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Mnemonic Instruction in Science and Social Studies for Students with Learning Problems: A Review

Jacqueline Lubin
Fort Hays State University

Edward A. Polloway
Lynchburg College

Over the years, mnemonic instruction has been promoted as an effective strategy to teach students with learning problems including learning disabilities (LD) or mild intellectual disability (MID). This paper discusses mnemonic instruction, including types, versatility in use, and effectiveness with struggling learners. Specific emphasis then is placed on research on mnemonic strategies in the content areas of science and social studies. The paper concludes with a discussion of how mnemonic strategies can be effectively used with students with learning problems to enhance performance.

Keywords: **Mnemonic instruction; learning problems; learning disabilities; mild intellectual disability; science instruction; social studies.**

Introduction

Mnemonic instruction has been proven to be a research-based method for teaching students with different kinds of disabilities (e.g., Brigham, Scruggs, & Mastropieri, 2011; Conderman, & Pedersen, 2005; Lloyd, Forness, & Kavale, 1998; Scruggs, Mastropieri, Berkeley, & Marshak, 2010; Veit, Scruggs, & Mastropieri, 1986). It has been used in special and general education for decades as a way to convert difficult-to-remember concepts into more memorable ones. Mnemonic instruction uses memory devices that may help students learn a significant amount of information as well as increase long-term retention (Mastropieri & Scruggs, 1991). Mnemonics may assist with both storage and retrieval of information (Mastropieri & Scruggs, 1998). Its use has been promoted as a way to assist especially those students who do not meet the minimum requirements with regard to their academic progress. Such learners often fail to develop the knowledge, skills, will, and self-regulation necessary to succeed in key subject areas. They could exhibit difficulties in specific areas (e.g., reading, mathematics) and would thus may be referred to as having a learning disability (LD). Or they may be identified as having a mild intellectual disability (MID) (Grünke & Morrison Cavendish, 2016). In any case, mnemonic instruction can be very effective to use for students who have problems in remembering information given that there are many subject area concepts to be learned, students are often unfamiliar with the content, and the information is often complex (Levin, 1993).

Mnemonic instruction has been empirically validated as a technique that can enhance students' learning since 1973 (Berkeley & Scruggs, 2010; Levin, 1993). By 1983, Mastropieri had shown that mnemonic instruction can be used with students

*Please send correspondence to: Edward A. Polloway, Lynchburg College, 1501 Lakeside Dr., Lynchburg, VA 24501, Email: polloway@lynchburg.edu.

with LD. As Scruggs and Mastropieri (2000) noted, mnemonic strategies are effective in teaching students with LD as they help them make use of their cognitive strengths. Mnemonic instruction has been documented to be versatile as it can be effectively used not only across abilities but across subject areas, including foreign language, English, science, history, math and social studies (e.g., Brigham et al., 2011; Letendre, 1993; Scruggs, Mastropieri, Berkeley, & Graetz, 2009; Zisimopoulos, 2010).

The purpose of this paper is first to discuss mnemonic instruction in general, noting various mnemonic strategies that may be used and the versatility and effectiveness of mnemonic instruction with students with learning problems. Then, research investigating mnemonic strategies that have been implemented in the subject areas of science and social studies, respectively, are highlighted. The paper concludes with a discussion of how mnemonic strategies may be effectively used with students with learning problems to enhance performance. While a substantial amount of research on mnemonic instruction occurred in prior decades, it remains an important tool that continues to be regarded as an empirically-validated practice.

