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Use of a Recall Enhancement Routine and Strategies in Inclusive Secondary Classes

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The purpose of this study was to evaluate the effects of training secondary science and social studies teachers in inclusive class settings to use a teaching routine to enhance their students' recall of information. A multiple-baseline across-teachers design was employed to determine the effects of training on teacher performance. In selected classes, a posttest-only comparison-group design was employed to determine the effects of teacher use of the routine on students' ability to (a) specify a mnemonic device that they would use to learn a given set of information, (b) select the most appropriate mnemonic device for the information, and (c) briefly explain how to use the device.

Results indicated that the teachers used substantially more components of the Recall Enhancement Routine at mastery levels after training than before training. Most students selected and explained a mnemonic device that they would use to recall content information. However, differences were found when items were analyzed to determine if students, when presented with items that were designed to be recalled with one of three specific types of devices, could select the most appropriate device. Students in experimental classes earned significantly more points than did students in the comparison classes on items related to devices presented by their teacher. Furthermore, students with learning disabilities (LD) in experimental classes earned significantly more points than did students with LD in comparison classes on items presented by their teacher. Both teachers' and students' mean satisfaction ratings were within the satisfied and somewhat satisfied range. The teachers all indicated a high likelihood that they would use the routine again and that they would recommend its use to others with or without inservice training.

To meet the demands of most regular secondary courses, students are expected to cover, understand, and recall large amounts of curriculum content. Students with mild disabilities, who are increasingly enrolling in these courses, have a difficult time meeting such demands due to the skills they bring to the learning situation (Schumaker & Deshler, 1984). One way that general educators can assist these students is to model, prompt application of, and teach them the most appropriate learning strategies for effectively processing and remembering course content (Pressley, Levin, & Bryant, 1983; Pressley, Woloshyn, & Associates, 1995; Scanlon, Deshler, & Schumaker, 1996). In other words, they can teach not only the course content but also the learning strategies that these students need to function as independent learners in the secondary setting.

One type of strategy that might be taught in secondary courses involves the creation and use of mnemonic devices or memory aids to improve recall of information. Scruggs and Mastropieri (1990) have argued that the use of mnemonic devices in classrooms can have a positive effect not only on students' recall of information but also on their comprehension and affect. Other commentators, reflecting a renewed interest in mnemonic devices and their potential use in classrooms, have documented the long history associated with research on mnemonic devices and have described types of mnemonic instruction and evidence supporting the use of mnemonic techniques (e.g., Bellezza, 1981; Higbee, 1979; Levin, 1988; Scruggs & Mastropieri, 1990; Weinstein, 1978). Books (Baddelley, 1982; Bellezza, 1982) and articles associated with various content areas such as science (Jackson & Anderson, 1988) and history (Bernard, 1989) also have been written to provide educators with examples and guidelines for developing their own mnemonic devices.

Recently, two groups of studies have been conducted related to the use of mnemonic devices to aid the recall of students with disabilities. In most of the studies in the first group, researchers prepared the devices and presented them (or had a special education teacher present them) to small groups or individual students with learning disabilities (LD) in conjunction with information to be remembered, such as history text (Scruggs & Mastropieri, 1989); vocabulary words (Condus, Marshall, & Miller, 1986); science facts (Mastropieri, Scruggs, McLoone, & Levin, 1985); and science vocabulary, facts, and concept attributes (Veit, Scruggs, & Mastropieri, 1986). In a recent experimental study, Bulgren, Schumaker, and Deshler (1994) created mnemonic devices,

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and one of the researchers presented them in a review at the end of a social studies lesson to large groups of students including students with LD. All of these studies showed that students with LD demonstrate significantly better recall of information when mnemonic devices are paired with that information than when they are not.

In the second group of studies, students have been directly taught strategies to create independently and use mnemonic devices to study and recall information (for a review, see Mastropieri & Fulk, 1990). For example, in an investigation conducted by Bulgren, Hock, Schumaker, and Deshler (1995), high school students with LD were taught a complex strategy (the Paired Associates Strategy; Bulgren & Schumaker, 1996) by their special education teacher to identify important factual information from both controlled materials (sentences) and content materials (chapters), select the type of mnemonic device most appropriate for use in recalling the information (imagery, associations, keywords, or codes), develop a mnemonic device to recall the identified information, study the information and the mnemonic device, and correctly answer questions on a test about the information. Ferro and Pressley (1991) taught both mildly academically handicapped and average-achieving students to form mental images of paired objects. King-Sears, Mercer, and Sindelar (1992) taught students a strategy to form their own keywords and found that student-constructed keyword mnemonic devices and teacher-constructed mnemonic devices were superior to a systematic teaching technique with regard to student recall of information. Mastropieri, Scruggs, Levin, Gaffney, and McLoone (1985) also taught students to generate their own mnemonic images when an experimenter told the students what keywords to use in developing an image. McLoone, Scruggs, Mastropieri, and Zucker (1986) taught students to generate their own keywords and images immediately after they had been presented with models of researcher-prepared keywords and images. Fulk, Mastropieri, and Scruggs (1992) found that students with LD can create mnemonic keyword devices to learn information derived from a variety of content areas. In addition, these authors found that academic performance was significantly better when students had been trained to create devices than when they learned a simple rehearsal technique. Similarly, Scruggs and Mastropieri (1992) found that students as a group could generate mnemonic keyword devices and apply them to novel content when guided by a teacher through the process. Again, retention was enhanced by the creation of the devices. The authors noted, however, that when students were guided through the process of generating their own keyword devices, the pace at which new content information could be covered was diminished by at least a third.

