Using Memory-Enhancing Strategies to Learn Multiplication Facts

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Casey and James are fifth-grade special education students receiving math instruction in a special education classroom. They have been working on mastery of basic multiplication facts for 3 years with limited success. They are mainstreamed into general education classrooms for science and, in one particular unit, are using memory-enhancing strategies to learn chemical compound formulas. When the teacher holds up a box of table salt, Casey remembers that potato chips are salty and that "No one can eat just one!" She then says to herself, "*N*ot *a C*hip *l*eft!" and writes down NaCl. When the teacher holds up a bag of sugar, James remembers that if he frequently eats food and drinks beverages with large amounts of sugar, he will develop painful cavities. Then he thinks to himself, "12 *C*avities *H*ave 22 *O*uches at 11 at night," and writes down $C_{12}H_{22}O_{11}$.

In this classroom scenario, two students with learning disabilities have learned how to use associative learning strategies to recall information that many other students memorize with little difficulty. Could students like Casey and James also learn associative learning strategies to remember basic multiplication facts? Yes, according to a recently published study (Wood, Frank, & Wacker, 1998). These researchers found that after receiving instruction on one strategy, each student's accuracy was often 100%, and this was maintained throughout the study even as they learned additional strategies. This article describes methods you can use to successfully teach students how to remember the basic multiplication facts.

Students will be motivated to learn each strategy if you teach them to graph the percentage of correct responses on each practice worksheet.

Families of Basic Facts

In this strategy, all 100 basic multiplication facts involving the numerals 0-9 are grouped into families: the zeros, ones, twos, fives, nines, and pegwords. For a fact to be included in a family, it must contain at least one numeral that corresponds to the name of that family. For example, the fact, 0 x 4, belongs in the zeros family because it contains at least one 0; the fact, 2 x 7, belongs in the "doubles" family because it contains at least one 2; the fact, 1 x 5, can be included in either the ones or fives family. Fifteen facts make up the last group of facts, called the "pegword family."

Strategies for Remembering Multiplication Facts

Teach students a specific strategy for remembering the facts within each family. The facts involving 0 and 1 are the easiest to learn, so teach the strategies for remembering these facts first. The facts involving 2, 5, and 9 are more difficult to learn, so introduce the strategies for remembering these facts after the students have mastered the zeros and ones families. The remaining 15 facts (pegwords) should be taught last because the strategy takes more time to learn (Greene, 1992).

The 0, 1, 2, 5, and 9 Families

Introduce your students to the memory-enhancing strategies, beginning with the "0 Strategy," using the lesson plan in Figure 1 and the corresponding strategy chart (Figure 2). Continue practicing a specific strategy in subsequent lessons until your students accurately answer the related multiplication facts.

"The students developed a positive and enthusiastic attitude toward math instruction."

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Figure 1. Plan for Teaching the Strategies

