

Enhancing School Success with Mnemonic Strategies

By: Margo A. Mastropieri and Thomas E. Scruggs (1998)

A few years ago, we revisited an inner-city middle school where-about a year before-we had conducted an investigation on the effectiveness of mnemonic techniques in helping students with mild cognitive disabilities remember U.S. states and capitals. As we entered the classroom, Crystal, a student classified as mildly mentally handicapped, recognized one of our graduate students immediately.

"Hey! I remember you!" she exclaimed enthusiastically. "You were here last year - you taught us states and capitals! I remember, go ahead, ask me one!"

"Well, uh," replied our colleague, taken slightly by surprise, "How about...Florida? What's the capital of Florida?"

"That's too easy!" she said, smiling. "Here it is: Florida, the keyword is flower - the flower is on a television set, and television is the keyword for Tallahassee!"

In this scenario, a student classified as mentally retarded effectively remembered information she had been taught 1 year previously. Even more impressive was the fact that she had not reviewed or rehearsed this information with any teacher since the last time we had seen her! As startling as this scenario is, it underscores something we have been witnessing for many years: the incredible power of mnemonic strategies to increase dramatically the amount of information students remember, even students with learning problems.

In this article, we describe the need for effective memory strategies for school learning. Next, we provide a brief description of what mnemonic strategies are - and what they are not. Following that, we describe how you can use these powerful learning tools to enhance the school success of your own students.

The need for mnemonic strategies

According to the Sixteenth Annual Report to Congress on the Implementation of the Individuals with Disabilities Act (U.S. Department of Education, 1994), 71.2% of all students now spend all or a substantial part of their school day in general education classrooms. As many as 78.9% of students with learning disabilities spend all or most of their educational time in general education classrooms. On the secondary level, students with disabilities are included in content-area classrooms, such as English, science, and social studies classes. Largely, ability to succeed in these classrooms determines their level of success in school.

What factors determine whether a student will succeed in secondary content-area classrooms? Pumam (1992b) surveyed 7th- and 10 th-grade teachers in Kansas, Indiana, and Florida, and reported that an average of nearly half of a student's report card grades depended on test performance. Clearly, such factors as attendance, punctuality, participation, and homework completion are also important. However, teachers made it clear that test scores were the single most important factor in report card grades. Teachers gave an average of 11 of these tests over the course of a single 9-week grading period. Clearly, students' academic survival is tied very closely with performance on academic tests.

In addition to the number of tests teachers give, Pumam (1992a) also examined the types of questions teachers asked on tests. He found that the overwhelming majority of test questions students were asked required factual recall:

The majority of questions on tests administered by main-stream secondary classroom teachers required the student to recall a specific fact - 25.3 per test. A sample question that asked for a specific fact was "Who discovered America?" Other possible responses, such as conclusion, sequence, opinion, discrimination, compare and contrast, purpose, correct an example, and summary, appeared about one per test. (p. 131)

Thus it can be seen that memory for factual information is absolutely essential for success in school, particularly at the secondary level. Unfortunately, it is also true that students with learning disabilities and other learning problems have been consistently shown to have particular difficulties remembering academic content (e.g., Cooney & Swanson, 1987). Our work in the area of so 7 mnemonic (memory-enhancing) strategies has been devoted to finding ways of increasing the amount of content-area information students are able to remember. This article provides information on the utility, and effectiveness, of mnemonic strategies in enhancing memory for school learning.

What mnemonic strategies are

Mnemonic strategies are systematic procedures for enhancing memory. Their particular use is in developing better ways to take in (encode) information so that it will be much easier to remember (retrieve). Although there are retrieval strategies that can be employed to attempt to retrieve information that has been forgotten, research has demonstrated that the way we encode information when we first study facilitates memory better. The particular task in developing mnemonic strategies is to find a way to relate new information to information students already have locked in long-term memory. If we can make a firm enough connection, the memory will last a very long time. For example, Crystal had learned the capital of Florida so well because the mnemonic strategy had carefully linked it to things she was very familiar with. Because Florida sounds like flower (the keyword), it was easy to teach her to make an automatic connection between Florida and flower:

What's the keyword for Florida? Flower, good! And, what state is flower the keyword for? Good, Florida!