These studies and others have provided valuable information regarding the ability of students with LD to benefit from the presentation of mnemonic devices and to create and use their own devices. However, no studies have focused on general education teachers' creation and embedded use of mnemonic devices within the context of secondary general education courses. In addition, no studies have addressed whether students enrolled in secondary general education courses can learn to create their own mnemonic devices by observing their general education teachers' presentation of those devices. Because general education teachers have indicated that they do not have the time to teach strategies in a systematic and intensive way and still cover all their required content (Lenz, Schumaker, & Deshler, 1991; Scanlon, Schumaker, & Deshler, 1994), research needs to be focused on the effects of less intensive instructional methods for strategy instruction in general education settings. Thus, the major purpose of this investigation was to explore the effects of teaching secondary general education teachers to use a routine, called the Recall Enhancement Routine (RER), to present mnemonic devices in conjunction with their curriculum content. Two studies were conducted. The purpose of Study 1 was to determine whether teachers would incorporate the RER into their regular classroom procedures, the fidelity with which they would use the routine, the types of mnemonic devices they would create for their students, and their own and their students' satisfaction with the routine. The purpose of Study 2 was to provide some preliminary information about whether students enrolled in general secondary courses in which the routine was used by their teachers could learn to identify and create mnemonic devices independently through watching their teachers' presentation of the devices through their implementation of the routine.

METHOD

Participants

Teachers. Nine general education teachers who taught in two suburban Kansas school districts participated in Study 1. They volunteered after the study was described to them individually and after they were offered $80 to participate. Descriptive information about the teachers and their schools appears in Table 1. All of the teachers taught general education classes in which a diversity of students, including those with LD, were enrolled.

Two of the teachers who participated in Study 1 (T4 & T5) also participated in Study 2 as the experimental teachers. In addition, two teachers who did not participate in Study 1 agreed to participate in Study 2 as the comparison teachers (T10 & T11). They taught the same subject matter (life science) to students of the same age (seventh graders) in the same schools as the two experimental teachers, and school personnel indicated that similar types of students were assigned to the paired classrooms in each school. Descriptive information about the comparison teachers appears at the bottom of Table 1.

Students. Student participants in Study 2 were enrolled in the life science classes of the two experimental and two comparison teachers just described. They volunteered to participate after having the study described to them and having their parents sign consent forms. Students of the two experimental teachers served as the experimental group; students of the two comparison teachers served as the comparison group. The numbers of student participants in each class in Study 2, including those with LD, are shown in Table 2. The students with LD were individuals who had been formally classified as meeting Kansas state guidelines for receiving services for a learning disability and were identified as such by the par-

TABLE 1
Descriptive Information About the Teachers and Schools

Teachers	School District	No. of Students Served in School	Grades Taught	Subject	Age	Sex	Years Experience
Experimental teachers							
1	A	1,648	10–12	Introduction to Science	49	F	1
2	A	652	9	Physical Science	39	M	6
3	A	1,648	10	Basic Biology	48	M	28
4[a]	B	913	7	Life Science	47	F	16
5[a]	B	658	7	Life Science	33	F	10
6	B	658	8	Social Studies	47	F	15
7	B	658	8	Social Studies	48	M	21
8	B	268	7	Life Science	47	M	22
9	B	658	7	Social Studies	41	F	18
M					44.33		15.22
Comparison teachers							
10[b]	B	913	7	Life Science	31	F	7
11[b]	B	658	7	Life Science	41	F	7
M					36		7

[a]Teachers participating in both studies. [b]Teachers participating in Study 2 only.

TABLE 2
Descriptive Information for Study 2

Teachers	School	No. of Students Served in School	Grades Taught	Subject	Total Students	Students With LD
4	A	913	7	Life Science	118	6
5	B	658	7	Life Science	87	8
10	A	913	7	Life Science	114	17
11	B	658	7	Life Science	66	8

ticipating teachers. Demographic data were not available to the researchers on any of the students.

The RER

The RER was developed based on the philosophy associated with the Content Enhancement approach (Bulgren & Lenz, 1996; Lenz & Bulgren, 1995; Lenz, Bulgren, & Hudson, 1990; Schumaker, Deshler, & McKnight, 1991), which is a strategic teaching methodology recently developed for teaching scientific or cultural knowledge to heterogeneous groups of students in which (a) both group and individual learning needs are to be met, (b) the integrity of the content is to be maintained, (c) critical features of the content are selected and transformed in a manner that promotes effective and efficient information processing, and (d) the content is delivered in partnership with students in a manner that facilitates and enriches learning for all students.

To prepare content for use in the RER, a teacher selects factual information from a unit or lesson that is judged to be important for students to master. After target information has been identified, the teacher then selects the most appropriate type of mnemonic device for the information from a menu of devices (see Mnemonic Devices section) and creates a mnemonic device for it. For example, a science teacher participating in this investigation developed an acronym to help students master the names of places that fossils can be found (i.e., sedimentary rock, marine environment, amber tree sap, road cuts, and tar pits) by isolating the first letter of each of the places and forming the word *SMART* with the letters. The teacher also constructed a mnemonic sentence to tie the acronym to the topic: "Get SMART when you try to find fossils."

Once the mnemonic devices have been prepared, the teacher is ready to implement the RER in class. The routine is to be implemented each time a new device is presented to students; it can be implemented at any time during a lesson, such as when the information is initially presented or at the end of class during a review. First, the informational item to be mastered by students is presented and explained by the teacher (Step 1) and is written on the chalkboard (Step 2). Next, the teacher cues the students that the information is important to master (Step 3) and that a certain type of mnemonic device (e.g., an acronym) will be presented to help them remember the information (Step 4). The teacher also cues them to write the information and the mnemonic device in their notes (Step 5). Then the teacher presents the mne-

monic device and links it to the information to be mastered (Step 6). At some later time (e.g., at the end of the lesson, at the beginning of the next lesson, whenever the information is mentioned in a subsequent lesson, during a review session prior to a test), the teacher and students interactively review the information and the device (Step 7). These steps can be performed in varying sequences according to teacher preference.

