Memory Strategies Used By Teachers

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Abstract

The current study examines how teachers use memory strategies to present their lessons. Two research questions are asked. First, what memory strategies do teachers use to teach their lessons? Second, how do teachers use memory strategies in their instruction? Eleven teachers complete an open-ended questionnaire to identify the memory strategies they use and give examples how they use these strategies to teach. Rehearsal is found to be the most frequently used strategy, followed by mental imagery, elaboration, mnemonics, and organization. Representative examples and activities of these memory strategies are given to show how teachers use these strategies in their classrooms.

Keywords: memory strategies, teachers, instruction

Memory Strategies Used By Teachers

School learning involves memorizing a variety of information. Whether used by teachers or students, memory strategies, such as elaboration, mental imagery, mnemonics, organization, and rehearsal, are helpful in remembering information. Most studies on memory strategies in classrooms focus on how students use these strategies, e.g., elaboration (Willoughby, Porter, Belsito, & Yearsley, 1999), mental imagery (Bozorgmanesh & Mohmmad, 2012), mnemonics (Scruggs, Mastropieri, Berkeley, & Marshak, 2010), organization (Pang, 1991), and rehearsal (Tam, Jarrold, Baddeley, & Sabatos-DeVito, 2010).

Only a few studies on memory strategies in classrooms focus on how teachers use these strategies. Pressley, Allington, Wharton-McDonald, Block, and Morrow (2001) noted that teachers' instruction of memory strategy is lacking in the intensity necessary for students to learn how to use memory strategies effectively. In addition, Ornstein, Coffman, and Grammer (2009) found that teachers vary considerably in how much they use memory-relevant language, such as strategies and metacognitive questions (questions related to students' knowledge of how memory works) that encourage students to remember information.

Memory Strategies

The memory strategies recommended to teachers and students include elaboration, mental imagery, mnemonics, organization, and rehearsal (Santrock, 2011; Schunk, 2012; Woolfolk, 2013). Discussion of each of these strategies is given as follows for teachers and students to adopt.

Elaboration. Adding distinctiveness to new information exemplifies the strategy of elaboration. Woolfolk (2013) explained that elaboration assists encoding and retrieval of new information because it links new information to older information. Ways to elaborate include generating self-reference examples and constructing meaningful sentences. For example, to remember how to spell the word, *rendezvous*, students can use elaboration to make a meaningful sentence (e.g., the restaurant will be our rendezvous). Another way to elaborate is to answer questions about new content. For example, to remember the fact that the Western Spotted Skunk lives in a hole in the ground, students can ask, "Why would that fact be true?" When students generate answers to *why* questions, they relate what they already know to the new information. After examining elaboration strategy use as a function of prior knowledge with students in elementary schools, Willoughby, Porter, Belsito and Yearsley (1999) got positive findings for elaboration for all grade levels when learners have access to an extensive network of information. In fact, elaboration is an effective memory strategy for both children and adults across a variety of learning tasks (Pressley, Wood, Woloshyn, Mmartin, King, & Menke, 1992).

Mental imagery. Visualizing images of verbal information lead to the construction of mental imagery. The dual coding theory (Paivio, 1971) states that memory for linguistic information is enhanced if relevant imaginal information is activated, and such activation of both verbal and nonverbal systems results in the dual coding of information. Schunk (2012) suggested different ways to elicit students' mental imagery, such as having students close their eyes and think about a story scene, steps of an experiment, or dance movement, etc. For example, to remember a historic incident, students can use mental imagery to visualize a battlefield with eyes closed. After reviewing the use of mental imagery in classrooms, Douville

(2004) concluded that mental imagery is best used in facilitating deep-level engagement in reading, generating descriptive words in writing, and concretizing abstract mathematical concepts.

Mnemonics. Imagery and words can be combined as mnemonics to aid memorization. There are various types of mnemonic strategies: rhymes (e.g., "righty tighty, lefty loosey"), spelling rules (e.g., "*i* before *e* except after *c*"), song lyrics (e.g., "head and shoulders, knees and toes"), phrases (e.g., use "never eat soggy waffles" to remember the compass directions "north, east, south, and west"), acronyms (e.g., use "HOMES" to remember the five Great Lakes – Huron, Ontario, Michigan, Erie, and Superior), method of loci (e.g., use the logical movement after supper to remember "a tiger" on the countertop, "a monkey" in the sink, "a hippo" in the dishwasher, and "a bald eagle" on the sofa), keyword method (e.g., connect vivid images of two apples getting married to remember "Annapolis is the capital of Maryland"). After reviewing educationally-relevant mnemonic strategy research, Levin (1994) stated that mnemonic strategies equip students with skills to acquire straightforward factual information, but fail to promote students' independent transfer and application of information.

