The √Problem Solver
A Math Newsletter for Adult Educators

Funded by Western Mass SABES & MA D.O.E *Vol. 7 No. 1 _ Winter 2004*

FORGING A NEW ASSESSMENT TOOL

The Adult and Community Learning Services (ACLS) and the Center for Educational Assessment are collaborating to develop an ABE assessment tool that will be used statewide to measure student's educational gain in math. The ABE Math Test Specifications Committee has been formed and begun the process of designing a test *"to measure students' knowledge and skill in specific standards in the Massachusetts ABE Math and Numeracy Curriculum Frameworks, so that their progress in meeting educational goals can be evaluated,"* according to Jane Schwerdtfeger from ACLS. It is not known whether or not the test will be designed solely for electronic administration.

Led by Professor Stephen Sireci and others from the University of Massachusetts /Amherst Center for Education Assessment, the committee includes the following ABE educators, practitioners and ACLS staff: Barbara Goodridge, Esther Leonelli, Mary Jane Schmitt, Kenny Tamarkin, Judy Titzel and Jane Schwerdtfeger.

Assessment format decisions have not been made at this time. The committee has met to start drafting the levels of the test, and what content areas should be assessed at each level, along with the cognitive abilities at that level (these include knowledge and comprehension, application - math connections, and math reasoning - analysis, synthesis and evaluation). All test questions will relate to skills and concepts outlined in the State's ABE Math and Numeracy Framework. That Framework covers four strands: Number Sense; Statistics and Probability; Patterns, Functions, and Algebra, and Geometry and Measurement. More information will be forthcoming in the months ahead.

Stay tuned! ☯

EDITOR'S ANGLE

What do doubling recipes, figuring gas mileage, enlarging photocopies and setting sales numbers to realize target profits have in common? All involve proportions, linear functions where every x-value has a single corresponding y-value when plotted on a Cartesian plane (forming a straight line graph). When the EMPower curriculum team, of which I am a part, met with practitioners and educators to ask what math was most important to teach adults, almost all those professionals included *proportional reasoning* on their list of top three topics.

Piaget considered formal proportional reasoning to be among the latest cognitive developments children experienced. In fact, many adults never develop formal proportional reasoning, regardless of experience. Multiplicative relationships remain impenetrable to them, even when transparently expressed in organized tables. They think in terms of addition. Others tend to over apply proportional reasoning to solve non-proportional problems.

In this issue we offer several proportional problems and activities. We also include a review of student solution methods showing different applications of proportional reasoning. To keep current on numeracy affairs, we offer on update on the Department of Education's assessment plan, a review of *Rethinking Assessment*, and other news tidbits.

Feedback and ideas for future issues are welcomed. Please contact Tricia Donovan at triciad @crocker.com. Enjoy! ☯

INSIDE

How many roses did Erin need to buy and sell in order to make the $12 she needed for a gift?

At Notre Dame Adult Education Center, South Boston, three solutions for *The Rose Problem* emerged during a division lesson. Though unique in framing and/or solving the problem, each method reveals proportional reasoning either directly or indirectly.

The Rose Problem *(EMPower Curriculum)*

Erin bought some roses to make money for a gift she wanted to buy. She paid $6.00 for every 12 roses she bought. Later, Erin was charging $6.00 for 8 of them. She sold them all and made a profit of $12.00. How many roses did Erin buy and sell?

Three Solutions

(All names have been changed to protect student anonymity. Note that all students, other than Miguel, appeared to have difficulty at first understanding the problem. EMPower curriculum writers recommend that classes read aloud the problem and that volunteers explain it in their own words or dramatize it.)

Noreen's Method

(unit cost + proportion)

Find out how much profit Erin made on each rose.

Bought 12 roses for $6 = 50¢
($0.50 each)
Sold 8 roses for $6 = 75¢
($0.75 each)
…So Erin made 25¢ on each rose.
2 roses = 50¢, 3 roses = 75¢, 4 roses = $1
12 x 4 = 48

Monique's Option 2

(unit cost including dividing to find how many blanks in a blank)

6 ÷ 12 = .50 divided to find the cost of one
6 ÷ 8 = .75 divided to find the selling price of one
12 ÷ .25 = 48 each one is 25¢ profit, so divide to find how many of those in total

Miguel's Option 3

(canceling out and proportion)

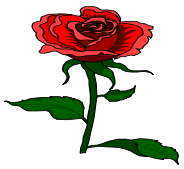
XXXX|XX "She buys a dozen. If she
XXXX|XX sells 8, she covers her cost."

XXXX OO } $ 3
XXXX OO } "The four free ones give her $3 because eight gave her $6."

XXXX OO } $ 3
XXXX OO }

XXXX OO } $ 3
XXXX OO }

XXXX OO } $ 3
XXXX OO }



"$3 + $3 + $3 + $3 = $12, so 4 dozen or 48 roses"

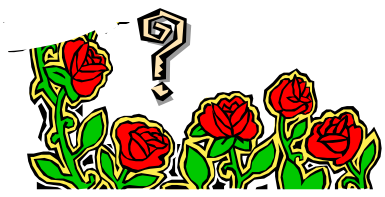
The use of proportional reasoning is clearly visible in Options 1 and 3, Noreen's and Miguel's. Noreen finds the unit profit then builds the ratio until she figures out how many roses are needed to make $1 profit. She is able to abstract that four roses equal one dollar, so she needs 12 times that to get her targeted profit. Thus, she needs 48 roses. Noreen clearly sees that an increase in the number of roses is matched by an increase in profits. If need be, she could build her ratio all the way to 48 roses = $12.