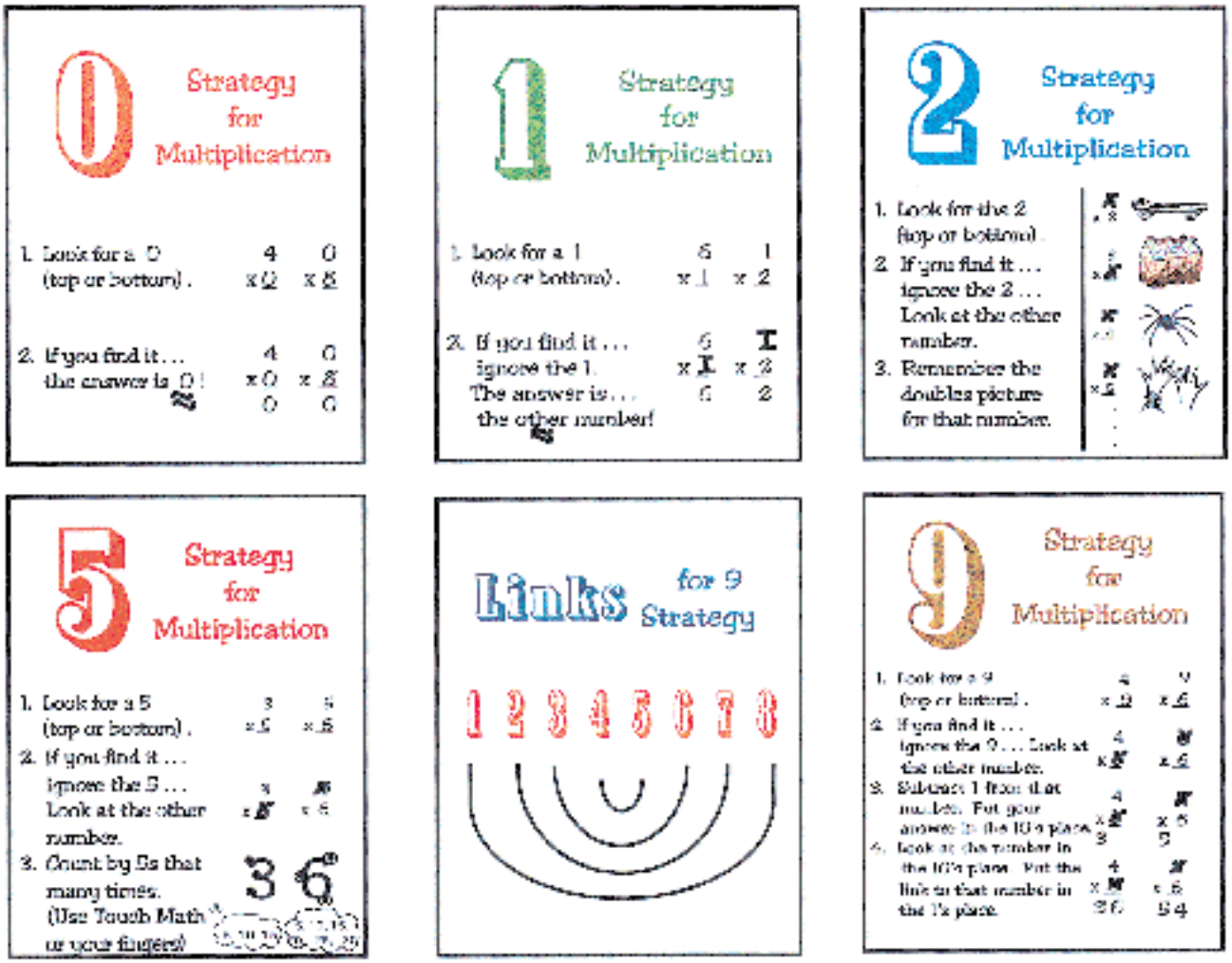
Preskills

Students must be able to correctly name and write the numerals from 0-9 and count by 5s.

Steps

1. If one or more strategies already have been taught, review them at the beginning of the lesson.
2. Give each student a worksheet on which has been written a few multiplication facts from each of the families.
3. Demonstrate how to find the problems in the family being taught by running your finger under the problems. Stop at each and think out loud. "Is there a _____ (e.g., 0) in this problem?" Then answer your own question.
4. Hold up the strategy chart. Read it to the students. Go through the examples on the chart. Have the students practice saying the rules.
5. Draw the students' attention to the first problem on their worksheet. Ask the question. "Is there a ____ (e.g., 0) in this problem?" If yes, lead the students in saying the rule, then direct them to write the answer under the first problem. If no ____ (e.g., 0) is present, tell students to skip the problem, and go on to the next one.
6. Continue this procedure until all problems in the family have been identified and answered.

Figure 2. The 0, 1, 2, 5, and 9 Strategy Charts



Quotes from a special education teacher who used this instructional method:

> The students developed a positive and enthusiastic attitude toward math instruction. This was in contrast to the attitude previously displayed by these students. They not only reported enjoying math more, but *attributed their learning successes* directly to the mnemonic methods and materials being taught.
>
> One of my students received daily medication for an ADHD diagnosis made when he was a first grader. Despite daily medication for ADHD, he exhibited attentional difficulties in all academic areas. However, a change in task completion occurred during mnemonic instruction. He learned to scan the multiplication facts on a worksheet, identify the correct strategy for solving each problem, write the answers, often completing the task *before the other students* in his math group!

Students will be motivated to learn each strategy if you teach them to graph the percentage of correct responses on each practice worksheet. Encourage your students to attribute their success to their use of the strategies.

An important part of this instructional package is continuous data collection to determine each student's progress in learning the multiplication facts.

Before introducing the "2 Strategy," teach your students to associate a visual image with each fact in the family. The following visual images on flash cards are easy for students to remember: 2 x 2—a skateboard with two sets of wheels, 3 x 2—a six pack of pop, 4 x 2—a spider with two sets of four legs, 5 x 2—two hands with all fingers held up, 6 x 2—a dozen eggs in a carton, 7 x 2—a calendar with 2 weeks circled (7 days and 7 days), 8 x 2—two octupi, each with eight tentacles, 9 x 2—an "18-wheeler" truck (9 wheels on each side).

Students will need to be fluent in counting by 5s before you introduce the "5 Strategy." This may be accomplished by providing students with practice over a period of several days. Tell your students this practice will help them to learn some of their multiplication facts.