Organization. Connecting items to one another can organize information in such a way that recalling one item also recalls other items linked to it. Santrock (2011) explained that organization makes large amounts of information more manageable and more meaningful. Woolfolk (2013) recommended the use of hierarchy to integrate pieces of information, the use of chunking to group information into higher-order units to be remembered as single units, or the use of outline to organize information. For example, to remember the 50 states, students can organize states by region (West, South, Midwest, Northeast, East, etc). To remember vocabulary, students

can group semantically related words by meanings (categories, instances, associates, synonyms, etc.). Banerjee and White (2015) found that organizational strategy is highly specific to the demands and goals of individual tasks even when tasks share commonalities such as involving the same cognitive domain. It means that organizing words on the basis of semantic category enhances memory of a word-list learning task, but organizing words on the basis of nonsemantic, phonemic characteristics enhances language fluency of a word-generation task. Therefore, organization strategy is one of the most efficient means of improving free recall in the absence of cognitive support.

Rehearsal. Consciously rehearsing information over and over can somewhat slightly extend the length of time it stays in memory. Santrock (2011) stated that rehearsal works best when encoding and remembering of a list of items for a brief period of time, but it does not work well when for retaining information over the long term. Woolfolk (2013) also mentioned that rehearsal works well with highly overlearned material, such as multiplication facts, spelling words, or a play script, but it does not work well for remembering more complex and meaningful information. For example, to remember multiplication facts, students can repeat them over and over verbally or in written form. However, Harris and Qualls (2000) stated that rehearsal is primarily used for disposable memory traces, such as a single-use telephone number that would be forgotten immediately after its use.

Memory Strategies in the Classroom

There are only a few studies on memory strategies in classrooms which focus on the types of memory strategy teachers teach their students and the types of memory-relevant language teachers use in the class. To observe the memory strategies teachers taught to support children's

learning, Moely, Hart, Leal, Santulli, Rao, Johnson, and Hamilton (1992) conducted a cross-sectional study of classrooms from kindergarten through sixth grade. They observed how teachers structured classroom learning activities in a range of subjects and how they monitored and directed children's study. To do so, they developed a coding system to record many aspects of the teaching process, and used factor analyses to identify four factors: teachers' responses to error; positive interactive teaching; communicating task-related information; and cognitive processes and strategies. Among these factors, cognitive processes and strategies included instances in which teachers gave suggestions about studying or learning, such as offering rationales for strategy use, providing information about appropriate cognitive processes for task performance; advising of the need for memory activity, telling children not to engage in certain study strategies, and requesting children's questions or problems.

The authors found that the most commonly coded teacher behaviors included requests for answers to questions. Instruction that called for children to engage in cognitive processing and strategy use occurred rather infrequently. Teachers of grade 4 and above provided rationales for the use of strategies more often than teachers of younger children. Teachers of lessons involving mathematics activity and language arts suggested students use such strategies more than those teaching lessons involving other activities. Teachers instructing language arts suggested deduction strategies most often whereas teachers instructing mixed subject matter (including math) most often promoted the use of specific aids for problem solving. Rehearsal was the memory strategy taught most often by all teachers, followed by elaboration, and mental imagery. Subsequent training in the use of the memory strategy of organization was also given to children. Among average and low achievers of the group, those whose teachers were relatively high in strategy

suggestions showed improved memory performance and more deliberate use of the organization strategy than did children whose teachers rarely made strategy suggestions.

In contrast to the study of Moely, et al. (1992), Ornstein and his colleagues (Coffman et. al., 2008; Ornstein, Coffman, & Grammer, 2009; Ornstein, Coffman, Grammer, San Souci, & McCall 2010) undertook a longitudinal study to examine the memory-relevant language teachers use during the course of instruction and the mnemonic goals expressed in their lessons. Based on Moely, et al.'s cognitive processes and strategies factor, Ornstein et. al. developed a coding instrument, the Taxonomy of Teacher Behaviors. The four categories of teacher memory-relevant language in the Taxonomy concerned the nature and extent of various instructional memory-related strategies: instructional activities (providing information about an upcoming activity), cognitive structuring activities (encouraging children to engage with the materials in ways that facilitate the encoding and retrieval of information), memory requests (asking students to retrieve information or to prepare for future activities), and metacognitive information (providing or soliciting metacognitive information with the goal of facilitating children's performance). The authors then followed students throughout their elementary school years and made several visits to observe them in their classrooms. During each visit, one observer employed the Taxonomy and another observer prepared a detailed contextual narrative of each lesson.

