WRITING TO LEARN in MATH

Teachers learn; students learn

COLLABORATION/COOPERATION
Learning Pairs and Groups

A Handbook for Mathematics Teachers

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Introduction

MODIFIED TEACHING STRATEGIES FOR MATH

Algebra is the basis for all upper level math courses, according to the California State Mathematics Framework (1985). It is important, therefore, that students get a thorough understanding of the basics of algebra. They'll need this kind of firm foundation to build upon in order to increase their chances of success in subsequent courses.

The teaching strategies offered in this **HANDBOOK** are those I originally compiled for use in Algebra classes . However, when I began to share them with math teachers, I learned that these instructional ideas are appropriate for any mathematics classroom with a teacher who is willing to collaborate and share her teaching with the students in the class.

GOAL:

It is the goal of this **HANDBOOK** to offer modified teaching strategies that **combine expressive writing with cooperative learning** techniques, substituting these teaching and learning strategies for the current ones that rely more heavily on such traditional methods as teach and test.

"Unless students write about what they are learning IN THEIR OWN WORDS, they will experience 80% loss of retention within three weeks." (McGill and Miller, 1989)

OBJECTIVES:

The first objective of these innovations is two-fold: to provide expressive/exploratory/ discovery writing activities that will **increase the confidence and competence** of students taking the course and to provide an **on-going evaluation tool** for the teacher to **assess** what students are learning without having to give stressful tests or tedious graded assignments. Literature reviews show that students who do more heuristic writing (writing to learn rather than to show learning) tend to retain more of what they learn for longer periods of time. (Tierney , 1982; Evans, 1986)

The second objective is to provide activities that will aid math teachers in bringing their **teaching** in line with the verbalization and cooperative learning **principles** outlined in the California State Board of Education Mathematics Framework (1985). Among these principles are teaching strategies that "enable the teacher to diagnose specific deficiencies" and "to measure the understanding of mathematical concepts and their applications (p.5).

PROCEDURE:

The variety of activities will:

Stimulate metacognition (thinking) by assigning expressive/exploratory/ discovery writing.

Stimulate verbalization (talking and writing) of math concepts by assigning cooperative/collaborative activities.

Encourage shared inquiry (discussing and questioning) by assigning combinations of expressive/exploratory/discovery writing and cooperative/collaborative learning group activities.

GETTING STARTED

MATH JOURNALS or **LEARNING LOGS** form the basis of this methodology. You may ask the students to set aside a separate notebook that they keep in the classroom, or set aside a section of their loose-leaf binder for exclusive use as **math journal or math log.** I prefer the students keep this kind of writing in their binders for ready access.

In this special place, students should be required to write:

(1) what they are learning

(2) reactions to their learning

(3) explanations of how to perform math tasks

(4) traditional lecture notes

It is important that this writing be started early in the course and be maintained on a regular basis. Part of the value of this kind of expressive/exploratory/discovery writing is the fluency that develops once students are accustomed to it.

Expressive writing is the kind of writing students do that puts into words what they think they are learning. This writing is very much like speech. It is usually uncensored for grammatical corrrectness and is usually intended to **communicate with the writer** not the teacher/reader. The students put into their own words their understanding of what is going on in the math assignments and how they **feel** about what they are learning.

10/28
Dear Journal
My first C!! Boy did I bomb this baby! My mistakes were mostly careless and since I didn't get time to check it, they couldn't be corrected. Some of the word problems were misinterrupted (sic) and so my answers weren't checked out. The exponent mistakes were just stupid!
OH WELL!!!!

EM
Sample of student journal entry

Exploratory writing is the kind of writing students do that helps them figure out how to solve certain math procedures.

9/28
3(x-5) = 1/5(10x-25). You would distribute 3 and 1/5 to the numbers. Then you would get the ex's to the left and 3's to the right. Then you would simplify and solve. Ones I can't do are c-2y=b. I cannot understand this! Which variable do you solve? How could you do it? I don't UNDERSTAND!!! I was trying to solve for Yb instead of just solving. I missed what the book said.

JL
Sample of student journal entry

Discovery writing is the kind of writing students do when they analyze and figure out what they know about the math assignments they are given. In assignments that call for this kind of writing, the students look carefully at the kind of errors they made on specific assignments, then write about what they discovered about their own work.

