Math Interventions

Self-Monitoring Math Problems

Technique:

Some students seem to answer math problems incorrectly; however, upon further inspection, the students may be doing some of the individual steps needed to get the correct answer while consistently missing others. This procedure provides students with continuous instructional cues or steps that help guide students as they work their math problems during independent seat work.

Most Likely to Benefit:

This procedure will help motivate students who are unwilling to do work in math class although they are able to do math problems fluently. These students often do not complete math work given in class, but when given the opportunity to earn activity time, their math performance increases within acceptable teacher-set goals.

Materials:

An individual math checklist, math assignment, and a student chart or graph.

Baseline:

Give the students math problems. Tell the students to do the problems without any help. After the students complete the work, examine the type of errors that the students are making on incorrect answers. Make a list of the errors.

Student Training:

1. Make a checklist for each student that tells the students how to correct each of the errors on the error list. A short and simple sentence telling the students what to do will be sufficient to remind the students to do the problem correctly. (See Figure 29.)
2. Show the students the checklists.

Figure 29. Example Checklist

Example Checklist

- ❑ I copied the problem correctly.
- ❑ I regrouped when I needed to (top number is bigger than bottom).
- ❑ I borrowed correctly (number crossed out is one bigger).
- ❑ I subtracted all the numbers.
- ❑ I subtracted correctly.

3. Point out the steps that they will need to review on the checklist as they work through the problem.

4. Give the students a problem to do.

5. Tell the students to put a plus sign next to each step on the checklist that was completed correctly and a minus sign next to any step that was incorrect or skipped.

6. Tell the students to raise their hands to signal that they have completed their work. Review students' checklists.

7. Tell the students that they will begin using the checklists independently in class and at home once they are able to answer several problems accurately and have placed correct marks by each of the steps.

Treatment Procedure:

1. Place the checklists on the students' desks at the beginning of math class.

2. Remind the students to use the checklists when working on problems.

3. Monitor the students working on problems and using the checklists. If a student is not using his checklist, prompt the student to look at the checklist as he works.

4. Approach the student when you notice the student raising her hand.

5. Check the student's work.

6. Praise the student for checking off the steps on the checklist.

7. If the student did not follow a step on any problem, then tell the student to redo the problem. If the student is unable to do the problem(s) correctly, help the student with the problem and tell the student to redo the problem three times.

8. Remind the students to write the number of points earned on their graph or chart.

9. To make the treatment more effective, the students can earn free time or some other activity for a certain amount of points at the end of the day or week. The students will earn one point for each correct response, and one point for each problem in which all of the steps on the checklist were self-monitored accurately.

Optional: To provide more practice for the student, give the student a checklist to complete as he is completing his homework. The student can earn additional points for accuracy and the correct recordings of a plus or minus for each problem.

Progress Monitoring: The student will write the number of points earned for each correct answer and correct self-monitoring on the checklist. When the student is able to do the work above 90% accuracy on several worksheets, remove the checklist. The student may still earn points, however, for each correct response.

Source:

Dunlap, L.K. & Dunlap, G. (1989). A self-monitoring package for teaching subtraction with regrouping to students with learning disabilities. *Journal of Applied Behavior Analysis, 22,* 309-314.

STUDENT SELF-MONITORING CHART

Name: _____

Date	Number of Problems	Points for Correct Answers	Points for Correct Checklist

CHECKLIST

Name: _____

Monitor these steps:	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
1.										
2.										
3.										
4.										
5.										
6.										
7.										

Cover, Copy, and Compare Math Procedure

Technique:

Many students need additional cues and practice before completing math problems correctly. In this procedure, the student first looks at how a problem is solved, then practices using the steps needed to do the problem correctly. Hence, students are provided with immediate corrective feedback and many additional opportunities to practice math facts and concepts. This procedure also promotes mastery with math problems without the use of peer tutors, additional teacher time, or additional materials.

Most Likely to Benefit:

Students who are having difficulty learning the necessary steps in computational problems may need additional practice and more specific feedback. If a student is performing below criteria (i.e., 20 digits per minute for 1st through 3rd grade or 30 digits per minute for 4th grade or higher), he or she may benefit from the additional practice and cues provided in this procedure.

Materials:

A math assignment, and a copy of the answers or another student's 100% correct paper.