It was also easy to teach her to establish a firm association between Tallahassee and television because television was very familiar to Crystal and the two words, again, sound very similar:

What's the keyword for Tallahassee? Television, good! And, what capital is television the keyword for? Good, Tallahassee!

Figure 1. Mnemonic representation of Tallahassee, capital of Florida. Copyright 1993 by M. A. Mastropieri and T. E. Scruggs)

Having linked the two words (Florida, Tallahassee) to concrete, familiar words that sound similar (flower, television), all that remains is to link the two familiar words together. And although memory experts Harry Lorayne and Jerry Lucas have suggested that these words must be associated "in some ridiculous way" (1974, p. 23), in fact all that is necessary is that the two keywords be pictured in some meaningful interaction. In the Florida instance, a picture had been created and displayed on an overhead projector of a flower sitting on a television set, as shown in Figure 1.

Although recalling that Tallahassee is the capital of Florida may be difficult for a student with learning problems, remembering a picture of a flower on a television set was much simpler, and - if the keywords had been learned - contained the same information. For this reason, we have found mnemonic strategies constructed according to these procedures to be extraordinarily effective (Mastropieri, Scruggs, Bakken, & Brigham, 1992).

What mnemonic strategies are not

It might be helpful, at this point, to also mention briefly what mnemonic strategies are not. Mnemonic strategies do not represent a "philosophy" of education. We do not use, or recommend the use of, mnemonic strategies because they are compatible with someone's particular philosophy or because they are a part of someone's theory about what education should be. We recommend mnemonic strategies for only one reason: Over and over again, they have been proven to be extremely effective in helping people remember things (Bulgren, Schumaker, & Deshler, 1994; Mastropieri & Scruggs, 1989).

It is also true that mnemonic strategies are not an overall teaching method or curricular approach. The focus of mnemonic strategies is so specific that they are intended to be used to enhance the recall of the components of any lesson for which memory is needed. We have found, for example, that mnemonic strategies can be used to enhance science learning when the curriculum involves a textbook/lecture format (Scruggs & Mastropieri, 1992) or when the curriculum involves a hands-on, inquiry learning format (Mastropieri, Scruggs, & Chung, 1997). Even though these approaches to science learning are very different (Mastropieri & Scruggs, 1994), mnemonic strategies can still be incorporated for the elements that require recall.

It is also important to consider that mnemonic strategies are memory strategies, and not comprehension strategies. Students who are trained mnemonically also perform better on comprehension tests of that content (e.g., Mastropieri, Scruggs, & Fulk, 1990; Scruggs, Mastropieri, McLoone, Levin, & Morrison, 1987), but that is generally because they remember more information that can be applied on comprehension tests. Nevertheless, when comprehension enhancement is called for, it is important to consider using specific comprehension strategies, such as content elaboration, prior knowledge activation, manipulation, coaching and questioning, or prediction and verification (e.g., Mastropieri & Scruggs, 1997; Scruggs, Mastropieri, Sullivan, & Hesser, 1993). Nevertheless, mnemonic strategies do not inhibit comprehension, as suggested by some (e.g., Kilpatrick, 1985), and, more importantly, there are many instances in school of students who have achieved adequate comprehension of a concept, but who have forgotten the facts associated with it. For example, it is completely possible to comprehend the nature of states and capitals while being unable to retrieve the capital of Florida. For another example, it is altogether possible to comprehend the concepts of a cell having a nucleus and consuming other organisms while being unable to retrieve the related verbal label (prokaryotic heterotroph). These are the areas where mnemonic strategies can help.

Finally, it should be emphasized that mnemonic strategies do not represent an educational panacea. There are many things that students must do to succeed in school, and remembering content information is only one part of the entire picture. However, when there is academic content to be remembered, mnemonic strategies may be an important instructional component. In the next section, we discuss some general procedures for improving memory, followed by a description of how to create specific mnemonic strategies.