10/28
Dear Journal. I could of done better on the test. I got two wrong on the exponents which I knew how to do but forgot. I made one silly error on Sci. Not (Scientific Notation) *by forgetting it was a negative (insert 10 (-4 exponent). One part I did not know the difference between of % and more than % and on the chemical prop. I set it up right but worked it out wrong. And I messed up on the age problems. Now I know to stick with the first answer.*

BA
Sample of student journal entry

You've probably noticed that none of this writing is completely isolated from the other kinds. A student may express, explore and discover in a single writing assignment.

Encourage students to be **honest** about themselves. Help them to see that the fact that they missed six problems may only occur because they didn't know two procedures. It may be that they had been asked three problems that called for knowledge of just two procedures!

The students should be encouraged to write **freely**, without worrying about whether they will be graded for adhering to the conventions of standard English. They should, however, be **explicit, complete and precise** in their entries. The more fluent they become the more they will learn about what they know/don't know.

You may wish to **reward** these efforts. This may be a combination of verbal compliments and homework grades or bonus points. But keep in mind **it is not necessary to grade every writing assignment.** The value in writing is writing. At the same time, you should avoid making negative comments or penalizing those who do not write very much initially. WRITING TO LEARN WORKS! Those who are reluctant should soon see the difference on graded assignments between those who write regularly and those who don't. Just keep on assigning writing and rewarding those who do it.

MATH TEACHERS' RESPONSES TO WRITING-TO-LEARN (WTL) IN MATH

As you begin assigning WTL activities in your math class you will notice changes in your own approach to teaching as well as changes in students approach to mathematics,

When asked how theuse of heuristic writing (WTL) in math changed her teaching style, one Algebra and Geometry teacher responded that *she prepares each chapter by thinking about what she will ask her students to know well enough to write about, and then begins teaching with care and clarity so they'll be successful writing this way.*

Students respond by paying closer attention to their textbook assignments because they know they will be ask to write about its contents in their own words. When you modify your teaching to include WTL, your students, too, will begin to:

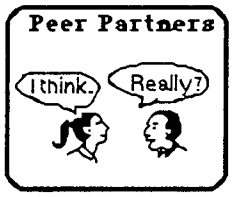
* **focus** on their assignments and performance on them
* **analyze** reasons for their success and failure in math
* **reflect** on the what they read in texts and hear in your lectures
* **verbalize** in written and oral form with you and their classmates
* **collaborate** with partners or groups as directed

Again, none of these results is isolated. A student may focus and analyze during a reflection on an assignment, then verbalize in a collaborative situation.

COOPERATIVE/COLLABORATIVE LEARNING GROUPS

Many teachers find it logical to combine some of the writing activities with cooperative or collaborative learning activities. Students may work in assigned or self-selected pairs, or groups of four or five students.

Paired Activities



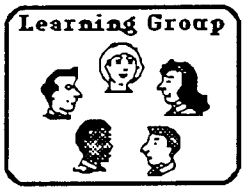
3-5 minutes

Desk-touching activities make good follow-up to many of the writing ideas described in this **HANDBOOK**. After students do math learning log entries, ask them to pull their desks together until they touch, thus forming a common work surface. The students share what they've written, trying to **help** each other see more clearly **how** and **why** certain errors were made, then suggest alternative ways to solve the problems.

It is important to allow the students just a few seconds less time than they seem to need. Leave them wanting to keep sharing. Begin with two to three minutes, then gradually increase the sharing time as students learn how to use the time productively. Usually five to six minutes are enough.

Another Algebra teacher who uses WTL in math remarked that *she saves time because once the students have written about their own math work, talked with a partner or a group, they seem to work out more things for themselves. Several students can talk to each other at the same time, resolving individual problems in less time than it took her to answer individual concerns during whole class discussion time.*

Group Learning Activities



5-15 minutes

For some reason group work seems to work best when the number is kept to four or five students. These groups may be randomly organized with students merely pulling their desks into circles of four or five students; or the teacher may structure the groups according to predetermined compositions. You may wish to have groups :

Varying in ability - One high, one low and two middle achievers
Varying in sex - Two male, two female
Varying social or language ability - Two outgoing, one shy, one ESL

Whatever the make-up, students tend to talk more freely in small groups. Since **talk teaches** students to organize and verbalize their thoughts, seriously consider coordinating writing to learn activities with paired and group activities.