Miguel relies fully on proportional reasoning, and a bit of commercial experience. As a businessperson, he figures that the first task is to cover expenses. He sees that Erin covers her cost by selling eight roses, leaving her four on which to profit. He further reasons that if she sold eight for $6, then the four left, being half of eight roses, will yield sales of $3. The reasoning is elegant. He then sees that she needs to repeat her sales four times to yield the $12 target profit. The result is she needs to sell four dozen, or 48 roses.

Monique's use of proportional reasoning is less evident. In what appears to be the most efficient solution to the problem, Monique determines the unit profit then looks to find the number of those 25-cent profits in $12. Here, the more formal proportional reasoning surfaces. Her equation: 12 ÷ .25 = 48 seems to simplify the formal proportion 12:x :: 1:.25. She uses her equation to answer the question: How many single rose profits are there in $12 of profit? This is the same as thinking: one rose makes 25¢ profit, so ___ roses makes $12 profit. The relationship between the two variables, roses and profit, is transparent. There will be one value for profit for each value of roses.

Of course, finding the unit rate is key to all three solutions. Knowing to do this is, in itself, reflects proportional reasoning. Find the unit rate, and you can find the corresponding value for any number of items. A graph would demonstrate this beautifully.

Not all students were able to access proportional reasoning. At least one student kept losing track of roses and profit as she tried to build the ratio from profit on one rose to profit on two, to profit on three, etc. She did not see a direct relationship between the two variables and was unable to continue the ratio on her own to reach a solution. This student, like many others, needs to develop an intuitive sense of proportion. Activities such as doubling recipes, and *How Long Will It Take?* (p. 3), as well the use of manipulatives to observe the relationship concretely are ways teachers can help students in this situation. ☯



EMPOWER ACTIVITY: HOW LONG WILL IT TAKE?

Objectives: 1) Determine and describe a sample work rate; 2) Predict from the sample for a larger amount 3) Illustrate various ways to show that the ratio or rate remains the same.

Materials and Prep: Set up 3 stations before class, multiple stations for large classes.

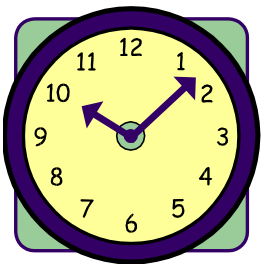
Station 1 – 20-30 sheets of paper and a pile of 20-30 envelopes. Fold one sheet in a trifold and stuff it in an envelope as a sample.

Station 2 – One medium size (1/2 lb.) potato for each team and one potato peeler.

Station 3 – a jar of pennies, no more than 200, and a few empty penny rolls.

Newsprint with a table like this:

TASKS	TIME ESTIMATES TEAM 1 TEAM 2 TEAM 3
Fold & stuff 1,000 envelopes	
Peel 50 pounds of potatoes	
Roll 10,000 pennies	
Total Time	



Activity -- *Read Aloud*

You offered to help at a community event and said you were willing to give about 4 or 5 hours of your time. Therefore, the coordinator assigned you the following jobs:

Sending out 1000 announcements
Peeling 50 pounds of potatoes for a huge potato salad
Rolling 10,000 pennies from the penny-toss

You think these jobs are going to take a lot more time than you offered, but want some proof.

To get a good estimate of how much time these tasks take, you sample each activity and use the idea of equal ratios to figure out the time needed for the total job. ***How long do you estimate the assignment will take?***

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Work with your team to answer the questions for each station/activity.

1. Take a sample of how long it takes to do a part of the job;
2. Use the sample rate to predict for the larger quantities;
3. Show how you figured out how long the larger quantity would take to do;
4. Use one other way … a picture, a graph, a table, equal fractions, or decimal form to confirm that the ratios/ rates are equal.

Questions for Each Station: Envelopes – Potatoes - Pennies

1. The sample we took and what we found out:
2. Method we used for figure out how much time it would take to finish the job
3. Our final estimate: _____
4. How we checked that the ratios are equal with another way… a table, graph, fraction form to decimal or whole number form.

Station 1: Stuffing Envelopes

How long would it take to fold these flyers and stuff 1,000 envelopes? (Some else licks and stamps.)

Station 2: Potato Salad

How long would it take to peel 50 pounds of potatoes?

Station 3: Rolling Pennies

How long would it take to roll 10,000 pennies?

Book Corner – Australians Raise Assessment Awareness

Once again the folks 'Down Under' have tackled a key issue in adult numeracy education. In *Rethinking Assessment: Strategies for Holistic Adult Numeracy Assessment*, Beth Marr, Sue Helme and Dave Tout share assessment theories and practices based on research conducted with experienced teachers. This resource book is a practical guide to performance-based assessments that consider needs of students, as well as teachers and programs. The wealth of tasks, organizational tools and insights into what it means to be competent in numeracy will make you re-think your own assessment practices and, perhaps, question assessment practices designed with different aims in mind. Available from Aris, Language Australia, *sales@languageaustralia.com.au.* ☯

Web Lines – The Power of 10

The link below opens with a picture of earth from 10 million light years away and zooms in at a factor of ten, and another ten, and another ten, down to the quarks in an atom of a leaf. Scale and proportion are visually arresting.

http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/

After you look at it once you can back it up and zoom out into the universe. ☯

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