General techniques for improving memory

Mnemonic strategies as described in this article are not the only way of improving memory in students who exhibit difficulty remembering things. It is important that you consider all possible methods for improving memory and not assume that mnemonic strategies are your only option. In other publications (Mastropieri & Scruggs, 1993; Mastropieri & Scruggs, in press), we have described more general methods for improving memory. These include the following:

1. Increase Attention.

Students will not remember something that they did not pay attention to in the first place. Be sure your students' memory problems are not really attention problems. Use strategies for enhancing attention, such as intensifying instruction, teaching enthusiastically, using more visual aids and activities, and reinforcing attending.

2. Promote External Memory.

Many things that need to be remembered can be written down, a practice known as "external memory." Practices such as keeping an assignment notebook and maintaining a student calendar can be helpful in remembering to do things. Unfortunately, external memory is usually of little use (ethically, anyway) on tests.

3. Enhance Meaningfulness.

Find ways to relate the content being discussed to the student's prior knowledge. Draw parallels to the students' own lives. Bring in concrete, meaningful examples for students to explore so the content becomes more a part of their experience.

4. Use Pictures.

Pictures can provide a memory advantage. Use pictures on the chalkboard or on the overhead projector. Bring in photographs or other illustrations. Show concrete images on videotape, when appropriate. If pictures are simply unavailable, ask students to create images, or "pictures in their heads."

5. Minimize Interference.

Avoid digressions and emphasize only the critical features of a new topic. Make sure all examples relate directly to the content being covered.

6. Promote Active Manipulation.

Students remember content better when they experience it for themselves (Scruggs, Mastropieri, Bakken, & Brigham, 1993). For example, rather than lecturing the class on the effect of weak acid (such as vinegar) on calcite, allow students to place calcite in a glass of vinegar and see for themselves.

7. Promote Active Reasoning. Students remember better if they actively think through new information, rather than simply repeating it. For example, rather than simply telling students that penguins carry their eggs on the tops of their feet, ask students why it makes sense that penguins would carry their eggs on the tops of their feet.

8. Increase the Amount of Practice. Students remember information better if they have practice using it more frequently. Use lots of review in your teaching; do not simply finish one topic and then never mention it again. Remind the class, and have students practice previous information frequently.

All these strategies can be used to improve memory, and all should be considered. Unfortunately, none of these strategies specifically targets recall of information contained in new or unfamiliar words, and this is the aspect of memory where students most often fail. For example, in the Scruggs, Mastropieri, Bakken, and Brigham (1993) investigation, students who engaged in active manipulation remembered more information about electricity and rocks and minerals than students who studied from textbooks. However, neither condition improved recall of critical vocabulary or terminology, the area where mnemonic strategies are most effective. In the following section, we describe several different types of mnemonic strategies that can be used to improve students' memory.

Specific mnemonic techniques

The keyword method

The keyword method has already been described for helping students remember states and capitals. However, the keyword method is extremely versatile and has a variety of helpful applications. One possibility is in teaching new vocabulary words. For example, to help students remember that barrister is another word for lawyer, first create a keyword for the unfamiliar word, barrister. Remember, a keyword is a word that sounds like the new word and is easily pictured. A good keyword for barrister then, is bear. Then, you create a picture of the keyword and the definition doing something together. It is important that these two things actually interact and are not simply presented in the same picture. Therefore, a picture of a bear and a lawyer in one picture is not a good mnemonic, because the elements are not interacting. A better picture would be a bear who is acting as a lawyer in a courtroom, for example, pleading his client's innocence. We have created pictures and shown them on overhead projectors, but you could show them in other ways as well. When you practice this strategy, be certain students understand all parts of it:

Class, barrister is another word for lawyer. To remember what a barrister is first think of the key word for barrister: bear. What's the keyword for barrister? [bear] Good, the keyword for barrister is bear, and barrister means lawyer. Now [displays overhead] look at this picture of a bear acting like a lawyer. The bear is the keyword for . . . ? [barrister] Barrister, good. So remember this picture of a bear acting like a lawyer. When you hear the word barrister, you first think of the keyword . . . ? [Bear] Good, and remember what is the bear doing in the picture? [being a lawyer]. Right, being a lawyer. So what does barrister mean? [lawyer] Lawyer, good.>

The keyword method can also be used for more specialized vocabulary such as ranidae the scientific term for common frogs. A good keyword for ranidae could be rain and you could show a picture of frogs sitting in the rain. Practice the strategy as in the barrister example. When you question individual students, ask them to give the answer and then describe how they remembered. You should get an answer something like:

Ranidae is the word for common frogs. I remembered because the keyword is rain and it was raining on the frogs.