MAINTAINING ORDER
KEEPING CLASS ON TASK

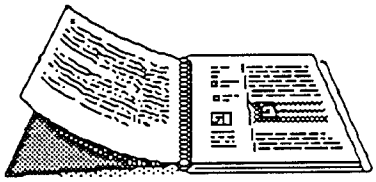
While students are learning to use this sharing time wisely, circulate around the room listening to the discussions, but avoid entering the conversation. Frequently this **focused talking** can be as valuable as your teaching. As the students come to the sharing time, having already written about their own attempt to solve the problems, they are more likely to be able to focus on the assignment and are more ready to get right on task.

If the students tend to stray, try one the these strategies:

(1) **Stop the session** at once and have students return desks to regular seating arrangement. Then, resisting the temptation to berate the students at this time, continue with the scheduled lesson. The next day, set them to task again. This time, **repeat** the instructions, **model** what they should be writing and talking about in their pairs or groups, **remind** them to stay on task and **reduce** the amount of time you allot for talking. Increase the time in about half-minute increments each day until five-six minutes limit is reached.

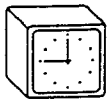
(2) **Circulate and record** during the sharing time. Listen for those who stay on task, recording on a prepared seating chart those pairs of students who do so. Stop the session when the alloted time is up, then award points for those pairs who stayed on task. (The purpose is to demonstrate that you feel this time is valuable **learning time** and reward those who use the time productively). Avoid penalizing those who have not yet learned to share in this mode. This is new for many students and it takes time to learn how to act. Give them the time through repeated assignments of these kinds of activities. Students will **learn by doing!**

SET UP OF HANDBOOK



The **HANDBOOK** is set up so that the various writing assignments are described and illustrated in alphabetical order. Recommending:

Who should do the assignment - individual, pair or group
What is the descriptive name of exercise
When during the period should an assignment be given - beginning, middle, end, anytime
Where assignment should be written - in log, on loose-leaf paper, on note cards
Why you should give assignment - for focus, analysis, reflection, collaboration,all
How should writing be credited or graded - check or grade (letter or number), either



A key element of this teaching strategy , using WTL in math, is **time saved.** Teachers who use it find that individual assignments take 1-5 minutes and paired and group assignments only 5-20 minutes. You will find that, you, too, will begin to have more direct teaching time, as you **substitute** WTL for traditional instructional methodologies such as: reviewing homework, and going over quizzes and tests at the beginning of the period, preparing for quizzes, tests and exams and administering these assignments to determine acquisition of math facts and concepts.

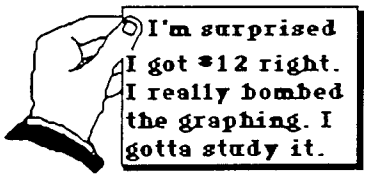
WRITING-TO-LEARN

and

COLLABORATIVE LEARNING

ACTIVITIES

ADMIT SLIP



WHO? X_ Individual _ Pairs _ Group

WHEN? X_ Beginning _ Middle _ End _ Anytime

WHERE? _ Math Log _ Loose-leaf Paper X_ 3 x 5 card

WHY? x_ Focus _ Reflect _ Collaborate _ All

HOW? X_ Check _ Grade (letter or number)

Description of Activity

Distribute 3 x 5 cards as students enter the classroom. Students write, anonymously, one or two sentences indicating particular kind(s) of problem(s) they experienced while doing the recent homework assignment. Collect, then quickly read these slips, either silently or aloud.

