants, the Egg-stravaganza Diner. You will notice at each table a set of menus. I would like for you and your group members to read over the menu items, the special of the day, and the prices listed."

Along with setting out the menus at each table, I displayed a poster-size menu on the board:

"In a diner, time and efficiency are of the utmost importance, so there is a particular shorthand used when writing down a customer's order. It takes too long to spell each food item completely on the ticket, so each food item is abbreviated and only the first letter of each item is used. For example, if a customer wanted green eggs, the waiter would write only G. Today's special, which is green eggs, ham, and a large drink, is abbreviated as X. For the time being, you will be assisting the cook and telling him what has been ordered. Let's look at the first ticket, $G + H + S$. What did the customer order?"

"He ordered green eggs, ham, and a small drink," Justin said.

"How do you know that?" I asked.

"A capital G is used for green eggs, capital H is used for ham, and capital S is used for a small drink," replied Justin.

"How much is his order?" The students quickly solved for $4.50.

"How did you find the sum mentally?" I asked.

"Well, I know that 25 cents and 75 cents make a dollar, so I added the small drink, which is 75 cents, to the green eggs, which is $2.25, for a total of $3.00. Then I just added to $3.00 the cost of ham, which is $1.50, to get $4.50," Misha answered.

"Did anyone do it a different way?"

"I added up all of the dollars first, $2.00 plus $1.00, to get $3.00. Then I added the cents together, $0.25 plus $0.75 plus $0.50; that is $1.50. Then all I had to do was put them together to get $4.50," Frank replied.

I then pointed to the "orders" I had written on the board:

$X + G + S = ?$ $2G + B = ?$ $E + 3H + 2L = ?$

"I would like you to take a look at some other orders that have been sent to the kitchen. With your partner, discuss what was ordered and then mentally calculate the cost of each bill. Make sure you both agree and can explain to the class your thinking and the strategies you used." The students eagerly went to work and quickly figured out what was ordered and the total of each bill.

"Do you think the first order was made by one person?" I asked.

"We don't think so. A special was ordered plus another order of green eggs and a small drink. The special already has eggs, ham, and a drink in it. If it is one person, he sure is hungry," Ken said.

"Does anyone disagree with Ken?"

"No, Valerie and I think he ordered a special, regular eggs, and a small drink, too," Alex said.

"How much was the bill?"

"We think it came to $7.00 even," Jenny offered.

"How did you calculate that?"

"I did what Misha did before. I know that 25 cents and 75 cents make a dollar, so I added the small drink, which is 75 cents, to the special, which is $4.25, for a total of $5.00. Then I just added that to $2.00 to get $7.00," Jenny answered.

"What did the second person order and how much was her bill?" I asked.

"We think she ordered two orders of green eggs and one order of bacon," Kim suggested. "The 2 in front of the G is saying she ordered two green eggs, and you don't need to put a 1 in front of the B. It is a given. If you have one letter B, then you only need one order of bacon."

"Jeff and I figured the bill was $5.75," Mark said. "Since we needed two green eggs, we multiplied $2.25 by 2 to get $4.50 and then we added the bacon, which was $1.25."

"We did it a little differently," Joe chimed in. "We added $2.25 plus $2.25 plus $1.25 together and we just used Frank's way of adding dollars together first and then cents. Two dollars plus $2.00 plus $1.00 is $5.00 plus 75 cents equals $5.75."

"And what did you and your partner come up with for the last one, *E + 3H + 2L?"*

Carlotta responded, "The E stands for regular eggs, so they ordered one regular eggs. The H stands for ham, so they ordered three of those, and the L stands for large drinks, so they also ordered two large drinks."

"We think the total is $8.50," Mike said. "One order of regular eggs is $2.00 and two large drinks is also $2.00. So we have $4.00 so far. We needed three orders of ham and each order is $1.50, so we multiplied $1.50 by 3. We added $4.50 to the original $4.00 for a total of $8.50."

"Can anyone explain it in a different way?"

"We liked what Frank did, so we added all the dollars together first and then added all the cents together and then added the two answers together for the total. We also got $8.50," Francesca said.

"The cook has a few more large orders that have been sent to the kitchen," I said. "With your partner, discuss what was ordered and then calculate the cost of each bill. Make sure you both agree and can explain to the class your thinking and the strategies you used." On the board, I wrote the following "orders":

$2(G + H) = ?$ $(G + S) + 2H = ?$

$X + 3(E + L) = ?$ $3(E + B + L) + 2X = ?$

Once again, the students shared their solutions and the strategies they used to solve each order. Many students figured out the cost of the food items in the parentheses first and then used repeated addition to make the number of groups necessary. Other students used the distributive property in some form by figuring the cost of each food item and then adding the totals together.

"What did the last party order and how much was their bill?" I asked.

"They ordered three regular eggs, three sides of bacon, three large drinks, and two specials," Justin said.

"What is another way of looking at that order?"

"It could have been three people wanted the same thing — regular eggs, bacon, and a large drink — so instead of writing it three separate times, he wrote it once with a 3," Misha said.

"Or it could mean they wanted three sets of eggs, bacon, and large sodas and two orders of the special. Either way, they ordered the same thing," Kim said.

"How did you calculate the cost?" I asked.

Justin replied, "Since we looked at it as three separate orders of eggs, three separate orders of bacon, and three separate orders of drinks, we first figured out how much three orders of eggs were. Three times $2.00 is $6.00. Then we figured out how much three orders of bacon would be, which is $1.25 times 3. Then we figured out three large drinks would be $3.00. Once we had $6.00, $3.75, and $3.00, we added them up. After that we added $4.25 to it because they ordered two specials. The total for the specials was $8.50. Finally, we added the two totals together to get $21.25."