Mnemonic Devices

Nine types of mnemonic devices were selected to be included on a menu of devices that teachers could prepare. Several of the devices were reconstructive elaborations as described by Scruggs and Mastropieri (1990). They included: (a) literal pictures (mimetic reconstructions) for familiar, concrete information (hereafter referred to as *exact pictures*), (b) symbolic pictures (symbolic reconstructions) for encoding familiar but abstract information (hereafter referred to as *changed pictures*), and (c) keywords (acoustic reconstructions) for encoding unfamiliar information (hereafter referred to as *keywords*). These new names were associated with the devices to facilitate communication with and use by students. In addition, a fourth type of reconstructive elaboration (hereafter referred to as *familiar associations*) was included, whereby a word—usually a person's name—for which an exact picture cannot be formed is associated with the mental image of a familiar person with the same name. Then, the image of this familiar person is associated with an image of the item of information to be mastered.

Three other types of mnemonic devices were included on the menu and have been described by Scruggs and Mastropieri (1990) as follows: Acronyms that involve words formed from the initial letter of successive words (hereafter referred to as *acronyms*), loci in which a specific sequence of places is memorized and used to associate ordered information with each place in the preselected sequence (hereafter referred to as *loci*), and pegwords in which each of several pairs of preselected rhyming words (e.g., one–bun, two–shoe, three–tree, etc.) is associated with an item in a sequence of items to facilitate mastery of numbered or ordered information (hereafter referred to as *pegwords*).

Another mnemonic device that was included on the menu was a rhyming device in which the words in a constructed rhyme represent information to be mastered (Bellezza, 1982; hereafter referred to as a *rhyme*). Finally, a number-substitution device, similar to the number–sound mnemonic device described by Scruggs and Mastropieri (1990), was included on the menu (Bulgren et al., 1995). This device (hereafter referred to as a *code*) involves mastering strings of numbers (e.g., the numbers in an important date) by substituting letters for the numbers and using those letters to create a word or a sentence in which the letters are used as the first letters of the words in the sentence.

The procedures the teachers were to use in preparing the mnemonic devices and in implementing the RER were described in a teacher's manual that included a definition and discussion of each mnemonic device, example mnemonic devices, directions for developing and incorporating mnemonic devices into a class presentation, a description of the seven steps of the RER, an example of the routine in use, a cue card for teachers to use during lessons to remind them of the steps of the routine, and a planning form for use in the development of a mnemonic device.

Measurement Systems

Teacher observation checklist. An observation checklist (OC) was employed in Study 1 to assess the fidelity of teacher implementation of the RER in their classrooms and to record the mnemonic devices presented by the teachers. On the checklist were seven items corresponding to the seven steps of the RER. Next to each item was a space on which an observer could write a number of points to indicate whether the corresponding step of the routine was performed by the teacher being observed. The following numbers of points were awarded: 5 points for presenting the information, 5 points for writing it on the board, 5 points for cueing the importance of mastering the information, 20 points for naming the mnemonic device, 20 points for cueing the students to take notes about the device, 40 points for presenting the mnemonic device and linking it to the information to be mastered, and 5 points for reviewing the device and its associated information (a total of 100 points was available). Either all or none of the points were awarded for each of the seven items on the checklist. The mastery criterion was set arbitrarily at 85 points. There was also space on the checklist where the observer could record the words the teacher used for presenting the information in each of the steps.

Each item on the checklist was defined and described in an evaluation manual. Examples of teacher statements or actions that qualified for points and those that did not qualify were also included. The evaluation manual specified that observers were to use the checklist to record teacher behavior during any situation in which the teacher indicated in any way that the students needed to know the specific information being presented or during any situation in which any mnemonic device was mentioned or written on the chalkboard. Each of these situations was called a *presentation*. Thus, several OCs could be completed during a given lesson because several presentations of mnemonic devices were possible. Each use of the checklist corresponded to one presentation of a single mnemonic device.

Interscorer reliability on the checklist was determined by having two scorers independently score 15% of the class sessions. The points awarded by the two observers were compared item by item. An agreement was tallied if both observers awarded the same number of points for the same item. The percentage of agreement was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. The observers agreed on 118 items out of 119 opportunities to agree (total percentage of agreement = 99.2%). The percentage of agreement ranged from 93% to 100% on individual presentations.

Student test. A test was designed for use in Study 2 to measure whether, when presented with items designed to be recalled with specific types of mnemonic devices, students

could independently select a device, select the most appropriate mnemonic device, and explain how they would use the selected device. Items associated with three types of mnemonic devices (mental images, acronyms, and keywords) were included. These types of devices were chosen based on the observers' records of the most frequently used devices in the classes.[1] Items were randomly selected from a pool of items previously constructed for use in a parallel study (Bulgren et al., 1994) to measure student ability to recall information with mnemonic devices.

Six items were on the test; two items were associated with each type of device. An item consisted of a statement containing information to be mastered (e.g., "Four characteristics of tabloid newspapers are that they have pictures, are interesting, are gossipy, and are small-sized" [acronym]) and two questions. The first question asked the student to show the memory device that would be used to master the information in the statement; the second question asked the student to tell how he or she would go about memorizing the information. Each student was awarded 1 point if any mnemonic device was created, 1 point if he or she created the most appropriate device (e.g., an acronym for a list of items), and 1 point if he or she told how the device was used to learn the information in some way. No points were given if the student failed to create a mnemonic device, failed to name the most appropriate device, and did not show how he or she used the device to learn the information, respectively. Therefore, 3 points were awarded for correct responses in all three response categories. For example, consider the task of remembering the information in the statement, "Four characteristics of tabloid newspapers are that they have pictures, are interesting, are gossipy, and are small-sized." If a student created an acronym (e.g., "PIGS") to recall the information, 1 point was awarded for creating a mnemonic device and 1 point was awarded for choosing the most appropriate device. If the student explained how "PIGS" would be used to remember the information, 1 more point was awarded. In addition, the type of device used by the student was named by the scorer.