The authors found that instructional activity was the most frequent activity and memory request was the second-most frequent activity. The narratives showed that most of these memory-related requests were implied deliberate, in which the demand for the use of memory was implicit without an expressed prompt to remember or not to forget, and a small percentage of these requests were expressed deliberate, in which memory demands were explicitly stated. In addition,

they also found that the achievement of low-achieving students increased when they were placed in classrooms in which teachers were categorized as "high-mnemonic teachers" who frequently embedded memory-relevant information in their teaching.

Purpose of the Present Study

Previous studies on how teachers use memory strategies focused on the types of memory strategy teachers teach their students and the types of memory-relevant language they use in the class. Moely, Hart, Leal, Santulli, Rao, Johnson, and Hamilton (1992) investigated how and when teachers ask students to use study and memory strategies in the elementary school classroom. Ornstein and his colleagues (Coffman et. al., 2008; Ornstein, Coffman, & Grammer, 2009; Ornstein, Coffman, Grammer, San Souci, & McCall 2010) examined the memory-relevant language teachers use to encourage students to use memory strategies during the course of instruction in elementary school classrooms.

The current study further examines how teachers use memory strategies but the focus is on the types of memory strategies teachers use to present their lessons. Two research questions are asked. First, what memory strategies do teachers use to teach their lessons? Second, how do teachers use memory strategies in their instruction? Getting to know the memory strategies other teachers use help teachers make informed decisions how and when to use these strategies in their own instruction.

Method

Participants

The participants in this study were 11 mathematics teachers enrolled in a graduate program in education at a Midwestern state university. There were 3 males and 8 females with a

mean age of 29.6 years, ranging from 22 to 44 years old. The average length of teaching experience was 6.15 years, ranging from 1 to 21 years. One participant taught first grade, two taught second-grade, four taught fourth-grade, and four taught fifth-grade.

Procedure

Participants completed an open-ended questionnaire as part of the requirement for a graduate course in education. They were asked to write responses to two questions: "What information did your students need to remember in the subject you teach?" and "What strategies did you use to help your students to remember this information?" The first question served as a lead-in to help participants answer the second question. The responses shared by participants in the second question were coded if they fitted as rehearsal, mental imagery, elaboration, mnemonics or organization strategies according to Schunk (2012).

Results

Table 1 presents the memory strategies teachers use to teach their lessons. Out of the 238 examples of memory strategies used, 111 (46.64%) were rehearsal, 54 (22.69%) were mental imagery, 46 (19.33%) were elaboration, 17 (7.14%) were mnemonic, and 10 (4.2%) were organization.

Table 1

The Number and Percentage of Memory Strategies Used By Teachers

Memory Strategies	Number of Examples	Percentage of Examples
Rehearsal	111	46.64%
Mental Imagery	54	22.69%
Elaboration	46	19.33%
mnemonic	17	7.14%
organization	10	4.2%
Total	238	100%

Representative examples and activities of these memory strategies explain how teachers use these strategies in their classrooms. For example, teachers use drill and practice, and a variety of games to help students rehearse what they have learned (see Table 2). One teacher wrote, "We created flashcards to practice memorizing common conversions that were the building blocks for more complex conversion." Rehearsal was used widely from first to fifth grade no matter how much teach experience the teachers had.

Table 2

The Examples and Activities of the Memory Strategy of Rehearsal Used by Teachers

Memory Strategies	Examples	Activities
Rehearsal	Drill	1. Tracing letters. 2. Unscrambling a sentence. 3. Repeating the letter sound. 4. Reciting the specific rule and formula. 5. Listening to a script and reciting it.
	Practice	1. Using flashcards. 2. Completing worksheets. 3. Doing homework. 4. Reviewing at regular intervals. 5. Performing the movements, 6. Giving self-test. 7. Asking peers questions, 8. Looking for the concepts in daily life, 9. Solving real world situations.
	Games	1. *Jeopardy!* for common conversions. 2. *Go-fish* for letter cards and corresponding pictures. 3. *Bingo* for single and two-digit multiplication problems. 4. *Tic-Tac-Toe* for 3 levels of multiplication. 5. *Multiplication Wheel* for multiplication. 6. Velcro cards for matching element's name, symbol, atomic number, and numbers of neutrons, protons and electrons. 7. Computer games for multiplication facts, identification of A.M. & P. M., review of the periodic table, and classification of living organisms and cell types.