If you practice the strategy carefully and frequently, students should remember this information very well. At early stages of learning, you might find some students give the answer rain when you ask what ranidae means. In these cases, you simply remind the student,

No, rain is the keyword - it just helps us remember the answer. Now think in the picture, what is it raining on? [frogs] Right, frogs. So what does ranidae mean? [common frogs]. Correct, common frogs.

Mnemonics can also be used in acquiring foreign language vocabulary. A list of some Italian vocabulary words (from Mastropieri & Scruggs, 1991, p. 24) and corresponding mnemonic strategies are given in Table 1. Before you read, cover up the keywords and strategies and see if you can come up with your own.

Table 1. Sample Italian Vocabulary Words and Corresponding Mnemonic Strategies

Word and Meaning	Keywords	Strategy
mela (apple)	mail	an apple in a mailbox
capre (goat)	cop	a goat dressed like a cop
lago (lake)	log	a log in a lake
carta (letter)	cart	a cart with a letter in it
fonda (bag)	phone	a phone in a bag

Keywords have also been used to improve recall of map locations. For example, students with learning disabilities were much more successful in locating Revolutionary War battle locations on a map when they were mnemonically encoded (e.g., a picture of a tiger, keyword for Fort Ticonderoga) than when representational pictures were used. When asked for the location of Fort Ticonderoga, students proved much more able to identify where on the map the tiger had been than they were to identify the location of a more traditional illustration. Further, if the tiger was shown tending a cannon, students were more likely to remember that at Fort Ticonderoga, cannons were captured that were helpful in the American war effort (Brigham, Scruggs, & Mastropieri, 1995).

The pegword method

Pegwords can be used when numbered or ordered information needs to be remembered. Pegwords are rhyming words for numbers and include the following:

One is bun	six is sticks
two is shoe	seven is heaven
three is tree	eight is gate
four is door	nine is vine
five is hive	ten is hen

Pegwords are substituted for the number to be remembered and associated with the other information. For instance, to remember that insects have six legs whereas spiders have eight legs, create a picture of insects on sticks (see Figure 2) and another picture of a spider on a gate. To remember Newton's first law of motion (objects at rest tend to remain at rest unless acted on by

another force), create a picture of a bun (pegword for one) resting. To remember that a garden rake is an example of a third-class lever, create a picture of a rake leaning against a tree (pegword for three, or third).

Pegwords can also be combined with keywords. To teach that crocoite is a mineral that is number 2 on the Mohs hardness scale, create a picture of crocodiles (key-word for crocoite) wearing shoes (pegword for 2). To remember that the mineral wolframite is hardness number 4, black in color, and used in making filaments for lightbulbs, create a picture of a black wolf (keyword for wolframite), looking in a door (pegword for 4), and turning on a lightbulb. Research has shown that elaborate strategies such as this are very effective, and that color, appropriately encoded, can also be easily remembered (Scruggs, Mastropieri, Levin, & Gaffney, 1985). That is, a picture of a black wolf is much more likely to be remembered than a picture of wolframite colored black.

Figure 2. Mnemonic representation of insects having six legs. (Copyright 1993 by M. A. Mastropieri and T.E. Scruggs.)

Figure 3. Mnemonic representation of Polk as the 11th U.S. president (Copyright 1993 by M.A. Mastropieri and T.E. Scruggs.)

Pegwords can also be extended beyond the number 10 (11 is lever, 12 is elf, etc.). For instance, to remember that the 19th amendment of the U.S. Constitution guaranteed women the right to vote, create a picture of a woman dressed as a knight (19 = knighting) riding to a voting booth. To remember that James K. Polk was the 11th American president, create a picture of a polka-dotted (keyword for Polk) lever (pegword for 11) as shown in Figure 3 (Mastropieri, Scruggs, & Whedon, 1997).