Baseline:

Collect the student's previous class work and calculate the percentage of correct answers. If class work is unavailable, begin collecting class work in a folder.

Treatment Procedure:

1. This technique may be used before or after the student attempts to do the work independently. It can be used to monitor the student's work during independent seat work to check if the student is able to do the first few problems correctly. Or, use this procedure at the start of seat work if the student is consistently below 70% correct on class work.

2. Give the student a copy of the answers or another student's assignment that is neatly written, demonstrates the needed steps, and is 100% correct.

3. Tell the student to do the following five steps when working on each problem.

   a. Look at how the problem was solved.

   b. Cover the correct answer.

   c. Do the problem on your own paper.

   d. Uncover the correct answer.

   e. Compare your answer with the correct answer.

4. If needed, set a time limit for this procedure.

5. Once the student has finished the worksheet, give the student several problems that are similar to the problems practiced for two minutes. Tell the student to do them without using the cover, copy, and compare procedure.

6. If the student is able to do the additional few problems correctly, praise the student's work and provide a few minutes of free time. Or, the student may earn a decrease in the number of problems on his next homework assignment. If the student does not get all the problems correct, he or she can redo the cover, copy, and compare method. The teacher and student may also set a goal if the student is unable to get all the problems correct.

Progress Monitoring:

Evaluate the student progress on both the problems given after the cover, copy, and compare procedure and any independent seat work or homework given to the student using the same math skill. The student should be able to do most of the work correctly immediately after using this procedure. Moreover, the student's fluency (i.e., digits per minute) should increase when given the same types of problems during a timed assessment.

Source:

Skinner, C., Turco, T., Beatty, V., & Rasauage, C. (1989). Cover, copy, compare: A method for increasing multiplication fluency in behavior disordered children. *School Psychology Review, 18*, 412-420.

COVER, COPY, COMPARE RECORD SHEET

Name: _____

1. Look at how a problem was solved.
2. Cover the correct answer.
3. Do the problem on your own paper.
4. Uncover the correct answer.
5. Compare your answer with the correct answer.

Date	Percent Correct on Independent Problems	Did You Meet Your Goal?

Peer Tutoring in Math

Technique:

This procedure is designed to increase student accuracy and rate on basic math facts that are needed for more advanced computational problems. Moreover, this procedure allows teachers to monitor students' progress while students are busy providing each other with additional opportunities to practice math facts with immediate feedback.

Most Likely to Benefit:

Students who are performing below 20 digits correct per minute on basic math fact problems will benefit by increasing both their accuracy and fluency using this procedure.

Materials:

Math problems written on index cards with the answers written on the backs of the cards, student folders, skill sheet for testing, a timer, and student charts.

Baseline:

Give the students several skill sheets on basic facts. Tell the students to try to get as many problems correct as they can within two minutes. Use the skill sheets for the peer tutoring sessions that were scored at 20 digits or below.

Treatment Procedure:

1. Write the basic math facts on index cards. Each card should have the problem written on one side and the answer written on the other side. Students can make their own cards and keep them in their own folder.

2. Have the students work in pairs with each student working on 20-30 cards that match the problems presented on the skill sheets that they will be tested on.

3. The students or the teacher will set a timer for three minutes.

4. One student will present a card while the other student tries to say the correct answer.

5. If the student is unable to say the answer within five seconds, the student presenting the card will read the answer written on the back of the card.

6. When the timer goes off, the students will switch roles. The timer will be reset for another three minutes.

7. After the tutoring session, the teacher can assess both students on basic math skill sheets.

8. The teacher will set the timer and tell the students to start. The students will complete as many problems as they can within the two minutes.

9. Score the skill sheet by counting all of the correct digits. For example, $6 \times 6 = 30$ would count as one digit correct, whereas $6 \times 6 = 36$ would count as two digits correct.

10. Praise the students for correct answers. Moreover, students will earn a point each time that they are able to beat their best score on the same basic math skill sheet. In addition, the students get a point if both of them are able to beat their best scores. When the student pair collects a certain number of points and each person has at least a certain number of points, the student pair earns five minutes of activity time. The number of points should be adjusted such that the students are able to get activity time about every three days. In addition, students should be beating their best scores almost every day.