To generate mental imagery, teachers use realia and visual aids, or engage students in mental math or visualization (see Table 3). One teacher wrote, "As I described unit to unit conversion, students imagined what this looked like in both units." Mental imagery was used widely in different elementary grade levels by teachers with less than five years of teaching experiences.

Table 3

The Examples and Activities of the Memory Strategy of Mental Imagery Used by Teachers

Memory Strategies	Examples	Activities
Mental imagery	Mental math	1. Using base ten notations 2. Adding up the number of dots.
	Realia	1. A circuit board. 2. A "D"cell battery. 3. Two or three wires. 4. Different types of conductors and insulators. 5. A light bulb. 6. A motor. 7. A small demonstration clock.
	Visual aids.	1. Flashcards with pictures. 2. Vocabulary cards with pictures and letters. 3. Pictures on bulletin boards, whiteboard, or posters. 4. Illustrations within story books. 5. Video or Smartboard demonstrations. 6. Songs with physical motion, 7. Scripts with physical motion but without voice.
	Visualization.	1. The equal sign of an algebraic expression as a scale holding the same weight at both sides. 2. A compass rose as a favorite uncut pie with 360 small cuts. .

Not only can teachers elaborate the information by using analogy and making meaningful connections to real life, they may also ask students to generate their own personalized examples, complete their own projects, and teach their peers (see Table 4). One teacher wrote, "I used what

the kids already knew and built on it." Elaboration was used mainly by fourth and fifth-grade teachers no matter how much teaching experience they had.

Table 4

The Examples and Activities of the Memory Strategy of Elaboration Used by Teachers

Memory Strategies	Examples	Activities
Elaboration	Analogy	1. Multiplication is analogous to repeated addition. 2. Division is analogous to repeated subtraction. 3. Mowing the yard is analogous to area because you mow the whole yard, 4. Setting up a fence is analogous to its parameter because you go around the edges.
	Meaningfulness	1. Calculating area when one wants to buy carpet for houses, order tiles for a kitchen, or build a house. 2. The letter *A* comes before the letter *P* in the alphabet, so A.M. comes before P.M. just as morning comes before night. 3. Since "tablespoon" and "teaspoon" both start with the letter *T*, and *T* rhymes with "three", remember that there are 3 teaspoons in a tablespoon.
	Peer teaching	1. After finishing their work, students can help others determine examples and non-examples, identify the type of speech in sentences, and apply the parts of speech to compose sentences. 2. Working together to discuss the question, figure out the answer, and share the strategies of how to get the answers. 3. After summarizing their sections, each student teaches that section to the class and other students may ask questions about that section.
	Personalized examples	1. Connecting a script to an emotion students identify with and relating it to a previous event from their life. 2. Using the new words to write personalized sentences relevant to their life and making meaningful connections to the words. 3. Deriving the formulas themselves. 4. Writing a song, rap, or poem about a state and its capital. 5. Creating a sentence for each common interjection. 6. Writing down definitions, making observations, drawing pictures, making hypotheses and predictions, discussing

		the steps and strategies, and explaining the successes and failures of one's project. 7. Creating flashcards with the material and other visuals. 8. Rewriting and explaining the concepts in one's own words.
	Projects	1. Creating a poster of a topic and presenting the poster to the class. 2. Choosing an experiment for science fair based on what students have learned and presenting their results to the whole class. 3. Constructing 3-D prisms with grid paper and discovering the standard algorithm for finding volume. 4. Creating one test question for teachers to put into a test. 5. Making a cake to show the type and parts of cells.

Acronyms, phrases, and songs are mnemonics teachers use in different subjects (see Table 5). One teacher wrote, "Tablespoon and teaspoon both start with the letter T, T rhymes with 3, so there are 3 teaspoons in a tablespoon." Mnemonics were used mainly by fourth and fifth-grade teachers with less than five years of teaching experiences.

Table 5

The Examples and Activities of the Memory Strategy of Mnemonics Used by Teachers

Memory Strategies	Examples	Activities
Mnemonics	Acronyms	1. Using "KFC" as a cue for remembering the fraction operation: keep, flip, and change. 2. Using "FANBOYS" as a cue for remembering conjunctions: for, an, nor, but, or, yet, and so. 3. Using "SOH CAH TOA" as a cue for remembering geometry equation: Sine = opposite/hypotenuse, cosine = adjacent/hypotenuse, tangent = opposite/adjacent.
	Phrases	1. Using "King Henry doesn't make Disney channel music" as a cue for remembering the conversion of measurements in the metric system: kilo, hecto, deka, meter, deci, centi, milli. 2. Using "Please excuse my dear Aunt Sally" to remember the order of operations in math: parenthesis, exponents, multiplication, division, addition, and subtraction.