Pegwords can also be extended beyond the number 19, by using, for example, twenty is twin-ty (twins), thirty is thirsty, forty is party, and fifty is "giftty," or gift-wrapped. For example, to remember the math fact, $7 \times 8 = 56$, create a picture and practice the pegword phrase, "Heaven's (7) gate (8) holds giftty sticks" (pegword for 56). To remember that Taft was the 27th president, create a picture of a taffy (keyword for Taft), being pulled between twin heavens (pegword for 27).

Letter strategies

Letter strategies, which involve using letter prompts to remember lists of things, are the most familiar to students. Most former students remember using the acronym HOMES to remember the names of the Great Lakes and FACE to remember the notes represented in the spaces of the treble clef, from bottom to top. Except for the FACE strategy, however, most acronyms assume that a name of something will be remembered when the first letter is retrieved. However, this may not always be true. For example, if a student is unfamiliar with Lake Ontario, remembering simply that the first letter is O is insufficient to prompt recall. The names of the individual lakes must be practiced until they have become familiar.

Acronyms are most helpful when the first letters of a list can be used to create an entire word; however, sometimes modifications can be made. For instance, consider the acronym FARM-B, which represents the five classes of vertebrate animals: fish, amphibian, reptile, mammal, and bird, as shown in Figure 4. The B for bird does not really fit, but it can be added to FARM and practiced until it becomes automatic.

Figure 4. Mnemonic representation of the vertebrates: fish, amphibians, reptiles, mammals, and birds. (Note. From *A Practical Guide for Teaching Science to Students with Special Needs in Inclusive Settings* [p 158], by M. A. Mastropieri and T. E. Scruggs 1993, Austin, TX: PRO-ED. Reprinted with permission.)

In other cases, appropriate words cannot be easily constructed from the first letters of the words to be remembered. For example, if you wished to remember the names of the planets in their order from the sun, the letters would be M-V-E-M-J-S-U-N-P, from which a word cannot be made. In these cases, an acrostic can be created, in which the first letters are reconstructed to represent the words in a sentence. In this case, the sentence could be "My very educated mother just sent us nine pizzas" (Mastropieri & Scruggs, 1994, p. 271). Again, the names of the planets must be sufficiently familiar so that students can retrieve a planet name, given only the first letter. Also, students should be sufficiently familiar with the solar system to know that the first M stands for Mercury, and not Mars.

For another example, to remember the classification taxonomy of living things, remember the sentence, "King Philip's class ordered a family of gentle spaniels." This sentence helps prompt kingdom, phylum, class, order, family, genus, and species, in order.

Training independent strategy use

Several research studies have described the effects of training students with memory problems how to use mnemonic strategies independently (Fulk, Mastropieri, & Scruggs, 1992; King-Sears, Mercer, & Sindelar, 1992; Mastropieri, Scruggs, Levin, Gaffney, & McLoone, 1985; McLoone, Scruggs, Mastropieri, & Zucker, 1986; Scruggs & Mastropieri, 1992). The earlier studies successfully trained students with disabilities to use the mnemonic procedures and then to generalize the procedures for learning new vocabulary words (Mastropieri et al., 1985; McLoone et al., 1986). More recent studies trained students with disabilities to use the strategies across different content areas, including science and social studies (Fulk et al., 1992; King-Sears et al., 1992; Scruggs & Mastropieri, 1992). All of these studies demonstrated some positive benefits for training students to use mnemonic strategies independently. More importantly, however, studies shared seven common elements during the training sessions with students with disabilities, as described by Fulk (1994) and Bulgren et al. (1994) and summarized next.

Step 1. Inform students about the purpose of the instruction and the rationale for the strategy training. Tell students that strategy training will be beneficial for them and that their efforts at using the strategies will result in better performance. Provide examples of how the strategy can be beneficial across a variety of learning situations and content areas. For example, in teaching students how to implement the strategy to learn science vocabulary, show them how the method can also be helpful in learning social studies content and for learning English and foreign language vocabulary.

