Preservice Point of View:
Verbal Interpretation of a Linear Equation Involving Division

by DesLey Plaisance and Nell McAnelly

This section of the *LATM Journal* is designed to link teachers and future teachers. In each issue of the journal, responses to a mathematical task by preservice teachers are presented. It is anticipated that these responses will provide insight into understanding, reveal possible misconceptions, and suggest implications for improved instruction. In addition, it is expected that this section will initiate a dialogue on concept development that will better prepare future teachers and reinforce the practices of current teachers.

Preservice elementary education students enrolled in a junior-level mathematics course specifically designed for elementary education majors were given the following equation:

$$13 = n/10$$

The students were asked to write one "word problem" that would result in having to solve the given equation. Before reading on, think about this equation. What word problem would you write that would result in "having" to solve this given equation?

An equivalent form of this linear equation is $13 \cdot 10 = n$; ultimately, in order to solve the original equation $13 = n/10$, one would multiply 13 times 10. However, the original form of the equation asks for a situation in which 13 results from some number "n" being divided by 10. Is writing a word problem that implies multiplication actually writing a problem that results in having to solve $13 = n/10$?

Every equation has a number of equivalent forms, but these equivalent forms may not be arrived at directly from a specific situation. Consider the following example of this idea provided by Professor Scott Beslin of Nicholls State University:

> A line segment of length 1 is cut into two pieces, one piece longer than the other. The ratio of the length of the longer piece to that of

of the shorter piece is the same as the ratio of the length of the entire segment to that of the longer piece. What is the length of the longer piece?

If the longer piece is represented by "x" and the shorter piece represented by "$1-x$," then the equation applicable to the situation would be as follows:

$$\frac{x}{1-x}=\frac{1}{x}$$

An equivalent form of this equation is $x^2+x-1=0$. However, it is highly unlikely that anyone would write this second form in response to the line segment problem, and in fact this second form does not aptly represent the concept of ratio referred to in the problem. Therefore, is writing a word problem that would most likely result in the equation 13·10 = n be appropriate for the problem posed in which one is asked to write a word problem resulting in having to solve the equation 13 = n/10? This idea is what may make the posed question interesting to some. Are there any non-contrived situations that would result in one having to solve the equation in its given form of 13 = n/10?

When examining the work of the preservice elementary education students, an overwhelming majority (31 of 38 responses) of the students wrote word problems that "could" be solved by utilizing the given equation, but probably would be solved by directly multiplying 13 times 10. All of these problems asked in some form to "find the total" needed for 13 groups of 10 or 10 groups of 13. Some responses of this type are as follows:

> 1) Tania had to split a group of students into 10 groups. There were 13 students in each group. How many were students were there?
>
> 2) Jane baked cookies for a party she was attending. After baking all of the cookies she put 10 cookies on each tray. When she was through, she had 13 trays of cookies. How many cookies did she bake all together?
>
> 3) Betsy is setting up for a banquet. She found that when she set up the room, she needed 13 tables. Each table had 10 chairs around the table. If each person gets one chair, how many people are attending the banquet?

Four of the 38 responses were incorrect in that the word problems did not result in one having to solve the given equation directly or indirectly. All used the numbers "13" and "10" but did not result in having to eventually multiply those two numbers. All responses involve division, but not dividing the unknown quantity by 10 in order to get the quotient of 13. These responses are as follows:

> 1) Jordan has 13 pieces of apple. She wants to put the apple pieces into 10 groups. How many apple pieces are there in each group?
>
> 2) You have a class with "n" amount of students. If you divide this amount by 10, how many groups of students do you have if the total of students in class is 13. Explain. Do you have an exact amount of groups? Explain.
>
> 3) Farmer Paul has 130 cows and needs them in rows of 10. How many columns will the cows be in?
>
> 4) What would 10 need to be divided by to get the quotient of 13?

Two of the 38 students providing responses used the variable "n" within the word problem. These responses provided problems that seem to result in solving the equation n/10 = 13 directly. The exact equation given in the assignment is 13 = n/10. The symmetric property of equality (If a=b, then b=a.) allows one to rewrite an equation in this manner. Therefore, would n/10=13 be considered a "different form" of 13 = n/10? In both equations one is looking for some quantity that has to be divided by 10 to arrive at the quotient of 13. It is possible that some may consider n/10 = 13 and 13 = n/10 as two different forms. The student responses are as follows:

> 1) There are <u>n</u> children that attended vacation bible school this summer. We know that there were 10 children in each group and 13 groups. How many children attended vacation bible school?
>
> 2) Ms. Kelly had "n" pieces of candy to hand out among 10 students. Each student received 13 pieces. How many pieces did Ms. Kelly start with?

The final student wrote a word problem that again resulted in having to multiply 13 times 10. However, it appears that the student may have been thinking about the equation as a proportion in that he represented the “13” as ratio of “miles per gallon.” The problem is as follows:

> My car gets 13 miles per gallon of gasoline. If I used 10 gallons on a road trip yesterday, how many miles did I drive?

One of the goals of this column is to “initiate a dialogue on concept development.” There was definitely a “dialogue” as the column was being written. Think about the problem posed with 13 = n/10. Have your students think about this problem. We believe that there will be quite an engaging dialogue.

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