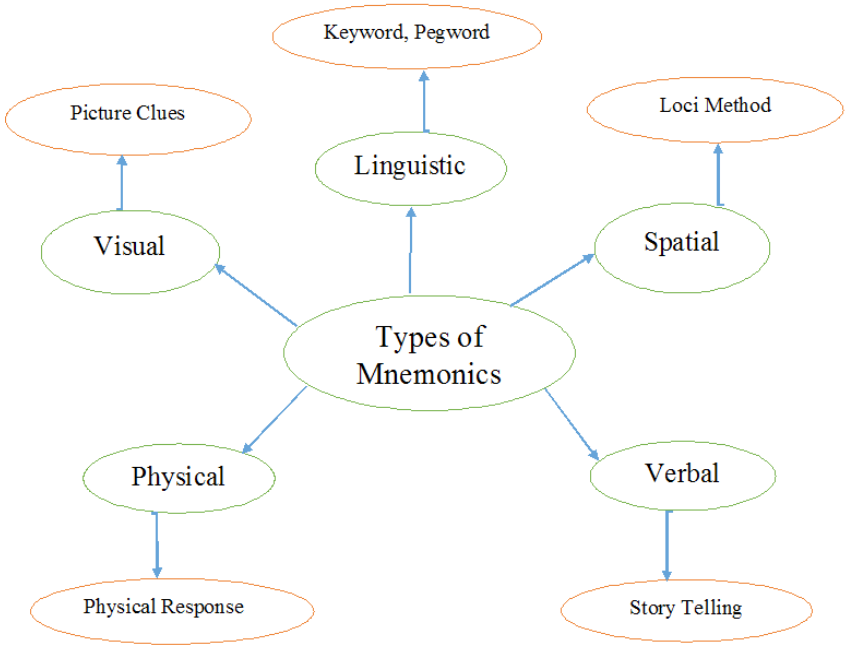
Mnemonic Instruction

Mnemonic instruction includes a variety of strategies that are applicable across multiple settings and may be used effectively with students with varying abilities. The Division for Learning Disabilities and the Division for Research within the Council for Exceptional Children highly recommended mnuemonic instruction as an empirically validated practice that may be used with students with LD (i.e., Berkeley & Scruggs, 2010; Brigham & Brigham, 2001; TeachingLD, 2015). This section highlights general information about the utility of mnemonics.

There are many types of mnemonic strategies that teachers may employ. According to Thompson (1987 as cited by Amirousefi & Ketabi, 2011), there are five classes of mnemonics: linguistic, spatial, visual, physical response and verbal methods. Linguistic mnemonics, such as the pegword and keyword methods, involve associating the new concept with familiar words and/or phrases to help remember the item. Spatial mnemonics, which include the loci, spatial grouping and finger methods, involve connecting the new concept to a familiar place, pattern or finger to help in memorization of the material. Visual mnemonics make use of pictures or visualizations to create an association to the target concept (e.g., symbolics, pictographics). The verbal method uses meaning and stories to help students remember, with methods such as grouping or semantic organization and story-telling or narrative chains. Physical response methods make use of the body parts to aid in remembrance, either through movement or physical sensation. These five types of mnemonics are illustrated in Figure 1.

Specific examples of mnemonics are highlighted in Figures 2-4. In educational research and in practice, the most commonly used mnemonic devices include acronyms (Figure 2), acrostics (Figure 3), keywords (Figure 4), pegwords (for learning items in numerical or chronological sequence), symbolics, and pictographics (Figure 2, ii) . Students tend to be most familiar with acronyms and acrostics as well as find them to be the most helpful and useful techniques (Bloom & Lamkin, 2006; McCabe, Osha, & Roche, 2013), while keywords are frequently cited in educational research.

Figure 1. ***Types of Mnemonics***



Mnemonic instruction may be used by both general education and special education teachers. Given the degree of inclusion of students with learning problems, clearly much of the instruction for the students will occur in general education classrooms.

The use of mnemonic instruction in special education has been researched in particular with students with LD and for more than three decades a substantial literature base has been established on the effectiveness of mnemonic instruction with these students (e.g., Bulgren, Schumaker, & Deshler, 1994; Lloyd et al., 1998, Mastropieri, 1983; Scruggs & Mastropieri, 1989, 2000; Scruggs et al., 2009; Mastropieri, Scruggs, & Levin, 1985; Veit et al., 1986). The extant research collectively points to the value of mnemonic instruction in teaching and learning concepts that need to be retrieved quickly and automatically.