This strategy gives thc students time to focus on the precise assignment and the teacher an idea of what students do/do not understand. You, the teacher can then proceed, review or reteach according to the needs revealed on the **admit slips.**

ANALYSIS

WHO? X_ Individual _ Pairs _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _X Math Log _ Loose-leaf Paper

WHY? _ Focus _ Reflect _ Collaborate X_ All

HOW? X_ Check _ Grade (letter or number)

Description of Activity

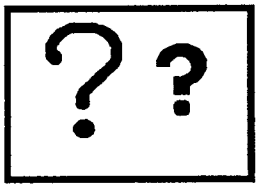
Students should be asked to write after a particularly difficult homework assignment or quiz and after each test. These writings force students to focus and reflect on their own work with its particular idiosyncrasies. Among the writing prompts to which they could respond are:

> What problem or kind of problem was most difficult for you that you are proud you could solve?
>
> What problem or kind of problem could you not solve?
>
> Try to describe the kind of error(s) you made most often. Why?

It is natural for students to resist this kind of writing. It is hard work. It is also different; students are unaccustomed to being asked to write without being asked to adhere to standards of conventional English. It is revealing writing. Students are uncomfortable becoming vulnerable.

Teachers, therefore , do your best to establish an atmosphere of community and shared learning.
KEEP ASSIGNING VARIOUS KINDS OF ANALYTICAL WRITING. It takes time for the students to realize the value of taking risks.

ANSWER THE QUESTION



WHO? X_ Individual X_ Pairs _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _X Math Log X_ Loose-leaf Paper

WHY? _ Focus X_ Reflect X _ Collaborate _ All

HOW? _ Check X_ Grade (letter or number)

Description of Activity

Have a math term on the board when the students arrive and ask them to write for a couple minutes answering the questions, **"What do you know about _____?** After writing in
their own words, they may add a sample problem or illustration, then share their work orally with a partner or in class discussion.

DOUBLE ENTRY LOG

WHO? X_ Individual _ Pairs _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _X Math Log _ Loose-leaf Paper

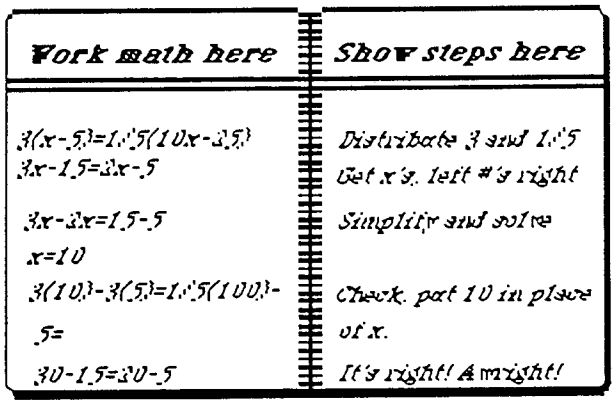
WHY? _ Focus _ Reflect _ Collaborate X_ All

HOW? X_ Check _ Grade (letter or number)

Description of Activity

On occasions it is useful to have students do a few problems in **double entry** format. In this case they would draw a line down the center of their paper or use facing pages in their math logs.. Then **work** the problems on the left side of the page and **explain** in words what they are doing on the right side of the page.

Sample Double-Entry Journal Page



This writing assignment helps the students develop a sense of order that may aid them in recognizing when they're off track at a later date. Often, they must use the current procedure along with several others, so if you can give them a tool for assessing their understanding of the procedures, they'll have more confidence in their ability to do math.

EXIT SLIPS

(Gere, 1985)

WHO? X_ Individual _ Pairs _ Group

WHEN? _ Beginning _ Middle X_ End _ Anytime

WHERE? _X Math Log _ Loose-leaf Paper _X 3 X 5 CARDS

WHY? X_ Focus X_ Reflect _ Collaborate _ All

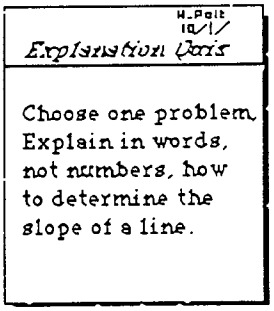
HOW? _ Check _ Grade (letter or number) X Neither

Description of Activity

Five minutes before the end of the period, distribute 3 x 5 cards to each student. Ask students **to write** in their own words **what has been taught that period** and **what they have learned.** Again, content not form is important in these notes. Merely collect these anonymous notes as the students leave the classroom. Reading them later, will give a better idea of what concepts the students have grasped and which ones need further clarification before proceeding on to new material.