"Misha, did your group do it another way?" I asked.

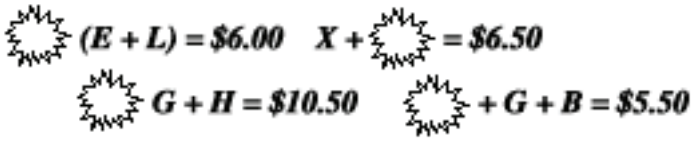
"Since we figured three people wanted the same thing, we calculated how much one order of eggs, bacon, and a large drink would be, which is $4.25, and then we multiplied that by 3 to

get $12.75. Then we multiplied the special by 2 and added that to $12.75 to get $21.25," Misha responded.

"We did the same thing except we noticed that one order of eggs, bacon, and a small drink was the same amount as a special, $4.25, so we multiplied $4.25 by 5 instead. We also got $21.25 as our answer," Frank said.

I then organized the students into groups of three. In each group, students took turns playing one of the following: customer, waiter, or cashier. Each customer decided what food items would be purchased. The waiter was responsible for writing the orders, and the cashier was in charge of calculating the cost of the dinner. The students took turns "ordering" meals, writing up the tickets, and calculating the total cost. Each customer was given a total of $10.00 to spend. Customers could pretend to be ordering for more than one person. The objective was to spend as much of the $10.00 as possible. After checking one another's work, the students switched roles and began again. As the partners finished up the second round of ordering, the class came to an end.

The following day, I began class by saying, "Today you will once again help the cook figure out what has been ordered. The only problem is that several orders have been soiled with grease spots and ketchup spills and the cook is having a hard time reading them. Work with a partner and, using the information that is legible, figure out what was ordered and/or the number of items ordered." I gave students the following to solve:



After the students worked on the problems for a while, I led a class discussion.

"How many orders of eggs and a large drink did the first group order?" I asked.

"They ordered two of them," Jeff said.

"How did you and your partner come to that conclusion?"

"Well, we know that the regular eggs is $2.00 and the large drink is $1.00, so we added them together to get $3.00. We also know that the total bill is $6.00, so we subtracted $3.00 from the $6.00. We had $3.00 left, so we figured they must have ordered two sets of eggs and drinks," Jeff answered.

"What about the second order? What did they order three of and how do you know?"

"First we subtracted what we already knew. One special equals $4.25, so we subtracted $4.25 from the total bill of $6.50. We were left with $2.25. We know that green eggs cost that much, but on the order they ordered three of something, not one. Since we had $2.25 left and they ordered three of something, we divided $2.25 by 3. The answer was 75 cents. We looked on the menu and the small drink costs 75 cents, so they must have ordered a special and three small drinks," Jenny said.

"Any other thoughts?"

"We think it is three small drinks, too. After we got our answer, we went back and added $4.25 plus $0.75 plus $0.75 plus $0.75 and we got the same answer of $6.50, so it must be correct," Kenny offered.

The students continued to share with the class the rest of their solutions along with their strategies and reasoning. Then the students worked with their partners to generate orders with ketchup stains and figure out what was ordered or in what quantities. One student was the cook and the other was the cashier. The students took turns writing down orders with missing information and trying to figure out what was ordered or in what quantities. After checking each other's work, the partners switched roles.

"Can someone explain to me in his or her own words a method or foolproof way to solve problems like the ones given?"

"Since you already know how much the bill was, all you need to do is subtract the known information first to see what's left. If you know how many of something they ordered, you divide what is left over by the number of items ordered. If you know what was ordered but not the number of items, you divide what is left over by the cost of the item," Alex explained.

"You just take away everything you already know first and then you divide the remainder of money by the cost or the number of orders they purchased," Jose added.

"Look at this equation. Can you put it into a real-world situation and then solve for the missing information?" I asked. I wrote the following equation on the board:

$$2x + 4 = 24$$

"It is like the menu. Maybe someone ordered two of something and $4.00 worth of hamburgers and their total bill was $24.00," Carlotta suggested.

"It could also be I have two packs of baseball cards plus four extra rookie cards and I have a total of twenty-four cards altogether. I need to find out how many cards are in each pack," Joe said.

"What is the missing information?" I asked.

"If it is like the diner, we can subtract the $4 from the total bill of $24, which leaves you with $20. And since I know they ordered two of something, I can divide the $20 by 2. Whatever they ordered two of costs $10 each," Justin said.

"Same thing with cards. You know he has twenty-four cards total and he has four loose ones, so you subtract the 4 from the 24 and you have 20 left over. You know he has two packs, so you divide 20 cards by 2 packs and you see that he has 10 cards in each," replied Misha.

The class and I spent several more days writing, simplifying, and evaluating polynomial expressions and equations based on *Green Eggs and Ham* and the Egg-stravaganza Diner theme. In order to calculate how much food and drink were sold on any given day, the students added like terms by adding the total amount of eggs, ham, and drinks sold in the morning to the total amount of the same food items sold in the afternoon. The students also subtracted like

terms by subtracting from the inventory file the total amount of food sold each day to figure how much food and beverages were left for consumption for the next business day. Finally, the students multiplied polynomials using the distributive property to find the total amount of the day's special sold each day.

By the end of the two weeks, the students seemed to have a deeper understanding of the process and algorithm of solving one- and two-step equations. When the students moved on to the more traditional exercises in their books, they were able to make connections between the processes they constructed and used to solve the diner problems and the more abstract equations presented in the text. Whenever a student got stuck, a peer or I would discuss the equation in relation to something previously done with diner equations. Oftentimes, the student would be able to figure out what to do next when the abstract equation was placed in a real-world story problem. The students had a great time and couldn't wait to read more Dr. Seuss in math class.