Further, mnemonic strategies may be used broadly across subject areas in lessons where new vocabulary, technical terms, the names of people places or things, number patterns and formulae need to be learned. In general, mnemonic instruction has utility for any academic task that requires factual recall of information and has been found to be effective in enhancing performance across subject areas (Therrein, Taylor, Hosp, Kaldenberg, & Gorsh, 2011).

Figure 2. ***Acronyms and Pictograhic for Science Concepts***

i. MR GREEN = The 7 characteristics of all living animals: Movement, Reproduction, Growth, Respiration, Excretion, Environmental Sensitivity, Nutrition

ii. CAM SEA, (pronounced "calm sea") which represents the six classes of invertebrate animals: Cnidarians, Annelids, Mollusks, Sponges, Echinoderms, Arthropods

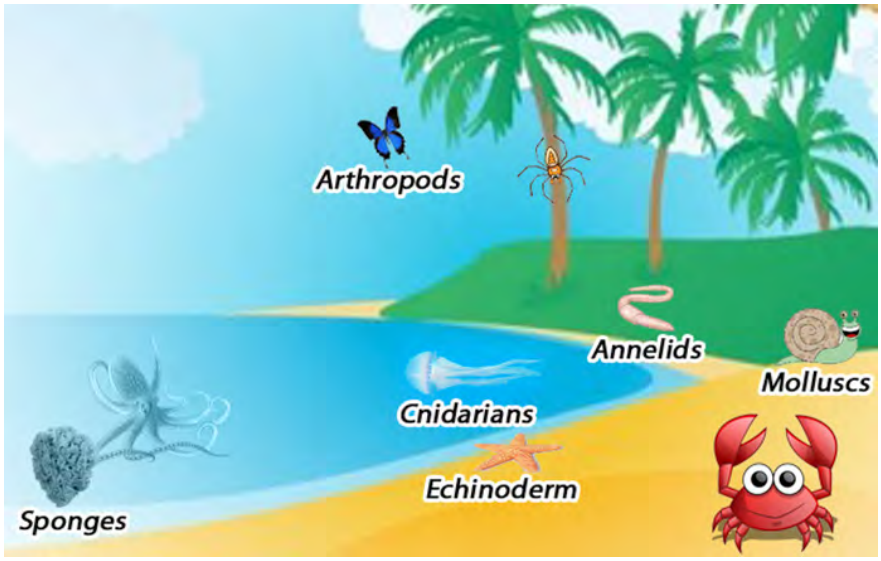


Figure 3. ***Acrostics for Science and Social Studies Concepts***

i. **K**ing **H**arry's **d**eeds **b**rought **d**eep **c**heer *to* **m**illions. Explanation: These stand for the metric prefixes and base unit. Kilo-, Hecto-, Deca-, base, Deci-, Centi-, Milli-

ii. First 16 American Presidents:

Washington **A**dams **J**ust **M**ade **M**any **A**dmirers,
George Washington
John Adams
Thomas Jefferson
James Madison
James Monroe
John Quincy Adams
====
Juggling **V**arious **H**eavy **T**rumpets.
Andrew Jackson
Martin Van Buren
William Henry Harrison
John Tyler
====
Please **T**ry **F**ollowing <the> **P**retty **B**oy's **L**egacy.
James Polk
Zachary Taylor
Millard Fillmore
Franklin Pierce
James Buchannan
Abraham Lincoln

Figure 4. ***Keywords for Social Studies Concepts***

States and capital. For example:

i. Keyword for Virginia is Virgin (Oil).
Keyword for Richmond is Rich-Man.

Virginia (Virgin Oil) *Richmond (Rich Man)*

ii. Keyword for Connecticut is Connect.
Keyword for Hartford is Heart.

Connect (Connecticut) Heart (Hartford)

In reading, mnemonic strategies may be used to enhance retention, which has the ripple effect of enhancing comprehension skills; as students remember more information, they are more likely to succeed in applying it to the comprehension task (Mastropieri & Scruggs, 1998). The use of mnemonic instruction also has significantly improved the retention of vocabulary learning (e.g., Amirousefi & Ketabi, 2011; Berkeley & Scruggs, 2010; Scruggs et al., 2009).