Four judges reviewed the items on the test and specified the most appropriate mnemonic device for each. One of the judges held a bachelor's degree and had over 60 hr of graduate study and extensive experience in teaching and curriculum development. One held a doctorate in special education and was certified to teach at the secondary level. Another held bachelor's degrees in education and special education, held master's degrees in special education and counseling, and was completing work on a doctorate in special education. The fourth judge had expertise in test construction and assessment and was pursuing a graduate degree in educational psychology and research. Each judge was asked to read each item, to study the menu of mnemonic devices along with the descriptions and examples of each type, and to identify the most appropriate device for the item. The four judges concurred on the type of mnemonic device that would be best associated with each item with 100% reliability.

[1] In actuality, three picture devices (the exact picture, changed picture, and familiar association devices), as a combined group, composed the second most frequently used group of devices by the teachers. However, only items related to exact pictures were included on the test because the other devices rely on personalized images that would be difficult to score.

Interscorer reliability on the tests was determined by having two scorers independently score a randomly selected sample of 15% of the tests (n = 58). Agreements and the percentage of agreement were determined as previously described. The scorers agreed on 1,317 items out of 1,392 opportunities to agree, for a total percentage of agreement of 94.6%.

Social validity questionnaires. Two questionnaires were developed to measure teacher and student satisfaction with the RER and the mnemonic devices. The teacher questionnaire had 20 items, and each item had a 7-point Likert-type scale associated with it. Seventeen items were used to elicit satisfaction ratings with regard to the routine and the devices; the scale ranged from 1 (*completely dissatisfied*) to 7 (*completely satisfied*). The other 3 items were used to determine the likelihood of continued use of the routine and devices and of recommending them to others and ranged from 1 (*very unlikely*) to 7 (*very likely*).

A student questionnaire was designed to be administered to students in the classes of the nine teachers who implemented the RER. It included seven items, each rated on a 7-point Likert-type scale ranging from 1 (*completely dissatisfied*) to 7 (*completely satisfied*).

Procedure

Baseline procedure. During baseline, the teachers participating in Study 1 were observed during lessons that they designated as lessons in which they would present information that they expected students to master. All observed lessons in Study 1 were associated with the one class of students selected by each teacher, which contained a diverse group of learners including students with LD. During each lesson, observers independently recorded information on the OC as described previously.

Teacher training procedure. In a 2-hr workshop session in their schools, the teachers were provided with a manual, an overview of the routine including rationales for using it, a verbal description of how to prepare the devices and use the routine, and a demonstration of how to use the routine. This instruction was followed by teacher practice in selecting the best mnemonic device or devices for specific types of factual information from the teachers' own texts and resource materials. Next, time was allotted for preparing the selected device or devices, presenting them through the use of the RER to the other teachers and researchers, and receiving individual feedback.

Implementation procedure. After the teachers were trained, they implemented the RER in their classes, and observers attended their classes each time the teacher indicated the routine would be used. If they requested help, one of the researchers consulted with them. If they did not reach the mastery level with regard to performing the steps of the routine, feedback was given by a researcher. Teachers imple-

mented the routine in their classes for periods of time ranging from 1 to 7 weeks, depending on their assignment to particular parts of the experimental design.

Experimental Design

Teacher design (Study 1). Multiple-probe designs (Horner & Baer, 1978) were utilized to illuminate the effects of training the teachers to create the devices and use the routine. A three-legged, multiple-baseline, across-teachers design (Baer, Wolf, & Risley, 1968) was utilized for three teachers (T1, T2, & T3). In addition, a two-legged, multiple-baseline, across-teachers design was utilized for two teachers (T4 & T5) and was replicated twice more (T6 & T7, T8 & T9). For each design, at least three initial baseline observations were conducted in each teacher's class. Once the teachers' baselines were stable, the first teacher in each design received training. Baseline observations were continued for the other teachers until teachers who had been trained had implemented the RER at the mastery level. Then the second teacher in each design received training. The third teacher in the three-legged multiple-baseline design was trained after the second teacher had performed the routine at the mastery level.

Student design (Study 2). A posttest-only comparison-group design was used to determine the effects of teacher use of the routine on student construction of mnemonic devices. The student test was administered at the end of the school year in the classes of the two experimental and two comparison teachers. The test performance of students in the experimental group was compared to the test performance of students in the comparison group. In addition, the test performance of the experimental class in each school was compared to the test performance of the comparison class in the same school.

RESULTS

Teacher Implementation of the Routine

Figures 1, 2, 3, and 4 show the teachers' performance with regard to implementation of the routine. In Figure 1, the performance of three teachers is shown. In each of Figures 2, 3, and 4 the performance of two teachers is depicted. Each graph in the figures depicts one teacher's implementation of the routine. For each teacher, baseline performances are shown to the left of the vertical line within each graph, and posttraining performances are shown to the right of this line. If only one or no presentations occurred during a lesson, the percentage of points earned during that presentation is depicted with a solid dot. If there were several presentations during a lesson, the average number of points earned across the presentations during that lesson is depicted with a circle.