Step 2. Provide instruction in the strategy and in positive attributions toward strategy usage. Demonstrate, model, and lead students using many examples to ensure their complete understanding of the mnemonic process during the strategy component training. Provide instances and noninstances of correct usage and have them identify and correct any incorrect examples.

Make charts listing the steps involved in generating strategies. King-Sears et al. (1992) taught students the IT FITS strategy:

Identify the term.

Tell the definition of the term.

Find a keyword.

Imagine the definition doing something with the keyword.

Think about the definition doing something with the keyword.

Study what you imagined until you know the definition. (King-Sears et al., 1992, p. 27)

Provide ample modeling and practice with students, attributing their successes to strategy use.

Say, for example, "When I try hard and use the strategy, I will remember more information."

Reinforce students for trying hard to use the strategy and attribute success and failure to strategy usage.

Step 3. Provide models during which examples and thinking processes are said aloud. Demonstrate how you proceed with your thinking while generating a strategy for specific examples. Include statements attributing your success to the hard effort and use of the strategy.

Step 4. Allow students opportunities to practice orally and provide corrective feedback. Practice several examples with the class as a whole. Encourage brainstorming during the development of the keyword and interactive picture phase. Allow students to work in small groups and practice generating strategies and brainstorming. Then, have students work with partners to develop strategies before working independently.

Step 5. Arrange guided practice with relevant feedback on both strategy usage and attribution feedback. Give students additional items to practice using the mnemonic and attribution strategies. Provide corrective feedback and allow opportunities for students to share their thinking with one another about how they developed their strategies.

Step 6. Provide generalization instruction, practice, and feedback. Use different types of materials to demonstrate how the strategy can be applied across content areas and various types of factual information. Have students practice generating strategies for vocabulary words in English, for names of famous people and their accomplishments in history, for minerals and their associated attributes in science, and other associated factual information they may need to learn in school.

Step 7. Include positive reinforcement and positive attribution training for completing the tasks and for remembering the information correctly. Provide review and practice with information that was learned using strategies. Students will still need to practice retrieving information learned with strategies. When implemented as a package of training, students with disabilities may be more likely to learn to use and generate these strategies independently.

Limitations

Research has indicated that students who have been taught strategies for creating their own mnemonics out-perform comparison students in free-study conditions. Unfortunately, however, when students generate their own strategies, instruction may proceed at a much slower rate and students' performances may be lower than when teachers supply the strategies (Scruggs &

Mastropieri, 1992). During a given unit of instruction, teachers should consider whether learning a strategy or learning the content is the priority.

Moreover, initial development of many of these strategies can be difficult for anyone. Try developing several strategies yourself before teaching your students with disabilities. If you experience difficulties, imagine that the task will be much more difficult for your students. Each year, develop a few strategies to accompany the content areas that you teach most frequently. Over time you will have a great number of effective strategies that you can teach your students. This does not mean that you should not teach your students to develop strategies independently. You can still encourage active strategy development on the part of your students, but if students have difficulties generating strategies, you can supply the ones developed by you or your co-teachers. Perhaps you will find that a combination of teacher-created and student-generated mnemonic strategies is the best way to enhance recall and still promote independent strategy use.

Summary

Although many changes in schooling have taken place in recent years, memory for academic content remains an extremely important part of the school learning experience. Students with learning disabilities and other special needs may be at particular risk for failure in this important arena of school functioning. In order to promote academic success in school, we recommend that teachers teach students how to remember as well as what to remember. This can be done by a variety of strategies, but by far the most powerful have been the keyword method, the pegword method, and letter strategies. Systematic instruction using mnemonic strategies for important information to remember, as well as systematic instruction in independent use of mnemonic strategies, can be important factors in determining school success for students with learning and memory problems.

About the authors

Margo A. Mastropieri, PhD, is a professor of special education, Department of Educational Studies, Purdue University. Her research interests include ways to facilitate learning, memory, and thinking of students with disabilities. Thomas E. Scruggs, PhD, is a professor of special education, Department of Educational Studies, Purdue University. His research emphasizes research synthesis, science instruction for students with disabilities, and mnemonic instruction for students with disabilities.

http://www.idonline.org/article/Enhancing_School_Success_with_Mnemonic_Strategies