In mathematics, mnemonic strategies may be used to promote the performance of students with LD as there are many concepts that students need to know automatically in order to carry out more complex tasks (Miller & Strawser, 1996). Greene (1999) found that mnemonic instruction increased the retention of math facts over traditional instruction by 28% with students with LD. Given difficulties with computation, for example, increasing the ability to memorize information can enhance math performance (Miller, Stringfellow, Kaffar, Ferreira, & Mane, 2011).

The principal goal of mnemonic instruction is to help students remember facts and concepts and this goal is imperative to school success as there is content in every area that needs to be memorized and quickly retrieved. The proven effectiveness of mnemonic instruction makes it a valuable tool in the classroom (Lloyd et al., 1998). The focus below is on research that has been conducted on the use of mnemonic instruction in the subjects of science and social studies, respectively.

Mnemonic Instruction in Science

Students with learning problems often find it difficult to remember science concepts (Therrien et al., 2011) and they may perform significantly lower in science exams than their typically developing peers (Mastropieri, Emerick & Scruggs, 1988). The main instructional strategies used in traditional general education classrooms typically include textbooks and/or lectures. Students with learning problems typically struggle to grasp concepts when these are the sole techniques used in classrooms (Therrien, Taylor, Watt, & Kaldenberg, 2014). A valuable instrument which is highly effective in improving students with learning problems ability to retain and recall science facts is mnemonic instruction (Brigham et al., 2011; Scruggs, Mastropieri, Levin, & Gaffney, 1985; Therrien et al., 2011). Table 1 outlines five studies that have demonstrated the effectiveness of mnemonic instruction in helping students acquire science concepts and facts. These are then discussed below.

Mastropieri et al. (1985) conducted two experiments comparing three instructional strategies (i.e., mnemonic instruction {pegword, keyword}, questioning and free study) used with students with and without LD. Their aim was to find out which instructional method helped respective students recall the greatest number of scientific facts (i.e., hardness level of metals) and to find out whether they would perform at comparable rates as students without LD using the same instructional strategies. The first experiment included ninety ninth graders with LD. They were placed in two achievement groups, with lower and higher reading comprehension groups each containing 45 students, respectively. Then, each group was broken into three subgroups where 15 students were randomly assigned to mnemonic instruction group, questioning procedure group and free study group, each. In the end, there were six groups of 15 students with LD. Students in the mnemonic strategy groups recalled the hardness level of metals at a higher level than those in the other instructional groups (i.e., questioning, free study). This result was statistically significant.

Table 1. **Mnemonic Instruction in Science**

Article	Participants	Age/ Grade Level	Disability	Mnemonic Strategy	Results
King-Sears, Mercer, & Sindelar, 1992	37 students - 34 males - 3 females	12-14 yrs Grade= 6-8	learning disabilities (30) emotional/ behavioral disorders (7)	Keyword (Science vocabulary- animal and plant life, earth science, body terms, weather, astronomy)	Significant keyword effect during the fourth week of instruction
Mastropieri, Emerick, & Scruggs, 1988	8 students - 7 boys - 1 girl	7-11 yrs Grade= 1-4	emotionally disturbed	Keyword and interactive illustrations (Vocabulary words on food chain and animals)	Students scored average of 94.5% correct with mnemonic condition as opposed to 58.8% with traditional instruction
Mastropieri, Scruggs, Whittaker, & Bakken, 1994	9students - 5 boys - 4 girls	15-18 yrs	mildly mentally handicapped	Keywords (name parts of the ear and eye)	On the eye test- 77% accurate recall compared to teacher report where students had difficulty remembering information On ear test- 62% recall
Scruggs, Mastropieri, & Levin, 1985	90 students - 68 boys - 22 girls & 45 students without disabilities - 25 boys - 20 girls	14 -16 yrs Grade= 9 12-13yrs Grade= 7	learning disabilities	Pegword Keyword (17 minerals- hardness level)	77% of mnemonic students reported that strategies were effective in aiding in recall as opposed to 2% and 1% of questioning and free-study group