		3. Using "Never eat soggy waffles" to remember cardinal directions: north, east, south, and west.
	Songs	1. Using songs on perimeter and area, states and capitals, living organisms classifications, cell types and their parts, and the periodic table and its elements.,

Teachers also use anchor charts, concept maps, check sheets, and bookmarks, or engage in chunking to organize the information for students to remember (see Table 6). One teacher wrote, "We made a web of words that often gave clues as to whether a person should add or deduct." Organization was used mainly in fourth and fifth grades by teachers with less than five years of teaching experiences.

Table 6

The Examples and Activities of the Memory Strategy of Organization Used by Teachers

Memory Strategies	Examples	Activities
Organization	Anchor chart	1. Writing the similarity and difference between insulators and conductors in two columns.
	Bookmark	1. Figuring out an unknown word in a variety of ways, such as sounding out words, breaking words apart, and looking for context clues and text features.
	Check sheet	1. Identifying main ideas and supporting details, such as reading the entire passage first, deciding whether the passage is fiction or non-fiction, listing the important parts of the passage, looking for the sentence telling the main idea, and summarizing the passage with the main idea and supporting details.
	Concept map	1. Writing key words to identify the operation of addition (sum, total, more, sum) and subtraction (reduce, decrease, less than, difference) in boxes and connecting them to the respective operation.
	Chunking	1. Parts of speech as four smaller units: nouns, verbs, connections, and interjections. 2. Adjectives, nouns, and pronouns as a descriptive unit. 3. Adverbs and verbs as a motion unit. 4. Prepositions and conjunctions as a connecting-word unit.

General Discussion

The current study examines the types of memory strategies teachers use to present their lessons. Rehearsal and mental imagery were used widely by first to fifth-grade teachers whereas elaboration, mnemonics and organization were used mainly by fourth and fifth-grade teachers. Rehearsal and elaboration were used by teachers regardless of their teaching experiences whereas mental imagery, mnemonics and organization were used by teachers with less than five years of teaching experiences.

Rehearsal is found to be the most frequently used strategy, followed by mental imagery, elaboration, mnemonics, and organization. Previous study also found that rehearsal is the memory strategy taught most often by teachers to their students (Moely et al., 1992). The high percentage of teachers using rehearsal in the classroom (46.64%) indicates that teachers frequently use drill and practice, as well as games, to repeat foundational information for students to remember. As reviewed, rehearsal works well in remembering a list of items, arithmetic facts, spelling words, and scripts but is less effective for remembering more complex and meaningful information and/or information over the long term (Santrock, 2011; Woolfolk, 2013). From the examples given by teachers, rehearsal is used appropriately for students to remember foundational matter that is continuously revisited and built upon. In fact, rehearsal is the strategy to encode information to working memory where information is stored long enough to be processed to complete a task.

When the information is deemed important, other memory strategies are needed to move it to long-term memory. Memory strategies which move information from working memory to long-term memory are elaboration, mental imagery, mnemonics and organization. However, the

percentage of teachers using rehearsal (46.64%) to encode information in working memory is much higher than the percentage of teachers using any of those strategies which move information to long-term memory. To move information to long-term memory, teachers should adopt these strategies more often and more widely. In planning lessons individually or as a team, these memory strategies can be incorporated into instructional activities of a variety of topics.

The memory strategies discussed in the current study may benefit other teachers or educators who would like to apply memory strategies in their own educational settings. With exposure to how other teachers use memory strategies, teachers or educators can equip themselves with a number of strategies before developing their own versions. However, caution has to be taken when reading these strategies because they are ascertained from teachers' self-reported responses to an open-ended question. In the real classroom, teachers who participated in this study may not use these memory strategies or may not implement these strategies in the ways they describe. Nevertheless, exposure to a teacher who teaches memory strategies would lead students toward more effective learning (Moely, et al., 1992). Further studies might compare students' academic performance under teachers who use more memory strategies and those who use fewer memory strategies in presenting the lessons, or examine memory strategies by content matter and grade level.

Conclusions

Memory strategies are critical in promoting learning at schools. The types of memory strategies teachers use to present their lessons determine how students would remember the information. Rehearsal is helpful in remembering foundational information in working memory, whereas elaboration, mental imagery, mnemonics and organization are helpful in moving

information from working memory to long-term memory. Therefore, teachers are encouraged to learn from other teachers how to incorporate these memory strategies in presenting lessons to their students.

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