During baseline, the mean percentage of points earned by the teachers on the OC was 6.73% (range = 0%–62.50%). On average, before training, the teachers provided the students with ways to recall important information 0.15 times per classroom observation. In general, teachers cued their students to master information and presented that information

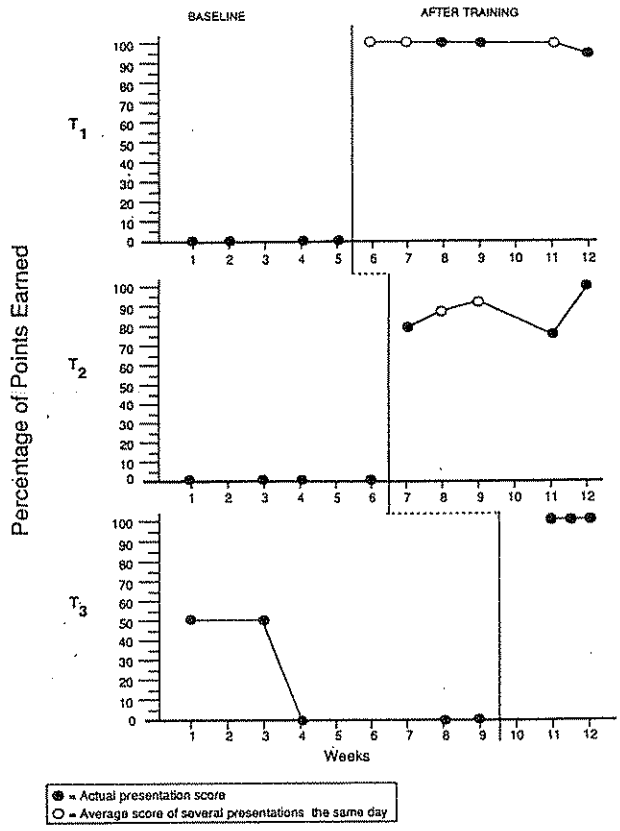

FIGURE 1 Performance of Teachers 1, 2, and 3 on use of the RER.

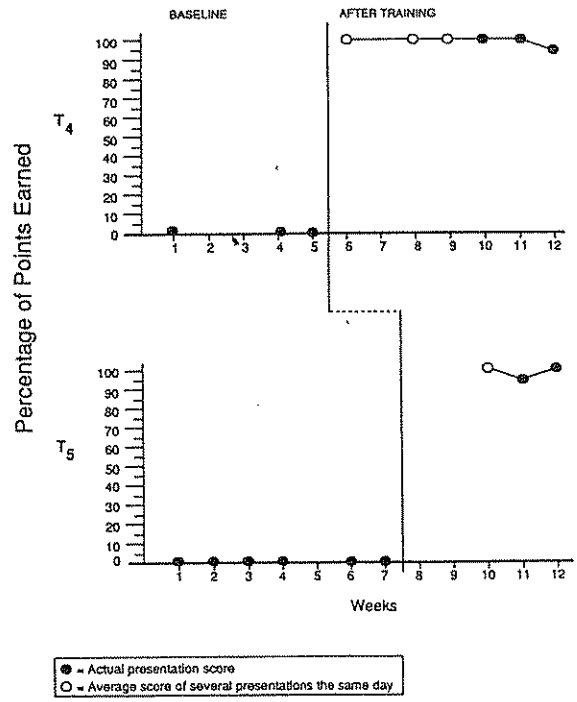

FIGURE 2 Performance of Teachers 4 and 5 on use of the RER.

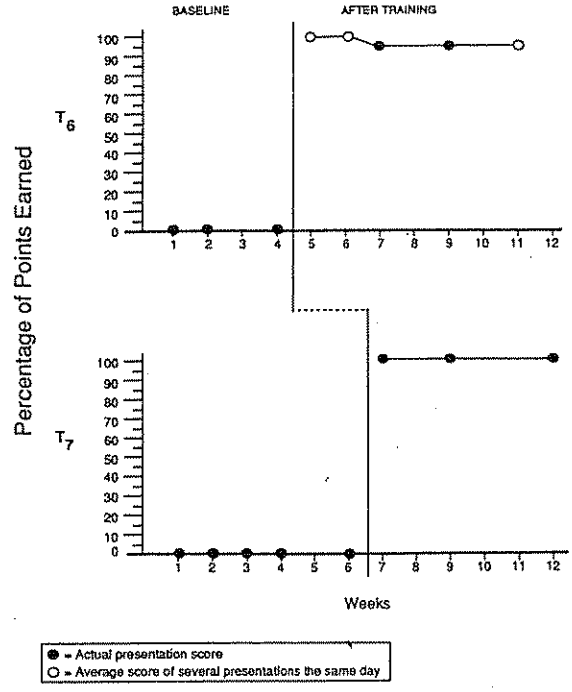

FIGURE 3 Performance of Teachers 6 and 7 on use of the RER.

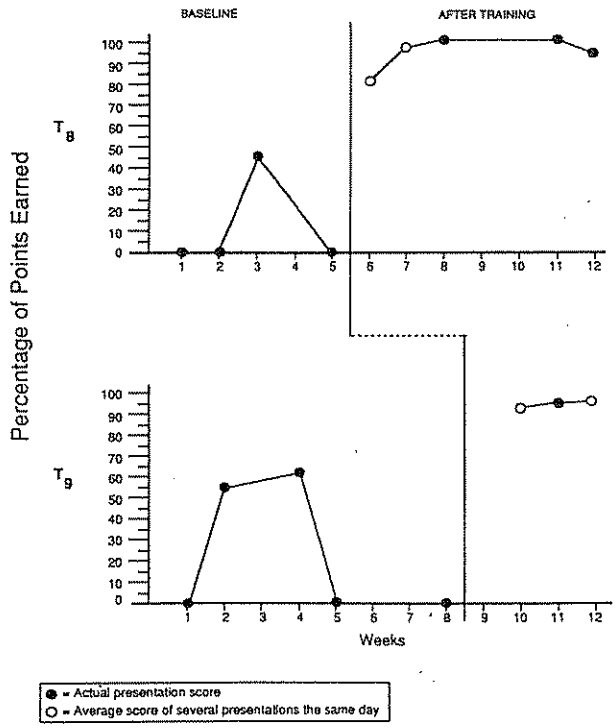

FIGURE 4 Performance of Teachers 8 and 9 on use of the RER.

orally and visually. During the 39 baseline observations, the teachers provided 27 importance cues. In 6 of those 27 instances (22%), the teachers provided ways to help students master the information. An acronym was presented three times, a crossword-puzzle type device was used twice, and an exact picture was used once.