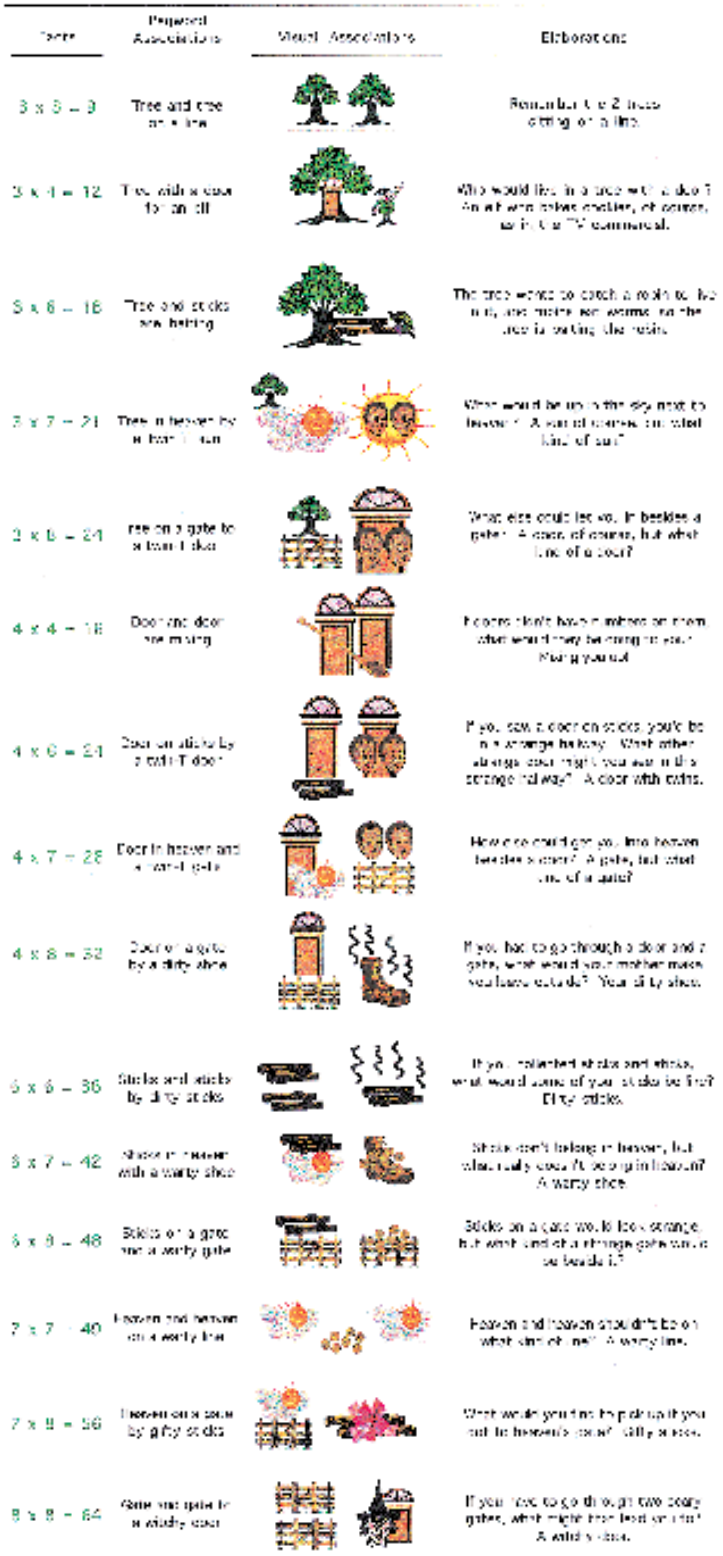
Figure 3. Numbers with Associated Pegwords and Symbols

Numbers with Associated Pegwords and Symbols

Number	Pegword	Symbol	Number	Pegword	Symbol
1	sun		12	elf	
2	shoe		16	mixing	
3	tree		18	baiting	
4	door		20	Twin-T	
6	sticks		30	dirty	
7	heaven		40	warty	
8	gate		50	gifty	
9	line		60	witchy	

Note: "Twin-T" symbol refers to a popular TV character called "Mr. T," who had his hair shaved except for a strip on the top of his head.

Figure 4. Pegword Family of Facts, Associations, and Elaborations



Keep the practice sessions short and brisk to maintain student attention.

The "9 Strategy" involves two charts (Figure 2). Use the "Linking for 9" strategy chart to teach your students to associate pairs of numbers. For example, show students that the number 1 is associated with the number 8, and the number 2 is associated with the number 7 (Schroeder & Washington, 1989). Once your students have learned these number associations, use the lesson plan to introduce the "9 Strategy" chart.

