The √Problem Solver
A Math Newsletter for Adult Educators

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Equipped for the Future?

The Problem Solver conducted the following interview with EFF National Facilitator Donna Curry of Maine (and formerly of the Mass. ABE Math Team).

1. *What is EFF and where is it in use?*

EFF is a standards-based systems reform initiative that came about when NIFL (National Institute for Literacy) was asked to address the Adult Literacy and Lifelong Learning goal of the National Educational Goals - "every American adult will be literate and possess the knowledge and skills necessary to compete in a global economy and exercise the rights and responsibilities of citizenship."

To address this goal, NIFL first asked over 1500 adult learners what skills and knowledge they needed to keep up with change in their lives. This research clearly defined four purposes for learning: (1) access and orientation, (2) voice so others will listen to them, (3) ability to take independent action, and (4) to bridge to the future to keep up with an ever-changing world. These 1500 also said these reasons for learning were driven by needs in the their primary roles as workers, citizens, and family members.

NIFL then asked hundreds of businesspeople, community and family members what it took to be successful in these roles. These sessions resulted in the development of the three EFF Role Maps: parent/family member, community member and worker and the EFF Common Activities considered "common" to all three roles. One of the Common Activities is 'Gather, Analyze, and Use Information.' Through further research, EFF identified *skills* used to perform the various Common Activities. These sixteen skills became the basis for articulation of the sixteen EFF Standards which are grouped into four categories: *Communication Skills; Decision-Making Skills; Interpersonal Skills* and *Lifelong Learning Skills.*

Currently, 38 states work with the EFF Center for Training and Technical Assistance, part of the Center for Literacy Studies at the

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Editor's Angle

With all the talk of educational 'accountability' and testing, it is helpful to remind ourselves of the importance of teaching and learning. Therefore, in this issue we acknowledge the inescapable requirements for testing as a measure of competency by sharing with you insights about common student errors on the current GED tests. However, we also devote considerable space to exploration of the EFF (Equipped for the Future) learning and teaching model which was developed in answer to the question: "What do adults need to know and be able to do in order to carry out their roles and responsibilities as (a) workers, (b) parents and family members, and (c) citizens and community members?"

We recognize that this newsletter arrives as many of you are preparing for graduations or new classes. The ideas presented are meant to help you through this transition time and to plant seeds for future classroom activities and approaches. As always, we are pleased to hear from you regarding your response to these ideas – whether as developed lesson plans to share or as letters of comment.

In addition to the articles in this edition, you will find intriguing activities in the pullout section. These activities were designed by members of the Teaching Math & Numeracy in the ASE/GED Classroom certification pilot course held this winter at the Western Mass SABES center. This same course, in a slightly different format, is currently being offered at the Southeast SABES center. Mixed in, you will find some information tidbits, problems and references. Enjoy. And please, write me at triciad@ crocker.com with your thoughts and teaching ideas. ☯

INSIDE

University of TN. Ginny Bleazey (bleazey@utk.edu) is the contact person there. Also, there are 5 states working on the assessment continuum. Because the EFF initiative is designed to address issues germane to adult basic education extensive research on each of the standards has been undertaken in order to develop an Assessment Framework.

2. *Please talk about what EFF math classes look like*.

In the EFF model, math is not a treated as a list of discrete skills, rather the model describes how it is we use math. For each EFF Standard, there are performance components that provide a common definition of what it means to perform the standard. To understand what we mean when we say someone can use math, we have articulated the following components of performance for the standard – **Use Math to Solve Problems and Communicate**:

- Understand, interpret pictures, numbers and symbolic information.
- Apply knowledge of mathematical concepts and procedures to figure out how to answer a question, solve a problem, make a prediction, or carry out a task that has a mathematical dimension.
- Define and select data to be used in solving the problem.
- Determine the degree of precision required by the situation.
- Solve problems using appropriate quantitative procedures and verify that the results are reasonable.
- Communicate results using a variety of mathematical representations including graphs, charts, tables and algebraic models.

If you use the EFF Standard as your guide, it really pushes you to put the "math" you are teaching into context. "Doing math" becomes much more than just doing pages of computation. We do computation for a purpose – to answer a question, to solve a problem, to communicate something. In real-life situations, we have to figure out which data to use (life problems are not cleanly written out for us in the form of "story" problems that provide all the data we need).