This WTL activity is an effective way for both student and teacher to learn, in a non-threatening way whether or not the information taught has been learned. If the students can find the words to write fairly clearly what was taught in the lesson of the day, they know they know; if they can't, they know that too and can either ask for help or study themselves. They don't have to wait until a graded assignment to learn what they know! These **exit slips** help tell who knows what, now.

EXPLANATION QUIZ



WHO? X_ Individual _ Pairs _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _ Math Log X_Loose-leaf Paper

WHY? _ Focus _ Reflect _ Collaborate X_ All

HOW? X_ Check X_ Grade (letter or number)

Description of Activity

Rather than have students merely solve problems on a quiz, alternate solving problems with **explaining procedures**. Give a few problems for which the students will be required to tell **how** they would solve the problem, using their own words rather than numbers and symbols in their explanations. (See Double-Entry Journal p.15 and Unsent Letters p. 24).

EXPRESS IN PICTURES

WHO? X_ Individual X_ Pairs X _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _ Math Log _X Loose-leaf Paper

WHY? _ Focus X _ Reflect _ Collaborate _ All

HOW? X_ Check _ Grade (letter or number) X Neither

Description of Activity

Some students are better able to learn and express themselves visually . When pictures would help clarify a concept, use them and encourage students to do the same. Ask them to use neither words nor mathematical symbols to express a problem. Graphs, pie charts, stick figures, and other pictorial renditions sometimes can illustrate and explain better than abstract words and symbols.

HELP THE AUTHOR

(Turner, 1989)

WHO? X_ Individual X_ Pairs _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _ Math Log _X Loose-leaf Paper

WHY? _ Focus _ Reflect _ Collaborate X_ All

HOW? X_ Check _ Grade (letter or number)

Description of Activity

Have the students **rewrite the textbook explanation** of a math concept in words which a fifth grader can understand. Then, have them share their writing with their partner or in their group. The group may collaborate to come up with a common explanation that is complete, clear and concise. If time permits, put these on 4 x 6 or 5 x 8 index cards making small posters. A member of each group can post their neatly written explanation on a bulletin board near an exit. Eventually, there will be an easy to red summary of the main concepts on display readily available for student review. (Remember to cover it during tests!)

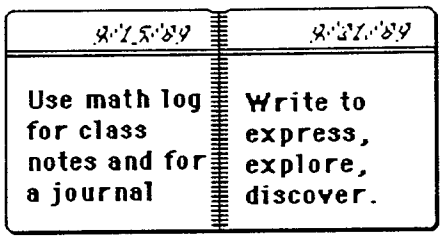
Variations

Prior to a chapter test, conduct the review by rewriting.

(1) Identify the sections of the chapter that will be on the test
(2) Divide the sections evenly among the students. Each one will be responsible for reading and writing a one sentence summary of the section assigned.
(3) Afterwards, have all students working on the same section meet in group to come up with the best wording.
(4) Then, ask each group representative to read their summary aloud while the rest of the class takes notes in their **math journals or logs.**
(5) Finally, conduct a question/answer session based on the concepts written about. Students can either respond with words from the notes or by doing a problem. This may be an individual or a team effort.

Token awards enhance enthusiasm for this type of review. (Hard candy works well).

MATH LOGS/NOTES



WHO? X_ Individual _ Pairs _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _X Math Log _ Loose-leaf Paper

WHY? _ Focus _ Reflect _ Collaborate X_ All

HOW? X_ Check _X Grade (letter or number)

Description of Activity

Journal or log notes refer to traditional class notes that students take during lectures. They use this type of writing mainly to record teachers explanations, board notes and examples. These writing **need not be graded,** instead give points for having taken notes regularly and comprehensively. It is merely writing that is expected to be done. Generally, a specific number of points may be given for each page of notes taken and will likely be sufficient encouragement for students to write regularly. Explaining the **value of writing in math** may further inspire student writing. (See samples of expressive/exploratory/discovery writing on page 5).