The Pegword Family

The pegword strategy (Mastropieri & Scruggs, 1991; Willot, 1982) is more complicated and thus will take more time for your students to learn. A few weeks before you introduce the pegword strategy, begin teaching students to associate each number word used in this family with what is called a *rhyming pegword* (see Figure 3).

1. Prepare flashcards, on one side of which are number words and the other side of which are the corresponding pegwords and symbols (e.g., the number word "one" on one side and the pegword "sun" on the other accompanied by a picture of a sun).
2. Begin each practice session by introducing about three new associations, then review previously learned associations.
3. Alternate using each side of a flashcard as the stimulus during these sessions, requiring a number word response when you hold up the pegword and symbol side and requiring a pegword response when you hold up the number word side.
4. Prepare flashcards that show combinations of pegwords. For example, the number 21 is illustrated by combining "twin-T" with "sun" (see Figure 4, the 3 x 7 fact), and the number 32 is illustrated by combining "dirty" with "shoe" (see Figure 4, 4 x 8 fact). Add these cards to your practice sessions.

Once your students are firm in their responses to all the pegword flashcards, begin instruction on the pegword strategy.

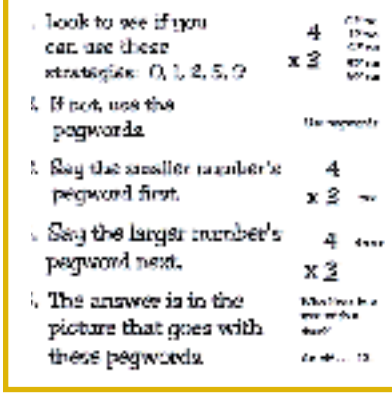
1. For this phase of instruction, prepare pegword *fact* flashcards using the information shown in Figure 4,

where a fact appears on one side of a flashcard along with the corresponding pegword and visual associations.
2. Introduce the pegword strategy using the chart shown in Figure 5, along with the first three pegword fact flashcards.
3. As you show each pegword fact flashcard, lead students through the corresponding elaboration provided in Figure 4. Require students to repeat the elaborations because this will assist them in remembering the facts.
4. Omit the worksheet portion of the lesson plan until you have introduced all 15 flashcards and the students have practiced them.

Student Self-Assessment and Self-Monitoring

An important part of this instructional package is continuous data collection to determine each student's progress in learning the multiplication facts. You can accomplish this by asking students to complete a multiplication facts worksheet two or three times per week as part of instruction. After the worksheets are scored (and analyzed if errors have been made), each student should plot the results on a graph similar to the one shown in Figure 6. Most students are highly motivated when they observe the progress they are making and strive to reach the goal shown on their graph.

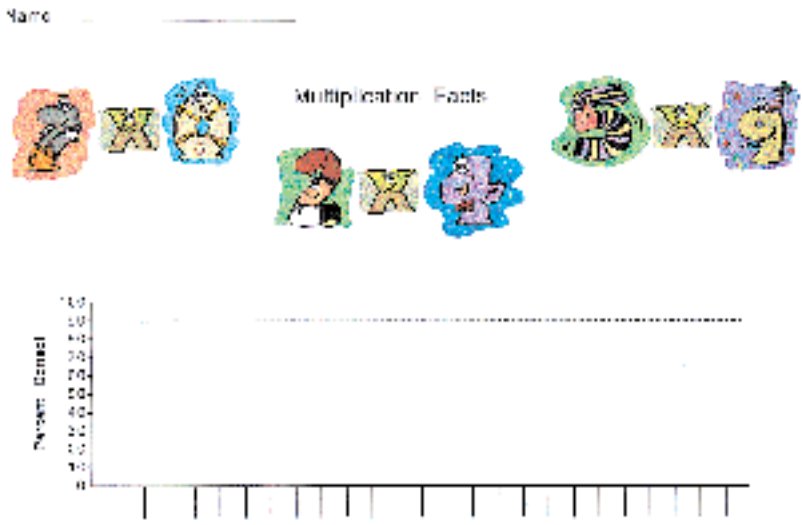
Figure 5. The Pegword Strategy Chart



Students as Active Learners

This instructional method will teach your students how to approach multiplication facts. Rather than relying on rote memorization, students will be able to approach multiplication facts with a set of strategies that will enable them to solve the problems. These strategies will allow students to become active learners, analyzing each problem and not only determining the correct strategy, but also applying each step in the strategy.

Figure 6. Example of a Student Progress Chart



Keep the practice sessions short and brisk to maintain student attention.

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