As an example, let's say students choose as a goal being able to buy a car. Too often, teachers give students all the information needed to do a variety of computations instead of asking: What are some of the questions you would have to answer before buying a car? Where would you get that information? What about insurance? Have you considered the difference between buying new vs. a used car? Is an estimate good enough?

Posing questions is the key role for the teacher. She works to figure out what is that they already know and are able to do by posing questions. She knows that, ultimately, students must be able to pose their own questions in order to address real-life issues involving a mathematical perspective.

3. *How do you ensure a breadth of curriculum?*

There needs to be discussion and reflection after every learning activity students engage in. If students want math to survive at work or home, they should be helped to gain a solid understanding of how to use math for their specific situations. This includes exploring various concepts that students will have to apply to be successful in those roles. As students gain confidence in using math for one type of activity, they are encouraged to broaden the types of situations in which they apply the math they're learning. For students wanting to get a GED, you can still begin with how they presently use math. When they say they only use math for shopping, explore what types of things they shop for. Is it gardening supplies? If so, the teacher can nudge them into investigations that involve area and perimeter as well as buying gardening materials.

EFF teachers always start with how students use math in life then make connections to the GED. If we teach to the test, but students don't have real-life skills that they can apply, we're doing a disservice both to the student and to our program.

4. *Talk a bit more about the EFF teacher.*

The EFF teacher begins with the student. She says to the student, 'You want your GED, but let's talk about how you are using mathematics now. Much of what

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EFF Teaching/ Learning Cycle

1. Determine individual goals and purposes.
2. Identify standards that would help learners achieve their goals.
3. Find out what learners already know and can do.
4. In a group situation, come to consensus on a shared priority (real life concern) that focuses the learning activity.
5. Design a learning activity to address the shared priority (real life concern) of the learners.
6. Develop a plan to capture evidence and report learning.
7. Carry out the learning activity.
8. Observe, document, evaluate, and report evidence of performance on the standard.
9. Reflect on how what was learned is transferable to other real life situations.
10. Determine next steps to help learners meet their goals.

STUDENT ACTIVITY: Walking to Integers – Carl's Conga Line

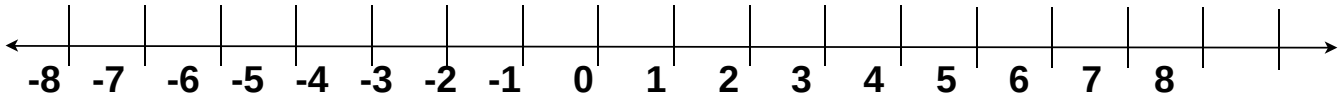
Source: Carl Coniglio for the Teaching Math & Numeracy in the ASE/GED Classroom Course (adapted from Robert Moses)

In this activity students walk forward and backwards to represent addition and subtraction, positive and negative. It is appropriate for small classes with pre-GED and/or GED students.

Objective: To strengthen understanding of adding and subtracting signed numbers.

Learners will be able to: (1) Walk in the correct direction both forward and backward to demonstrate an understanding of addition and subtraction with integers. (2) Use this understanding to explain addition and subtraction with integers on a chalkboard or with a number line.

Strand Addressed: Patterns, Functions, and Algebra, Intermediate ABE and Pre-GED



Materials Needed:

- Chalkboard
- Open area at least eight paces long
- Place-markers about a pace apart along a back and forth path through the room, for example duct tape strips on the floor
- Movable makers/pointers that can be used to indicate place and direction, for example a shoe, or glove.

Steps in Activity:

- Explain that in this activity:
  Plus means keep facing the same direction
  Minus means face the opposite way (turn around in place)
  Positive means walk forward. Mention that numbers w/o a sign are either positive or zero.
  Negative means walk backward (w/o turning around)

- Have each student take a position at different places along the marked path through the room. (Places can be shared.)
- Begin with students facing the same direction.
- Have each leave a unique marker (a shoe works) indicating both the *place* where s/he starts and the *direction* s/he is facing at the start.
- Slowly read aloud an addition or subtraction problem one term and operation at a time, for example, "Negative two (pause) minus (pause) positive (pause) equals ___" in this case, students walk backwards two places, then turn around in place and then walk two places forward.
- Have them mark their stopping place. (Use the other shoe.)
- Now ask them to see how many places they are from where they left their starting mark and whether or not they are in front of or behind their mark. In this example they will be four places behind, i.e. –2 – 2 = - 4.
- Write each problem and answer on the board as it is completed.

Equal Volumes?