In the 39 class periods observed after training, 64 presentations of the routine were observed. The mastery criterion was reached or exceeded in 55 out of the 64 presentations. The average teacher score after training was 96.4% (range = 75%–100%). During the 39 postintervention observations, the teachers used 65 importance cues; they presented mnemonic devices in 64 out of the 65 (98%) instances.

Six of the teachers achieved mastery in all presentations. Seven of the nine teachers reached or exceeded the mastery level during their first posttraining observations in all presentations. One teacher (T8) presented six devices during the first observation; his scores were 75% for one presentation, 80% for four presentations, and 95% for the sixth presentation (average score that day = 81.7%). After consulting with a researcher, that teacher exceeded the mastery level on the next four lessons, earning more than 95% of the points each time. Another teacher (T9) presented three devices during her first lesson and earned 80% of the points on one of them; across all three presentations she achieved a mean score of 93.3%. After that, she never failed to reach mastery.

Another teacher (T2) did not achieve the 85% mastery level in three of the five posttraining presentations. Scores were 80% during the teacher's first presentation of a single device and 75% during the fourth presentation of a single device. In the second lesson, he made three presentations, scoring 75% on one of the presentations, but 88.3% across all three presentations. This teacher expressed a strong preference for not using the cue card during presentations, preferring to rely on memory alone while performing the steps of the routine.

Teachers presented from one to six mnemonic devices during each of the observed class sessions. The mean number of mnemonic devices presented after training was 1.64 per class period. Only one teacher presented a total of six devices in 1 class period. None presented four or five devices during a single session. On 5 occasions, three devices were presented in 1 class period, and on 10 occasions, two devices were presented in a single class period. One device was presented in each of 23 class periods. Presentation time for each device varied from 2.5 to 55 min. The 55-min presentation involved the presentation of the device (an acronym) that was imbedded throughout the entire lesson.

Figure 5 shows the types of mnemonic devices presented by the teachers after training. Of note is the fact that the exact picture device, the changed picture device, and the familiar association device all are based on mental images; they were the focus of 25 (39%) of the presentations. Thus, the most frequently used devices were ones that could be classified as acronyms and mental images.

Student Test Results

Results on the written test showed that both groups of comparison and experimental students created mnemonic devices and briefly described how they might use those devices for over 80% of the items. However, the comparison students as a group created the most appropriate devices for 24.7% of the items, whereas the experimental students as a group created the most appropriate devices for 42% of the items.

Data were further analyzed to determine the relation of teacher presentation of a particular type of device to student

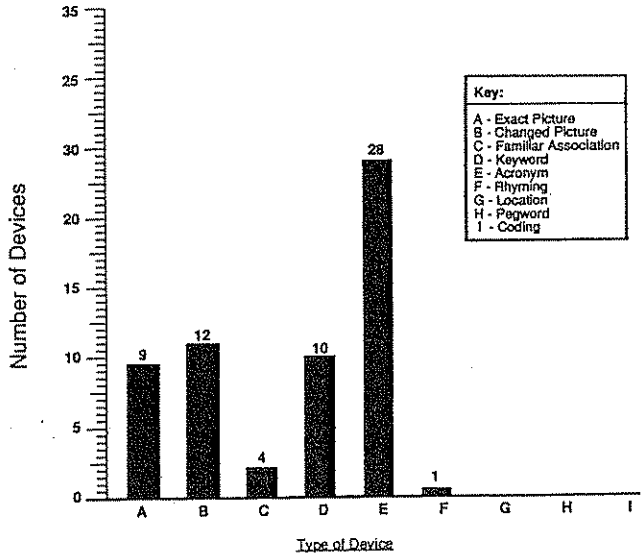

FIGURE 5 Types of mnemonic devices presented by teachers.

ability to select the most appropriate device for items related to that device. For this analysis, the number of points earned by the students in all of a given teacher's classes on a given device were summed and divided by the number of points they could have earned to yield the percentage of points earned. T4 presented acronyms most frequently (five times). Statistical analysis indicated that the entire group of students in her class performed significantly better than the comparison class on test items that could best be addressed through the creation of an acronym ($p = .000$). Students with LD performed significantly better in the experimental group than students in the comparison group ($p = .000$; see Figure 6 for percentage of points earned by the entire group and by students with LD). No significant differences were found between these experimental and comparison groups either for the whole groups or for students with LD regarding performance on items related to devices that were seldom used or never used by the experimental teacher (i.e., the keyword and mental imagery strategies). The percentage of points earned by students on these items was relatively low (i.e., less than 33%) in both experimental and comparison classrooms.

T5 most frequently presented mental images to her students (three times). A keyword was presented once, and no acronyms were presented. When the performances of this teacher's students were compared to the performances of the comparison students in the same school, significant differences were found in favor of the experimental group for items designed to assess the creation of mental images for the entire group ($p = .000$) and for students with LD ($p = .05$; see the middle portion of Figure 6 for comparisons). Significant differences were found in favor of the comparison group on items related to keywords, although percentages were low in both cases (i.e., scores were 9.24% for the experimental group and 22.81% for the comparison group).