QUESTION OF THE DAY

WHO? X_ Individual _ Pairs _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _X Math Log _ Loose-leaf Paper

WHY? _ Focus _ Reflect _ Collaborate X_ All

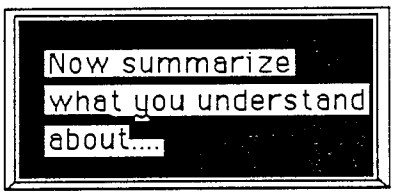
HOW? X_ Check _ Grade (letter or number)

Description of Activity

Have a math problem on the board when the students arrive. Ask them to explain in words how they would solve the problem. The problem may be one requiring skills learned earlier in the course, or those lrearned the day before. You may even wish to have a problem that will need skills you plan to teach that day! The Mathematics Teacher publishes a calendar in each issue of the journal. The calendar has daily math problems on it. Collect and use the ones appropriate for the grade, course and ability of your students.

Select problems that will review or challenge your students to apply their newly developed math abilities in real or imaginary situations.

SUMMARY SENTENCES



WHO? X_ Individual _ Pairs _ Group

WHEN? _ Beginning _X Middle X_ End _ Anytime

WHERE? _X Math Log _ Loose-leaf Paper

WHY? _ Focus _ Reflect _ Collaborate X_ All

HOW? X_ Check _ Grade (letter or number)

Description of Activity

When presenting lots of new information, stop periodically and ask the students to write **summary sentences.** At strategic points in the lecture, pause a moment and have the student focus and reflect on what they have been hearing. They should write in their own words (1) a definition of the concept, or (2) a summary of what they have learned so far. Allow a couple extra moments for a few students to read aloud what they've written. These readings will reinforce the value of the writing while revealing whether or not the students are grasping the ideas being presented. Frequently the students will phrase the definition in words more familiar to their classmates and more easily comprehensible than those in the formal definition or in the words you've been using.

This activity is an opportunity for the students to pause and digest and for you, the teacher to conduct a spot assessment of what about the lesson is or is not being understood.

UNSENT LETTERS (Gere, 1985)

WHO? X_ Individual _ Pairs _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _Math Log X_ Loose-leaf Paper

WHY? _ Focus _ Reflect _ Collaborate X_ All

HOW? X_ Check _ Grade (letter or number)

Description of Activity

Students may write to a pretend audience, like a reknowned mathematician: Euclid, Pythagoras, Cramer, etc., a current rock star or to a real audience: a classmate who is absent or a student in another class. The students can write about a newly taught math procedure, **explaining** to that person **what has been taught** and **how one would go about performing the procedure.** Students should be encouraged to write clearly and concisely.

The students will do a better job focusing their writing if they are told how knowledgeable the recipient is - whether certain math terms are known or unknown. For example, you may tell them that the recipient of the letter knows how to determine the slope of a line, or knows how to bring perfect squares outside the radical sign.

TELL WHY??

(Venne, 1989)

WHO? X_ Individual _ Pairs _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _X Math Log _ Loose-leaf Paper

WHY? X_ Focus X_ Reflect _ Collaborate _ All

HOW? X_ Check _ Grade (letter or number)

Description of Activity

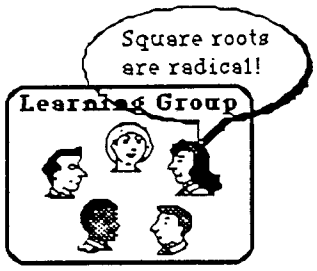
Sometimes students can prove to themselves what they understand about math concepts by telling **why** something is wrong. Have the students read several written statements of equations, then explain in a brief writing **why the wrong statement** could not fit the equation.

Example:

"Let's use the equation ***X + Y = 95.*** *These conditions explain the variables of X and Y: X + pounds of apples; Y = pounds of oranges. The students then choose the correct verbal representation from three statement.*

1. *Don has 95 pounds of fruit. He has apples, bananas, and oranges.*
2. *Dorothy bought a box of fruit weighing 95 pounds. Each box weighs 95 pounds.*
3. *Darren lifted a box of fruit weighing 95 pounds. In the box were apples and oranges."*

Sometimes students get a better sense of what is **right** when they are asked to determine what is **wrong!**



WORDS ALIVE !!