Assume you designed two popcorn containers from an 81/2" by 11" piece of paper – two cylinders – one tall, one short (you don't have to worry about tops and bottoms at this point). Do they have the same volume? Can they all hold the same amount of popcorn?

Number Clues

The following problem was adapted from Containers and Cubes, published by Dale Seymour Publications. It is a great way to practice times table facts and to think about factors.

Find 3 numbers that fit the clues. (1) If you count by this number, you will say 28, but not 30. (2) If you count by this number, you will say 120, but not 145. (3) If you count by this number, you will say 81, but not 80.

STUDENT ACTIVITY: Global Warming and You

Adapted from Materials presented by Amy Stamm for the Teaching Math & Numeracy in the ASE/GED Classroom Course

This activity offers ABE/Pre-GED students a way to practice working with numbers as they consider ways to reduce their carbon dioxide emissions.

Objective: Learners will be able to add, subtract, multiply and divide numbers to reach the goal of 2000 pounds.

Activity

Introduce the topic of global warming and Canadian Prime Minister Jean Chrétian's challenge to every citizen in the industrialized world to reduce carbon dioxide emissions by one ton or more.

Challenge pairs or individuals to devise a plan for reducing their personal, or their family's CO2 emissions by one ton, or 2,000 pounds a year. Remind them that they can do an activity for 1/2 or 1/4 of the time described in the Action box.

ACTION	CO2 SAVINGS
Eat meat-free meals every other day. Vegetarian food requires much less energy to produce	487 pounds
Park the car for 60 days this year. Walk, cycle, or take public transit.	917 pounds
Switch from hot to warm or cold water for every load of laundry.	600 pounds
Switch two standard light bulbs to more efficient fluorescent bulbs.	1000 pounds
Replace the current showerhead with a low-flow model.	300 pounds
Turn the thermostat down two degrees for one year.	500 pounds
Cut vehicle use by 10 gallons.	200 pounds
Replace the 20-year-old fridge with an energy-saver model.	3000 pounds
Send out one fewer 30-gallon bag of garbage per week.	300 pounds
Recycle aluminum cans, glass bottles, plastic, cardboard & newspapers.	850 pounds
Walk instead of travel by bus or train for 4 miles a week.	50 pounds

Pairs check each other's computations and verify or seek clarification.
Students present their plans to the class and compare results for factors such as *cost*, or *feasibility*.

See more items at *www.canadachallenge.org* or at *www.vtearthinstitute.org/carbonwksht*

Web Lines – *from the NCTM newsletter*

The Algebra I Web site provides first-year algebra students with tips for studying and test taking, problems of the week, explanations, interactive pages, and QuickTime movies – *www.bonita.k12.ca.us/schools/ramona/teachers/carlton/index*

Exploring Data provides curriculum support for teachers of introductory statistics – activities, worksheets, overhead transparency masters, data sets, and assessment to support data exploration – *exploringdata.cqu.edu.au*

Error Analysis: A Report from Kenn Pendleton

What errors are students making or *not* making on the GED mathematics test? Kenn Pendleton, Mathematics Test Specialist for the GED Testing Service in Washington, DC, reported on *Alternate Format Questions: What Can We Learn from Responses?* at the recent Adult Numeracy Network meeting held in San Antonio. Below is a summary of Pendleton's insights, guaranteed to be useful in preparing students for the GED.

Responses to the two format types – coordinate grids and standard grids – were analyzed by Pendleton. For the **coordinate grid questions**, he found that "over-whelmingly the single **most common error is a multiple response."** That is, students failed to enter one and only one answer on the coordinate grid in their answer booklet. Asked on one test question, *What is the location of point B, the fourth vertex of the rectangle?* students either copied the three points provided in the test booklet, drew various sides of the rectangle or found the point of intersection of lines that would be the fourth vertex. However, Pendleton said, " This is all well and good, but then they must erase all but the response, which is only the fourth vertex."

Similar issues arose when students were asked to find the point representing the center of a circle or to solve a set of linear equations where the x value is 3 and the y value is two. In the later case, students located 3 and 2 on the axis, not as a point (3,2) on the graph. Emphasize that there is only one correct answer, one point to mark, reminded Pendleton.

Standard grid questions, where students circle numbers corresponding to solution values were found to present the same error types as those found on any multiple choice test. Anticipated test errors particular to the grid use did not surface, he said. What types of errors are not occurring? Less than 0.1% of respondents are giving no response or multiple responses to these questions. Only 1.65% represent place value errors where, for instance, instead of bubbling in only the numbers 4 and 5 for an answer of 45, they bubble in 450000.