Article	Participants	Age/ Grade Level	Disability	Mnemonic Strategy	Results
Scruggs,Mastropieri, McLoone, Levin, & Morrison, 1987	48 students - 41 boys - 7 girls	Average age= 16 Grade= 10-11	learning disabilities	Keywords Pegwords (North American Minerals)	Experiment One: After receiving mnemonic instruction, students scored average of 93% as opposed to 55% by control group. Experiment Two: Students instructed with mnemonic instruction were able to correctly classify minerals 72% of time while non-mnemonic students classified accurately 42% of time

In addition, Mastropieri et al. (1985) reported participants' response latency (i.e., the time taken between the time the question is asked and the time the respondent begins an appropriate answer). Data on the latency of responses showed that the mnemonic group took longer to respond than the other groups, suggesting that utilizing mnemonic techniques may be require e time as students have to recall a code (i.e. mnemonic meaning), retrieve information (i.e. concepts learned) and connect mnemonic and concepts . Despite the delay, students in mnemonic groups generated more correct responses than students in the other groups. Lastly, 77% of the mnemonic groups reported that the mnemonic strategies were effective in helping them recall science facts (vs. three percent for the two other instructional groups).

The second part of Mastropieri et al.'s (1985) experiment included 45 seventh grade students without LD. They were randomly placed in three instructional groups (i.e., mnemonic, questioning, free-study) and taught the same scientific facts (e.g., minerals) as the students with LD. The results showed that the students in the mnemonic group recalled more concepts than students in the other two instructional groups. Moreover, similar to the students with LD, the mnemonic group took longer time to recall information than those using the questioning or study group techniques. The authors concluded that special and general education teachers may effectively incorporate mnemonic instruction in science classes with students with and without LD to help them learn and recall concepts.

Other research has supported and extended these findings. In a study conducted by Scruggs, Mastropieri, McLoone, Levin, and Morrison (1987), 48 high school students with LD were taught attributes of North American minerals using mnemonic and non-mnemonic illustrations (i.e. a picture using images different to the mnemonic illustration but depicting similar features of minerals) with dichotomized attributes in three areas- color, softness, and use. The study consisted of two experiments where the goal was to determine whether mnemonic instruction could be used with independent reading expository prose passages to help students with LD learn science concepts. The researchers sought to extend previous research that showed that mnemonic instruction was effective in helping the students learn a list of science facts. In the first experiment, 24 students with LD were randomly placed in two groups: one group was instructed using mnemonic illustrations (and keywords) with dichotomized attributes of minerals and a short passage on minerals, while the other group was instructed using non-mnemonic illustrations, a short passage on minerals and their own method of study. The mnemonic treatment group scored significantly higher in identifying attributes of minerals than the non-mnemonic group. In addition, the students in the mnemonic group rated their technique more helpful than the other group rated the alternative methodology.

Scruggs et al.'s (1987) second experiment consisted of 24 students with LD, who were divided into two equal groups. One group received mnemonic instruction (pegwords, keywords) with mineral passages, while the other group was instructed using non-mnemonic illustrations and mineral passages. Students who received mnemonic instruction with the prose passages remembered more concepts, retained more information over a longer period of time and were able to make more appropriate inferences (that is, transfer known information) on the attributes of minerals. In addition, Scruggs et al. (1987) reported that students in the mnemonic group

had a greater probability of classifying attributes correctly when they were unable to remember specific attributes. 82% of the students stated that they would use the mnemonic strategy again to learn concepts, while only 54% of control group students reported the likelihood of using their strategy again. These results further highlighted the effectiveness of mnemonic strategies in improving students with LD knowledge of scientific facts.

In another investigative study in science, Mastropieri et al. (1988) sought to evaluate the effectiveness of teacher-developed and teacher-presented mnemonic techniques on students with emotional and behavioral disorders (EBD). They chose difficult to remember science concepts that previous research had shown to be challenging. The study included eight students who were placed in two equal groups. Students were instructed in two areas (food chains and invertebrates), using two methods (mnemonic: keyword and illustrations, and traditional method). Each group received both types of instruction but at alternate times. While group one received mnemonic instruction on food chains, the other received traditional instruction on invertebrates. Then, the next week, the groups switched instruction and topic. Students were evaluated at the end of instruction on each topic. Students not only obtained higher scores after being taught using the mnemonic strategy, but also retained concepts for a longer period of time on topics. Mastropieri et al. (1988) also reported that students felt that they had attained more science facts and preferred learning through the use of mnemonics; teachers also found that students were more motivated when mnemonic instruction was used.