11. Remind the students to fill out their charts daily. Remember to cross off any points that have already been turned in for activity time.

Optional:

While the student is working on learning basic math facts, the student may also be able to work on learning steps for more advanced computational skills, allowing the student to use a calculator or a fact sheet with answers to problems, such as subtraction from 0 to 18. For example, the student can still learn subtraction with regrouping with the class while working on basic subtraction facts during peer tutoring sessions. This helps students to continue learning higher hierarchical skills with the class and prevents falling further behind their classmates.

Progress Monitoring:

A chart will be completed after each student's two-minute assessment. The student's progress in the number of digits correct in two minutes will be evaluated. The teacher can expect that the student will be working toward 100-140 digits correct within two minutes. When the student has mastered the skill sheet at this rate, give the student an additional sheet and change the problems on their index cards to match the skill tested on the new skill sheet.

When monitoring a student pair's progress, several factors may need to be readjusted to increase the effectiveness of this procedure. First, the students' cards may be too difficult if the students are not beating their best scores. In this case, reduce the cards to only 10 per tutoring session. Or, if the students are answering their problems too quickly, then add more challenging problems during the tutoring session. Moreover, the problems may be too simple if they are correctly completing close to 140 digits per minute. Also, the students may not be presenting the cards quickly to each other. If this is this case, shorten the amount of time they are given to present the cards and show the students how to present each card quickly and provide assistance within three seconds. Finally, the students may not be earning enough points to get their activity time. This may be a result of the peer tutors not adequately giving error corrections to each other. The teacher can monitor several tutoring sessions closely and prompt students to correct each other as needed. If

needed, the peer tutors can get points for presenting the cards quickly and giving the answers quickly to each other during a tutoring session.

Sources:

Heron, T.E., Heward, W.L., Cooke, N.L., & Hill, D.S. (1993). Evaluation of a classwide peer tutoring system: First graders teach each other words. *Education and Treatment of Children, 14*, 216-228.

Greenwood, C.R., Terry, B., Arreaga-Mayer, C., & Finney, R. (1992). The classwide peer tutoring program: Implementation factors moderating students' achievement. *Journal of Applied Behavior, 25*, 101-116.

Horton, S., Lovitt, T., & White, O. (1992). Teaching mathematics to adolescents classified as educable mentally handicapped: Using calculators to remove computational onus. *Journal of Remedial and Special Education, 13*, 36-60.

MATH RECORD SHEET FOR PEER TUTORING

Name: _____

Date	Digits Correct per 2 minutes	Best Score	Points for Beating Your Score	Activity Earned

Student: _____ **Teacher:** _____

Date: _____ **Grade:** _____

Teaching Math Facts

This intervention is designed to **build math fact fluency and increase accuracy**. This intervention can be used for addition, subtraction, multiplication, or division facts, for example. Requires approximately 7 minutes each day.

Materials needed: 5 math probes (i.e., worksheets containing math problems for the problem skill), timer, and monitoring chart. Draw a line under the first 2-3 rows of problems on the worksheet. Review progress and change materials weekly. Ask student to select 3 items/activities from the "Things I Would Like to Earn" worksheet.

Coach Card (conduct these steps every day):

_____ **Get out materials.**

_____ **Write name and date on math sheet.**

_____ **Work all the problems above the line on the worksheet with your teacher's or tutor's help.**

_____ **Set timer for 2 minutes**. Cover the practice problems above the line.

_____ **Work problems below the practice line for 2 minutes.**

_____ **When timer rings, stop working.**

_____ **Score your paper** with the answer key or teacher's help.

_____ **Count number of problems you got right**. Write the correct answer for the problems you missed.

_____ **Write score at the top of math sheet.**

_____ **Write score on your monitoring chart.**

_____ Did you beat your score? **Circle yes or no on the monitoring chart.**

_____ If you beat your score, **choose a reward from your reward menu.**

Sample Chart for Monitoring Student Progress

CHART FOR _____ IN _____
Student's Name Subject (Math, Reading, or Writing)

MONDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

TUESDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

WEDNESDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

THURSDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

FRIDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

Student: _____ **Teacher:** _____

Date: _____ **Grade:** _____

Teaching Multiplication Facts

This intervention is designed to **build fluency with multiplication facts while simultaneously decreasing errors**. Requires approximately 5 minutes each day.