The typical **multiple choice errors** that are surfacing include:

- Incomplete process (seeing only one step of a multi-step problem)
- Order of operations
- Graph interpretations

Less common are errors involving conceptual misunderstanding and entering a response in an incorrect location.

One example of an **incomplete process error** involves the following problem:

The complete process answer is $3.45 -$2.75 = $0.69; however,

> Electric switches that regularly sell for $0.69 each are advertised this week at 5 for $2.75. How much is saved by purchasing at the sale price rather than at the regular price?

students commonly mark as correct the incomplete process answer 5 x $0.69 = $3.45.

An example of an **order of operations error** involved this problem:

Here the correct response was C = 15 + (30)2/10 = 105, but students

> Carla's frame shop determines the cost of framing a painting with the following formula: C = 15 + x2/10. C is the cost (in dollars) for framing, and x is the LARGEST dimension (in inches) of the painting to be framed. If Simon has a painting that is 20 inches by 30 inches, what is the total amount he would be paying at Carla's shop?

selected answers such as C = 15 + 30/10)2 = 24 or C = 15 + 60/10 = 21 or C = (15 + 900)/10 = 91.50.

Correctly **interpreting graph features** also resulted in numerous errors for students. Given a graph with three lines representing the cost of different rental cars, for instance, students misinterpreted a y intercept that landed midway between $30 and $40 as 30.50 rather than 35. Or when asked, *For how many miles driven per day is the cost to rent from C the same as the cost to rent from A?* Students focused on the wrong point of intersection, marking the point of intersection for lines C and E, not A and C. They also failed to recognize the meaning of a flat line. When given the problem: *Kyle and Felix both rented cars for one day from E. If Kyle drove 40 miles and Felix drove 120 miles, how much <u>more</u> (in dollars) did Felix pay?* The correct response was 0, because the flat line showed that regardless of the number of miles drive the cost was $35; however, students responded either 35 (the cost of a daily rental) or 120 – 40 = 80.

The upshot seems to be that the forms are less baffling than the problems. If students can be guided to give single point responses to the coordinate graph questions, the forms will likely not be the cause of lower scores. The challenge remains to help students understand how to solve and represent mathematical problems and how to interpret given representations of problems. ☯

Decimal Places . . .

Nancy Markus

A problem with just using the counting decimal points algorithm is that because students don't understand what is happening, **they count from the wrong end!** I start off with numbers such as 1.3 x 5.64 and tell them the digits are 7332. Then I ask, what would make sense if you took 5.64, 1.3 times. Would you get 7332, 733.2, 73.32, 7.332 or .7332? Since we do a lot of estimating, we figure many of these out using number sense.

you use doesn't show up on a multiple guess test. For instance, how did you figure out when to leave to get here on time? How much money do you think you are going to have to make if you want a bigger apartment?" We shouldn't always be teaching for 10 years from now.

The EFF teacher starts with what the learner knows and can do. She then develops real-life activities using the components of performance for the EFF Standard. She uses workbooks and other materials as resources for practice and review for real-life situations, not as the core curriculum. If the student wants to go to college, s/he needs to know algebra and how to multiply and divide fractions, so the EFF teacher tries to develop real-world problems that illustrate the application of those skills. It's all about application. The EFF teacher is a guide; she prompts the students.

5. *What are some of the barriers to instituting an EFF?*

Wanting to think out of the box, but being connected to the K-12 paradigm. Being stuck by having to fit into this set curriculum rather than being free to teach what students want to know. Also, wanting to improve TABE scores. We try to tell teachers, if you give students a good foundation where they apply the math, they'll do better on the test, those scores will rise. You will see results, but it may take longer. Those students who need just a brush up, give it and let them go. Lastly, then the biggest barrier, as in all genuine teaching and learning, is time. ☯

EFF On-Going Pratices

- Work with learners to continually revisit and revise their goals.
- Engage learners, throughout, in identifying and applying their prior experience and knowledge to their learning.
- Build in opportunities throughout the activity for learners to reflect on and monitor their own developing knowledge, skills, and learning strategies.
- Make sure throughout that learners clearly understand what they are learning and why.
- Adjust the learning activity to reflect emerging goals and learning needs.

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Funded by Massachusetts Dept. of Education and Western Mass. SABES _ *sabeswest.org*

Tricia Donovan _ *triciad@crocker.com*
225 Hoosac Road Conway, MA 01341