King-Sears, Mercer and Sindelar (1992) sought to determine whether students with LD could use the keyword mnemonic strategy method independently. The study consisted of 37 students with LD and emotional/behavioral disorders (EBD), who were divided into three groups with sizes ranging from 10-18. Each group was taught science concepts (from topics such as animal and plant life, earth science, body parts, weather and astronomy) using one of three interventions: systematic teaching; systematic teaching with an imposed (teacher-provided) keyword mnemonic; and systematic teaching with an induced (student-provided) keyword mnemonic. The participants remembered more new vocabulary definitions when taught with an imposed keyword mnemonic. Students in the imposed mnemonic group stated that they enjoyed learning using the mnemonic strategy but it would have been less fun if they had to create their own mnemonic. Those in the induced keyword group confirmed the latter, expressing that it was challenging to create keywords with associated illustrations. King-Sears et al. (1992) recommended that a more extensive model may be needed to know whether students with LD and EBD may use keywords more independently. However, the results supported previous research that mnemonic instruction is effective with students with disabilities in improving retention of meanings of new concepts.

Mastropieri, Scruggs, Whittaker, and Bakken (1994) embarked on a classroom application project to determine the impact of mnemonic instruction on students with MID. One part of the project used science concepts while the other part included social studies concepts (which will be discussed in the next section). Nine high school students were taught the parts of the eye and ear, and definitions using

the keyword mnemonic strategy. After 14 instructional sessions, the results revealed that there was a significant increase in recall of science facts. The students and the teacher stated that they liked using mnemonic techniques.

In conclusion, research has consistently demonstrated that mnemonic instruction is effective in increasing recall and retention of science facts with students with learning problems. Science teachers may use these techniques to help students retain difficult-to-remember concepts. Across studies, students reported enjoying the use of mnemonic strategies and, in many cases, stated that they would use the technique again. Generating students' interest in mnemonics may help students use mnemonic strategies and thus retain scientific facts.

Mnemonic Instruction in Social Studies

Acquiring and retaining social studies concepts tend to be a challenge for students with learning problems. As Letendre (1993) noted, "students often feel overwhelmed with social studies content because of the need to recall facts, dates, and figures" (p. 26). Many students with LD and MID lack the skills needed to extract information from expository text (Hall, Kent, McCulley, Davis, & Wanzek, 2013) and lack a retrieval strategy (Mastropieri & Scruggs, 1989). Mnemonic instruction has proven not only to promote the acquisition of social studies content but make abstract information more concrete (Hall et al., 2013). Mastropieri and Scruggs (1989) noted that mnemonic instruction goes beyond teaching the concepts; it provides students with specific strategies to retrieve concepts at a later date. Therefore, mnemonic instruction is an appropriate tool to use in the social studies classrooms as it gives students with learning problems the opportunity to acquire content knowledge, make causal connections and learn a retrieval strategy that can be used beyond the classroom (see Table 2 for a summary of research studies).

Mastropieri and Scruggs (1989) investigated whether mnemonic instruction could be adapted in the social studies classroom as it had proven to be effective in laboratory-like settings. Their study included 14 students with LD and three with MID who were taught the history of transportation and natural resources in the state of Indiana. Students were placed in three groups and all groups were taught content using traditional, text-book based instruction and mnemonic instruction. Three special education teachers were trained to mastery in teaching both the mnemonic and traditional procedures. While one group from each teacher received mnemonic instruction on the first topic, the two other groups received traditional instruction on the second topic, and then instruction was reversed. All three teachers taught both topics using mnemonic instruction and traditional, text-book based instruction. Students in each classroom scored significantly higher under mnemonic treatment than the traditional treatment. Both students and teachers reported that they enjoyed using mnemonic strategies. The students noted that they were more motivated to learn, that mnemonic strategies helped them learn more facts, and that they would like to use them in other subject areas.

