been learned in addition to the presentation of new information (d) restate-review items - to rehearse an established (you hope) skill, (e) generalizing items - why explain this one to teachers?, (f) specifying items - to make use of a learned item in an illustrative case.

8- As you compose your program, follow this procedure: (a) use a 4x6 card for each frame, placing the completion on the back of the card (otherwise you won't be able to pupil-test efficiently make revisions, etc.), (b) give carefully-worded directions, (c) pay particular attention to transition, (d) student test your items, and (e) revise by adding more frames, writing a more precise bit of exposition, providing better (or more) cues, or giving an example or illustration.

You're on your own! One last word of caution: pupil-test, revise, and pupil-test again and again until you get about a 90 percent efficiency level for your program with average students.

Once you get started, you'll find programming a pleasurable activity (somewhat akin to the solving of crossword puzzles), and you'll find that it teaches you more than you thought it would about how children learn.

Have fun!

A CRITICAL ANALYSIS OF THE USE OF THE RATIO TEST IN COMPUTATION OF PROPORTIONAL EQUATIONS, by H. L. Larson

Editor's Note - Mr. Larson is superintendent of schools in Ponoka, and is president of the Red Deer Regional of the MCATA.

One outstanding feature of modern mathematics in elementary schools, as introduced by Scott Foresman texts, is the use of rate and ratio in solving problems. There is little doubt that Grade VI students can and do understand the first step in setting up the equation. Recognition of rate sense in so many problems and use of a placeholder to complete the open sentence is a startling innovation in the solution process. This is especially exciting when we note the methodical attack on problems made by youngsters at the tender age of eleven.

It is not this first step that we criticize, but rather the computational aspect. It is here that the development has been anything but precise. Let us examine some of the objectionable features of the use of ratio test -

(1) If we take any two rational numbers, such as a/b and c/d, and assume equality, it is true that ad = bc. A logical proof can be given and thus the cross products can be used as a property or, rather, theorem for further proofs.

It is also true that we often explain and develop solutions based upon fundamental laws which we have not formalized, especially at the elementary level. But can we conclude that students at this age can benefit from the short cut which we usually call cross-multiplication? Are we not falling into the traditional trap of using meaningless rules to get answers?

(2) But this is not the worst feature of the use of ratio test. Students at this age are not securely aware of the meaning of symbols. In using the ratio test we teach them literally to multiply across an equal sign. Later on when they multiply two rational numbers, especially algebraic numbers, they will certainly be confused to find a different situation entirely.

(3) Perhaps the strongest objection we can make in using the ratio test is that in so doing we are bypassing an excellent opportunity to teach these youngsters the use of fundamental laws of operation. These are the laws from which we derive our authority for using the "test" in the first place. We will show this by example later. We may sum up this argument with the old adage that the sins of omission are often worse than those of commission.

(4) Lastly, this excellent opportunity to use the basic laws of "inverse for multiplication" and "equality" will lay a firm foundation for deductive thinking. Children like to know the whys in mathematics and reference to basic laws is satisfying to them.

Of course these fundamental properties should be illustrated concretely. For example, the inverse law could be written 3/1 x 1/3 = 1 and changed occasionally using other whole numbers to replace 3.

Let us illustrate the solution of a problem using the ratio method by fundamental principles.

"What is the cost of 5 cans of corn if 3 cans cost 57 cents?"

Step One, English Problem - Mathematics Problem

Rate or Comparison	Ratio or Open Sentence
$\frac{3 \text{ cans}}{57 \text{ cents}} \quad \frac{5 \text{ cans}}{n \text{ cents}}$	$\frac{3}{57} = \frac{5}{n}$
or $\frac{57 \text{ cents}}{3 \text{ cans}} \quad \frac{n \text{ cents}}{5 \text{ cans}}$	$\frac{57}{3} = \frac{n}{5}$
or $\frac{3 \text{ cans}}{5 \text{ cans}} \quad \frac{57 \text{ cents}}{n \text{ cents}}$	$\frac{3}{5} = \frac{57}{n}$
or $\frac{5 \text{ cans}}{3 \text{ cans}} \quad \frac{n \text{ cents}}{57 \text{ cents}}$	$\frac{5}{3} = \frac{n}{57}$

All four of these are correct. For computational purposes, we shall use the second.

Step Two, Solution of Mathematics Problem or finding the replacement for n

$$\frac{57}{3} = \frac{n}{5}$$

$$\frac{57}{3} = \frac{n}{1} \times \frac{1}{5}$$ (Rational components, from Identity law)

$$\frac{5}{1} \times \frac{57}{3} = \frac{n}{1} \times \frac{1}{5} \times \frac{5}{1}$$ (Inverse law and Equality)

$95 = n$ (Simplify)

$n = 95$ (Reflexive law)

Step Three, Closing the sentence

$$\frac{57}{3} = \frac{95}{5}$$

Step Four, Interpretation

Five cans of corn will cost 95 cents.

In conclusion, we should note that, while the development of the above rationale may require a little more patience at first, it should be most rewarding. The student has been introduced to solving equations on solid ground that is sequential in nature. The ratio test method at this level is only an expedient that serves no developmental purpose in using fundamental principles for computation.

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