(McGill and Miller, 1989)

WHO? X_ Individual _ Pairs X _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _ Math Log _ X Loose-leaf Paper

WHY? _ Focus _ Reflect _ Collaborate X_ All

HOW? X_ Check _ Grade (letter or number)

TIME? 15 - 20 MINUTES

Description of Activity

(1) Ask students to write **three terms** which they thought were of special importance to the day's assignment or lesson.

i.es. *radical, radicand, square roots* or *point, slope, function*

(2) Ask them now to write for two or three minutes about **one** of the terms in the group of words.

(3) Students, then, form groups and spend 5-10 minutes sharing what they have written and also generating some questions for class discussion.

(4) Before the class discussion, while students work in groups, circulate among the students, listening and taking mental or written notes of what students are talking about. You may wish to make a record of groups who stay on task, then reward them later with class discussion points.

WRITE THE STEPS

WHO? X_ Individual X_ Pairs _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _X Math Log _ Loose-leaf Paper

WHY? _ Focus _ Reflect _ Collaborate X_ All

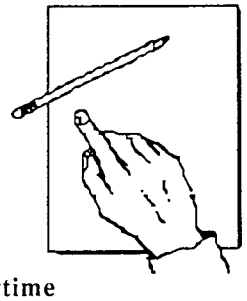
HOW? X_ Check _ Grade (letter or number)

Description of Activity

This is a variation of the summary sentence. After explaining a new procedure for solving a math problem, have the students in their own words write, **in order**, the steps to solving the problem. Ask the students to share aloud with a partner, group or class, they steps they wrote. As the steps are read, all can listen to these versions and all can hear a variety to ways of stating the procedure. When necessary, take the time to clarify any cloudiness or confusion.

Somehow, this can be a comforting exercise for the class. All can hear how classmates are thinking or not thinking and recognize that they are not alone in getting/not getting the new material. At the same time, you can monitor the learning, adjusting the teaching as the need arises. This non-graded activity can reduce the stress levels for both students and teacher, can reveal and clear up misunderstandings at once, and reduce the need for crammed reteaching just before a test or exam. By **writing the steps** the students can focus and reflect, figure out and clarify those steps to solving a variety of math problems.

WRITE YOUR OWN



WHO? X_ Individual _ Pairs _ Group

WHEN? _ Beginning _ Middle _ End _X Anytime

WHERE? _X Math Log _ Loose-leaf Paper

WHY? _ Focus _ Reflect _ Collaborate X_ All

HOW? X_ Check _ Grade (letter or number)

Description of Activity

After students have been working with word problems, have them try writing their own. This is a good opportunity to have them verbalize math ideas while using correct math terminology.

Be certain the point out the need for clarity and precision in writing. The students probably will need to be reminded of exercises they've done writing steps of various procedures as well as writing using the precise preposition. One way to get them started is by **patterning.**

Example of patterning:

Start with a familiar word problem, leaving out the variables. Have the students fill in variables that make sense.

Sample #1:
If 6 pounds of apples cost $2.00, how much will 40 pounds cost?

Have the students suggest alternative amounts, that make sense, then write their own problem to be solved. As they consider the pattern of the sentence as well as logical alternative variables, they are ***thinking about math concepts.***

Sample #2: *(Notice the conjunctions and prepositions) .*

Justin hikes 7 miles due east and then 3 miles due north. How far is he from the starting point.

Once students are familiar with the **pattern** of word problems, ask them to write one or two of their own, then evaluate them for clarity, precision and logic.

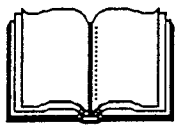
Variations

#1 After writing the **three terms,** students form groups to share the words they've chosen, but this time tell **why** they chose the terms, THEN working alone, students write for three minutes based on their group discussion.

#2 After writing the **three terms,** students may formulate a **question** for each word. The students respond in writing to one question, then form groups to share responses.

#3 After writing the **three terms**, students may write a **paragraph using** the three chosen terms. Students form groups to share their writing.

In any version of this **Words Alive!!**, keep in mind that **talk teaches.** Allow plenty of time for students to work through the concepts they are learning by talking about them with peers.



Appendix 2

Teacher/student/researcher description of experience taking one quarter of Algebra IA (advanced algebra for eighth graders).