Table 2. **Mnemonic Instruction in Social Studies**

Article	Participants	Age/ Grade Level	Disability	Mnemonic Strategy	Results
Mastropieri & Scruggs, 1989	17 students - 11 boys - 6 girls	Average age= 11 Grade 3-7	learning disabilities (14) mildly mentally handicapped (3)	Visual Mnemonics using pictures (History of Transportation in Indiana and Indiana Natural Resources)	Students scored on average 89.9% correct under mnemonic instruction and average of 74.9% correct under traditional method
Mastropieri, Scruggs, Bakken, & Brigham, 1992	29 students - 20 males - 9 females	Average age= 14 Grade= 7-8	learning disabilities	Keyword & Visual representation (for 40 states and their capitals)	Students remembered 72.9% of mnemonically instructed capital names as compared to 43.4% of traditionally instructed capital names
Mastropieri, Scruggs, & Whedon, 1997	11 students - 6 males - 5 females	Average Age= 14 Junior High	learning disabilities	Keyword-Pegword representations of presidents and their numbers (total= 32)	In mnemonic condition, students got 70.4% correct for name recall & 60.3% for number recall as compared to 23.9% correct for name recall & 31.3% correct for number recall when taught traditionally
Mastropieri, Scruggs, Whittaker, & Bakken, 1994	8 students - 3 boys - 5 girls	Average age= 13 Junior High	mildly mentally handicapped	Keywords (state & capital names)	94% correct (all but 2 got perfect scores) compared to inability to recall almost any information before mnemonic intervention

In another study conducted by Mastropieri, Scruggs, Bakken, and Brigham (1992), 29 students with LD were taught states and their capitals using mnemonic and traditional instruction. The mnemonic instruction included illustrations and keywords for state and capitals, while the traditional intervention included transparencies with a state outline, a star to represent the capital, and the names of state and capital. The goal of the study was to find out whether students could recall information gained through mnemonic instruction. Students were placed in two groups and received both traditional and mnemonic intervention on alternate weeks from graduate students. The results revealed that students produced higher grades after mnemonic instruction was employed and significantly lower grades after traditional instruction. There was a statistically significant difference in recall of information from students after receiving mnemonic instruction. The difference was equivalent to a student moving from an "F" to a "C" grade (Mastropieri et al., 1992). Students and teachers stated that they enjoyed and preferred mnemonic instruction to traditional instruction. Students reported that they not only learned more but were more attentive when mnemonic instruction was used. They emphasized that they would like to receive additional intervention. This study also found that students who were instructed with mnemonics could effectively recall information whether the concept was requested in a forward or backward format (i.e whether students were asked to identify state or capital first).

Mastropieri et al. (1994) extended the prior study by Mastropieri et al. (1992) by investigating the effectiveness of the keyword mnemonic strategy in helping students with MID learn states and capitals in the United States. Eight students were given a pretest on 20 states and capitals and their scores revealed that they were unable to answer most questions correctly. During intervention, they were instructed on the 20 states and capitals for four weeks during social studies class using the keyword mnemonic strategy with illustrations. The results showed that on average students were able to recall information correctly 94% of the time, while two students were able to recall concepts with 100% accuracy. All students stated that they enjoyed learning through mnemonic instruction. This study corroborated previous research that showed that mnemonic instruction can help students with a wide range of disabilities learn social studies concepts.