Materials Needed:
Construct a set of flashcards for a set of multiplication facts (e.g., multiplication by 3's). Construct a worksheet with the same facts randomly arranged (e.g., Basic Skill Builders). You will also need a digital timer and graph paper.

Teacher (or peer tutor) Coach Card: (complete these steps every day)

_____ **Present each flashcard** to the student while verbally prompting the student with the question (e.g., "what is 3 x 3?").

_____ **Praise** correct responses that occur within 3 seconds of the prompt (e.g., "That's right, 3 x 3 is 9").

_____ If no response occurs within 3 seconds or the student gives an incorrect response, **give the student the answer** (e.g., "3 x 3 is 9").

_____ Immediately **re-deliver the verbal prompt** (e.g., "What is 3 x 3?").

_____ **Present each card twice**.

_____ Present the student with a worksheet containing the math facts you have just presented with flashcards to **obtain a timed sample of independent work**.

_____ **Set a timer for two minutes**. Instruct the student to begin working when you say "start", to complete as many problems as possible before the timer rings, to work horizontally across the paper without skipping any problems, and to put the pencil down when the timer rings.

_____ At the end of the two-minute time interval, give the student the answer key and **direct the student to circle each error and write the correct response underneath.**

_____ **Direct the student to calculate the number correct per minute and the number of errors**. The student may graph his or her progress across days.

Student Coach Card: (complete these steps every day)

_____ **Practice flashcards** with your teacher or tutor.

_____ **Take the timed test**.

_____ Place the answer key next to the worksheet and begin to **compare your answers to the answers on the key**.

_____ When you come to an error, **circle the error on your worksheet**.

_____ Re-read the question and **write the correct answer** (from the answer key) next to the incorrect answer that you have just circled.

_____ **Count the number of answers you got right**. Write this number at the top of the worksheet.

_____ **Count the number of answers you circled because they were errors**. Now write this number at the top of the worksheet.

_____ Take out **your progress graph**. Find the correct day along the bottom axis of the graph (i.e., x-axis). Now find the number correct on the side axis (i.e., y-axis). Make a dot on the graph that marks both spots. Do the same thing for number of errors.

How will you know if it's working: Number of problems correct should increase across days. Number of errors should decrease across days. In order to maximize effects, this intervention should be conducted daily.

Promoting generalization: Conduct sessions with mixed multiplication problems randomly selected from the mastered sets of cards/problems periodically (e.g., once per week).

References

Bennett, K., & Cavanaugh, R. A. (1998). Effects of immediate self-correction, delayed self-correction, and no correction on the acquisition and maintenance of multiplication facts by a fourth-grade student with learning disabilities. Journal of Applied Behavior Analysis, 31, 303-306.

Rhymer, K. N., Skinner, C. H., Henington, C., & D'Reaux, R. A., & Sims, S. (1998). Effects of explicit timing on mathematics problem completion rates in African-American third-grade elementary students. Journal of Applied Behavior Analysis, 31, 673-677.

Sample Chart for Monitoring Student Progress

CHART FOR _____ IN _____
Student's Name Subject (Math, Reading, or Writing)

MONDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

TUESDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

WEDNESDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

THURSDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

FRIDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

Student: _____ **Teacher:** _____

Date: _____ **Grade:** _____

Teaching Math Facts

This intervention is designed to **build math fact fluency**. This intervention can be used for addition, subtraction, multiplication, or division facts, for example. Requires approximately 5 minutes each day.

Materials needed: 5 math probes (i.e., worksheets containing math problems for the target skill), timer, and monitoring chart. Review progress and change materials weekly. Ask student to select 3 items/activities from the "Things I Would Like to Earn" worksheet.