The analysis also indicated that students in the entire group of T5's class earned significantly more points than the comparison students on items related to acronyms ($p = .000$; see the bottom graph in Figure 6). This finding was initially very puzzling because T5 had not presented any acronyms. Researchers were informed by T5 that the students in her science class were also assigned to a social studies class taught by another teacher (T9) who had also been trained in the use of the RER. Analysis of the observation data collected in this teacher's class revealed that she did indeed present three acronyms in her class. Therefore, this finding suggests that students may generalize their knowledge about mnemonic strategies from one class to another. However, the scores of students with LD in T5's class were not significantly different from those of students with LD in the comparison classes for acronyms. This may have been an artifact of the small numbers of students with LD.

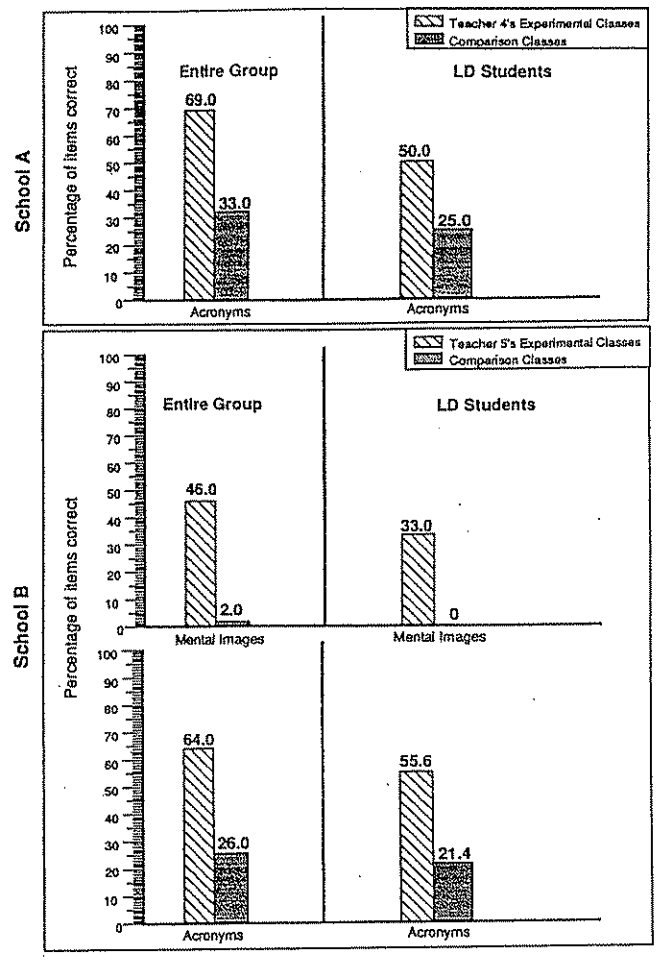

FIGURE 6 Student performance on identification of appropriate devices for recall.

Teacher and Student Satisfaction

The results of the teacher satisfaction questionnaire indicated that, on average, teachers' ratings fell between *satisfied* and *somewhat satisfied,* although ratings varied considerably among the questions. The mean ratings (and ranges) were as follows: flexibility of the routine, 6.56 (6–7); ease of use, 6.56 (5–7); preparation time, 6.33 (4–7); the devices helped students with LD to learn facts, 5.78 (4–7); the devices helped

students without LD to learn facts, 6.22 (4–7); students with LD perceived devices as useful, 5.22 (3–7); students without LD perceived devices as useful, 5.56 (3–7); achievement for students with LD improved as a result of using these devices, 5.67 (4–7); achievement for students without LD improved as a result of using these devices, 5.56 (4–7); attention increased for students with LD, 5.22 (4–7); attention increased for students without LD, 5.11 (4–7); notetaking skills increased for students with LD, 5.33 (4–7); notetaking skills increased for students without LD, 5.0 (5–6); study time increased for students with LD, 4.67 (4–6); study time increased for students without LD, 4.78 (4–6); students with LD used the devices in studying for tests, 5.56 (5–7); and students without LD used the devices in studying for tests, 6.0 (5–7).

When teachers were asked to indicate the likelihood of continued use of the routine, the mean rating was 6.67 (5–7). Similarly, the teachers indicated that they would recommend the devices to other teachers ($M = 6.56$, range = 5–7) and that they would recommend the devices to others if inservice instruction were available ($M = 6.67$, range = 5–7).

The results of the student questionnaire collected in eight of the nine experimental teachers' classrooms indicated that students were on average between *somewhat satisfied* and *satisfied* with aspects of the instructional program. The ninth teacher (T2) did not administer the student satisfaction survey due to lack of time. Mean ratings (and mean class ranges) were the following: whether the devices helped them follow what the teacher was saying, 5.29 (2.17–6.94); whether the devices helped them take notes, 5.12 (2.17–7.00); whether the devices helped focus attention on what was important in class, 5.28 (2.11–7.00); whether the devices helped them study for tests, 5.32 (2.22–7.00); whether the devices helped them do well on tests, 5.24 (1.83–7.00); whether students liked this new way of teaching as compared to when their teacher did not use the devices, 5.26 (2.17–7.00); and whether the devices helped improve their grades, 5.04 (1.72–7.00).