Mastropieri, Scruggs, and Whedon (1997) investigated the effectiveness of a keyword-pegword mnemonic strategy in teaching students with LD social studies content. The keyword-pegword mnemonic strategy involved the combination of these two mnemonic devices to teach word concepts and associated numbers. The study consisted of eleven teenagers with LD who were taught the order of 32 U.S. presidents using both traditional and mnemonic instruction over the course of 8 weeks. Sixteen presidents were taught using the traditional method while the other 16 were taught using keyword-pegword mnemonic strategy. The traditional instruction included the teacher presenting the president's name and number with an illustration and practicing it with students while the mnemonic instruction followed the same procedure except the illustration was replaced with keyword-pegword representation of presidents and their numbers. After receiving mnemonic instruction, students scored substantially higher on weekly tests than with traditional instruction and were able to retain information for longer period of time. Students showed greater ability

to recall the name of a president rather than just the ranking. This study further confirmed that mnemonic instruction has the capacity to help students with LD acquire, retain, and recall social studies content.

In summary, the literature documents the efficacy of mnemonic instruction in helping students with learning problems like LD or MID, learn and remember social studies facts and concepts. Given that text comprehension in social studies can be a challenge, mnemonic instruction may make abstract concepts more concrete (Hall et al., 2013). This tangible instructional format may help students remember social studies concepts more easily.

With mnemonic instruction, studies have shown that students not only learn content but they are more motivated to learn. They enjoyed instruction and as a result paid more attention in class than when traditional method of instruction is used. Mnemonic instruction may help students with learning problems remember concepts as they tend to be less motivated than their typically developing peers (Smith, Polloway, Doughty, Patton, & Dowdy, 2015). Social studies content may be overwhelming (Letendre, 1993) and so students may need motivation to stay focus to the task. Mnemonic instruction is a validated tool which literature has shown increases students desire to learn social studies concepts.

Discussion

The extant research has demonstrated that mnemonic instruction is an effective technique that may be used across subject areas as well as across abilities. Students with varying learning problems acquired and retained concepts when taught using mnemonic instruction. In fact, many students enjoyed learning in that manner. Teachers may provide struggling learners more opportunities to grasp concepts by using mnemonic instruction to learn, retain and recall concepts taught in subject areas. Consistent with IDEA (2004), students with LD or MID may be given access to the general curriculum and, because access may lead to success, mnemonic instruction may help achieve that goal. Subject teachers, particularly in the sciences and social studies, may use mnemonic strategies to promote gains in academic achievement for students with learning problems.

Recall of facts is a fundamental skill required for success in content subject areas, such as science and social studies. Students with LD or MID frequently have memory deficits (Mastropieri & Scruggs, 1998). The findings in these studies provide insight that they may process information (e.g. words, numbers) differently than their typically developing peers (Mastropieri et al., 1997). Mnemonic instruction can create a bridge between academic content and information processing. Therefore, classroom teachers may utilize mnemonic devices, such as those highlighted in the figures, to help students grasp science and social studies concepts.

The effective use of mnemonic instruction involves intensive planning. Teachers who use mnemonic instruction will need to ensure that they model the use of the technique and explicitly teach application strategies. Effective implementation of mnemonic instruction will require planning. Miller and Strawser (1996) further noted that the academic success that students with LD or MID gain from mnemonic instruction is worth the time spent developing it, as students are able to work more independently and spend less time learning critical skills. There may be intrinsic

gains from using mnemonic instruction. Students enjoyed using mnemonic strategy and so felt motivated to learn. This added incentive may make mnemonic devices beneficial tools in the classroom.

It is important to note that "that mnemonic strategies are not an overall teaching method or curricular approach" (Mastropieri & Scruggs, 1998, para. 2). Mnemonic instruction can only be effective if educators use it for its intended purpose (i.e., to help students remember). It involves techniques that students can use to encode and retrieve information quickly, which otherwise would not have been easily remembered. When used for its intended purpose, mnemonic instruction may be effectively utilized in science and social studies lessons to help improve academic performance.

Research over almost three decades has demonstrated that mnemonic instruction is effective with students with learning problems. It has helped students retain, maintain and generalize concepts which they would have otherwise forgotten. They have improved the academic achievement of typically developing students and students with LD, MID, and EBD. They have helped students acquire science and social studies concepts. Mnemonic strategies have increased students with learning problems ability to remember academic content, and retrieve it at a later date. They have equipped students with a strategy that can be used in other subject areas. The multiple benefits of mnemonic instruction make it an important tool for instruction.

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