Coach Card (conduct these steps every day):

_____ **Get out materials.**

_____ **Write name and date on math sheet.**

_____ **Set timer for 2 minutes.**

_____ **Work problems for 2 minutes.**

_____ **When timer rings, stop working.**

_____ **Score your paper** with the answer key or teacher's help.

_____ **Count number of problems you got right.** Correct your mistakes.

_____ **Write score at the top of math sheet.**

_____ **Write score on your monitoring chart.**

_____ Did you beat your score? **Circle yes or no on the monitoring chart.**

_____ If you beat your score, **choose a reward from your reward menu.**

Sample Chart for Monitoring Student Progress

CHART FOR _____ IN _____
Student's Name Subject (Math, Reading, or Writing)

MONDAY

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My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

WEDNESDAY

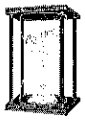
My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

THURSDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____

FRIDAY

My best score is: _____
My score on the timed test is: _____
Did I beat my score? _____



Classwide Math Intervention: Applied Practice

Step 1: Underline what's known
Step 2: Circle what's unknown
Step 3: Write the operation(s) next to the problem
Step 4: Write the problem, the answer, and label the answer

During 15 Minute Practice Period:

_____ Distribute worksheets to students and tell students to get into their working pairs.

_____ Instruct students to write their names and the date on math sheet.

_____ Students should complete as many problems as possible in **5 minutes** of the worksheet with help from their math buddy. **Each step should be completed** and the student writing the answers should **explain out loud** how they find the information for each step.

_____ After each problem, the peer buddy should say, "**How did you solve the problem?**" and the student should explain the answer (e.g., we started with 4 apples and sold 2, so 4 minus 2 equals 2, so 2 apples were left. 2 apples is the answer).

_____ Peer buddy completes checklist for each problem as partner explains answer, **giving a check for each step correctly explained**.

_____ Tell students to switch roles. Now, the other student should complete as many problems as possible in 5 minutes with help from their math buddy.

The goal is for students to work as quickly as possible completing as many problems as possible in the short amount of time with 100% accuracy. If one student is stronger than another, then you will have to monitor to make sure that the stronger student does not simply supply the answer but explains how to get the answer when that student is acting as the "coach" or "tutor." **You should spot-check each pair to make sure that they are doing the steps correctly.**

_____ Pass out probe sheet while students are finishing their second set of practice problems.

_____ Set timer for **2 minutes**.

_____ When timer rings, tell students to stop working.

_____ Have students trade papers and score.

_____ As you give the correct answer, **ask students to choral respond each of the 4 problem-solving steps with you**. Where many students missed a step, review the step.*

_____ Score 1 point for correct equation, 1 point for correct answer, and 1 point for labeling answer.

_____ Have students write the correct answer for the problems they missed.

*Initially, you will want to spend some time doing this for several problems. As children gain more practice and competence, you will only need to do this for problems that many children missed.

Teacher: _____ **Grade:** _____ Date: _____

Classwide Intervention: Teaching Math Facts (Use with Flashcards)

This intervention is designed to **build math fact fluency and increase accuracy** and can be used for addition, subtraction, multiplication, or division facts.

Teacher Coach Card (conduct these steps every day):

_____ **Instruct students to find their math partner and get out flashcards quickly and quietly.**

GUIDED PEER PRACTICE

_____ **Set timer for 3 minutes and tell students, "Begin practicing."**

_____ **When timer rings, tell students, "Stop. Switch flashcards."**

_____ **Set timer for 3 minutes and tell students, "Begin practicing."**

_____ When timer rings, tell students, **"Stop practicing."**

TIMED INDEPENDENT PRACTICE

_____ Pass out worksheets face-down on students' desks. Tell students, **"Write your name on the back of your paper. Don't turn them over until I tell you to."**

_____ Set timer for 2 minutes. Say, **"On your mark, get set."** Begin the timer, and say, **"Go."**

_____ When the timer rings, tell students, **"Hold your papers up in the air so that I can see that you are no longer working."**

_____ Tell students, **"Trade papers with your math partner for scoring. When I call out the answers, mark the answers 'right' or 'wrong'."**

ERROR CORRECTION

_____ **Call out the correct answers.** Review answers that several students miss.

_____ Tell students, **"Give papers back to their owners now. If you missed problems, write the correct answer under the problem where your partner wrote it."**

_____ Tell students, **"Write your score on your progress chart and pass your papers to the front so I can pick them up."**

REWARD/MOTIVATION

_____ Shuffle the papers. **Randomly draw a paper from the stack.** If the score on this randomly selected paper is higher than the randomly selected score from the day before (or the class median if you have calculated it), then deliver a classwide reward (e.g., 5 minutes free time).

Teachers: Every Friday, record each student's score on the Daily Intervention datasheet in the "intervention" column.