DISCUSSION

Although a paucity of efficacy data exists on the feasibility of including students with disabilities in the general education classroom for sustained periods of time, policymakers and administrators have continued to advocate for the placement of students with disabilities in the mainstream (Deshler & Schumaker, 1994). Many advocates of inclusive arrangements have strongly argued the merits of placing students in mainstream classes, especially those related to the social benefits that accrue to students with disabilities (e.g., Gartner & Lipsky, 1989; Stainback, Stainback, & Jackson, 1992). However, other researchers (e.g., Schumm, Vaughn, & Leavell, 1994) and commentators (e.g., Kauffman, 1994) have underscored the difficulty of including students with disabilities in the general education classroom from an instructional standpoint. This study sheds some light on the degree to which secondary general education teachers can integrate a simplified form of strategy-based instruction within the curriculum content in their classrooms. Specifically, this investigation addressed whether teachers could use a standard routine to present mnemonic devices to their students as an ongoing part of the curriculum and whether their students would learn to create their own devices by watching their teachers' presentation of devices. This is an important question because previous studies have shown that students can learn strategies to create mnemonic devices if they receive intensive instruction, including explicit description on how to create the devices, models of how to create the devices, and practice activities (e.g., Bulgren et al., 1995). Such explicit instruction was not a part of the routine utilized in this investigation because general education teachers have indicated that they do not have time for it.

Instead, the RER was implemented in this investigation in a spirit that is consistent with the vision of teaching described by Jones, Palincsar, Ogle, and Carr (1987), in which the teaching of content is integrated with the teaching of strategies for learning the content. Results of this study suggest that their vision may hold some promise. First, general education teachers seem able and willing to implement the RER at or close to mastery levels after only a couple of hours of training. The training resulted in increased numbers of teachers' cues to students that information was important to master by 2½ times as well as increased numbers of presentations of mnemonic devices. The teachers most frequently used three types of devices: acronyms (44%), mental images (39%), and keywords (16%). Several of the types of devices on the menu available to the teachers were not used at all.

The student results indicated that some students learn to select the most appropriate mnemonic devices for recall items by watching presentations of the devices, and some do not. Indeed, the ones who learned to create the devices did so without being explicitly told how to create the devices (i.e., the strategy for creating the devices was not explicitly described or modeled) and without practicing how to create the devices. They appeared to learn through a process of "osmosis" after relatively few presentations. Interestingly, some students with disabilities as well as some students without disabilities learned through this process. Unfortunately, some students in both groups did not learn to create devices through this process. Whether they might do so after additional presentations is unclear.

The satisfaction ratings by both teachers and students were relatively high. Because secondary content teachers are under such great pressure to cover large amounts of content, high ratings regarding the ease of use of the routine, the acceptable preparation time, the favorable impact on student performance, and likelihood of continued use of the routine in their classes suggest that the routine may qualify as an acceptable instructional intervention for secondary teachers to use with academically diverse classes.

The findings of this investigation are of particular interest when they are compared to those reported by Scanlon et al. (1996), who assessed the effects of training secondary general education teachers to incorporate intensive and explicit learning strategy instruction within the context of general education instruction for inclusive classes. Scanlon et al. found that the teachers performed relatively low levels of the required teaching behaviors (46%–53%) after they were trained. The teachers reported that competing demands to cover certain amounts of content by the end of the year prevented them from implementing the focused strategic instruction as often as they would have liked. As found in this investigation, some of the students with disabilities benefited from the strategy instruc-

tion and others did not. Satisfaction measures by both students and teachers participating in Scanlon et al.'s study fell considerably below those in this investigation.

Thus, both methods of teaching strategies in the secondary general education classroom have their weaknesses. Intensive strategy instruction does not seem to be embraced by the teachers and is poorly implemented. Although strategy instruction through osmosis seems to be embraced by teachers, it reaches only a portion of the students. This investigation has its limitations in that it only focused on social studies and science teachers and the instruction was implemented for a relatively short period of time. In addition, the investigation did not determine whether the teachers would continue using the routine after the researchers withdrew or whether students would actually use the mnemonic devices to study and master information and whether their test scores might improve as a result of their teachers' use of the RER. Whether student performance might improve as a result of adding cooperative group or independent practice activities to the routine is also unknown.

Further research is clearly needed to identify the instructional conditions that are most conducive to promoting the successful integration of learning strategy instruction within inclusive secondary general education classes. For example, research is needed to determine the influence of the complexity of the strategy to be taught and the instructional methods to be used on the level of teacher implementation and student learning. Additional research is needed to determine what types of devices are most practical and acceptable for general education class use. Research is also needed to determine the impact of several teachers teaching and reinforcing the use of a given strategy on student use of that strategy. Inasmuch as students in secondary schools have limited exposure to a given teacher during a day (and the teacher has limited opportunities for prompting use of the strategy), conceivably strategy mastery and generalization could be enhanced greatly if several teachers incorporated strategy instruction within their curriculum and required students to use the strategy. Furthermore, the teachers in this study were paid volunteers. Therefore, research regarding outcomes with nonvolunteers would be useful.

Future research might also explore more explicit teaching of a strategy by embedding the steps of the strategy within the steps of the teaching routine. This might be a way to enhance student learning while limiting the time teachers would have to spend on planning. Another research question that might be addressed is whether strategies are more readily learned if strategy instruction is embedded in content instruction and students have immediate proof of real-world application versus learning the strategy in isolation. Finally, research might identify the characteristics of those students who do not benefit from strategy instruction in general education classes so that they might receive the benefit of intensive instruction offered in a resource room or other support setting.

These kinds of information will be essential in order to determine how students with disabilities can be included most effectively within general education settings. Research has clearly shown that secondary students benefit substantially from intensive strategy instruction in support class settings such that they can generatively use strategies across settings, tasks, and time (Schmidt, Deshler, Schumaker, & Alley, 1989; Schumaker & Deshler, 1992). If students with disabilities cannot receive instruction in the general education setting that is powerful enough for them to master the strategy in a reasonable period of time in a way the classroom teacher deems palatable, an alternative setting where the instructional conditions can be implemented that result in student mastery of strategies may need to be considered. The bottom line for students with mild disabilities must be their ability to meet independently the demands of secondary and postsecondary curricula, and instruction needs to be tailored to produce that bottom line.

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