SO WHAT NOW?
AFTER THE WISC-III ASSESSMENT

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Abstract

The Wechsler Intelligence Scale for Children - Third Edition (WISC-III) is the instrument used by psychologists administering cognitive assessments to students in Palliser Regional Schools; commonly identified areas of difficulty include memory and attention deficits. The purpose of this project was to collect and collate proven teaching strategies to assist students whose difficulties with memory and/or maintaining attention impact negatively on their learning. Theoretical background information on memory and attention is summarized. Strategies to foster memory development include general strategies (mnemonics, associative, visual, auditory and temporal/environmental) and subject-specific strategies (reading, mathematics and spelling). Teaching approaches to assist students in maintaining appropriate attention and focus are outlined. All strategies discussed in the document were derived from academic research or practical teacher experience.

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Introduction

At present, I am a consulting teacher with Palliser Regional Schools. As part of my job duties, I am responsible for conducting and coordinating any assessments that support the coding of a student, according to Alberta Learning guidelines (see Appendix A for an overview of the most recent coding guidelines, as outlined by Alberta Learning). I am qualified to administer academic assessments; however, psychologists (working under contract to the school division) must administer psycho-educational assessments. We are very fortunate in our district; students who are referred for cognitive assessment receive timely assessment by a qualified chartered psychologist. The majority of students that are referred for cognitive assessment are either being assessed for meeting severe disabilities guidelines (severe cognitive disability, severe behavioural and/or emotional disability, or a medical disability, including autistic spectrum disorders), mild/moderate disabilities guidelines (mild or moderate cognitive disability or a learning disability) or to support a coding of gifted and talented. In our school, approximately twenty students per year are assessed using the Wechsler Intelligence Scale for Children - Third

Edition (WISC-III) instrument. After each assessment, the school receives a written report outlining the results in both the verbal and performance domains, and general recommendations based upon the cognitive results (for an overview of the performance domains and subtests in the WISC-III, see Appendix B). Often these recommendations are very general; it is then up to the classroom teacher and me to develop effective learning strategies for that student.

The WISC-III provides information about the "what" of the student; it helps to answer questions such as "What is the general ability level of this student?", "What are the specific areas of strength and weakness in this student's learning profile?" and "Is this student performing to his/her potential in the classroom?" However, knowing the answer to the "what" questions does not automatically lead to answering the question "So what do we do now for this student to help him/her achieve to the best of his/her ability?" Even though each report contains recommendations based on the findings of the examiner, the recommendations are often quite general and are not always easily translated to specific and practical programming interventions for that student. In our school, there was a feeling that a formal cognitive assessment should provide more than just support for funding purposes; it should also

provide the classroom teacher with some direction as to how to make the learning situation better for the assessed student.

Formal cognitive assessments, such as the WISC-III, assess many facets of ability and intelligence. To determine the foci for this project, I surveyed other consulting teachers in our district regarding common assessment findings in their student populations. I also collected a sample of assessment reports (with all identifying student information deleted, to maintain confidentiality) from surrounding schools in our district. Consistent findings, from direct observation of reports and from discussion with colleagues, indicated that, within the population of assessed students, the areas of memory and attention were significant and common areas of weakness. Significantly more students are referred for testing for identification of learning deficits than are referred for gifted identification; in this light, the identification of the deficit areas of memory and attention is not surprising. It is likely that most classroom teachers could have predicted those findings very accurately.

Formal cognitive assessments are expensive and time-consuming; not every student who experiences a learning difficulty will be referred for assessment. Teacher

intuition, in these cases, is invaluable; we often find in our school that formal assessments quantify and reinforce the classroom teacher's perceptions of the student's individual learning strengths and weaknesses. Classroom teachers are at the forefront of student assessment, either with or without formal external cognitive assessments. It is likely that problems related to memory and attention are also prevalent in the non-assessed student population. If this assumption is valid, then any measure instituted in the classroom to assist in the development of memory and attention skills should be of benefit to a wide range of students, and not just those students who have received formal assessments.

The purpose of this project is to collect and collate proven teaching strategies and approaches to assist those students in the classroom who experience difficulties with memory and/or maintaining attention. Many of the strategies were found in the research literature, while others were suggested by experienced and extremely capable classroom teachers. Regardless of their etiology (research-based or experience-based), they have all proven to be beneficial for students; however, professional discretion must still dictate which approaches might be most effective with specific students. Classroom teachers are responsible for

making those decisions for every student in their classrooms; hopefully, this document will assist teachers with some of those decisions.

There are two sections to this document; the first section outlines memory processes and memory development strategies, while the second section deals with helping students to focus their attention on learning tasks in the classroom. Each section is prefaced with a synopsis of current theoretical and research bases; even though teachers are busy people and often just want to get to the "meat" of the issue (i.e., what to do for students), the underlying theory is included for two basic reasons. This is a document produced for academic purposes, so theoretical justification for any proposed strategy suggestions is imperative. More importantly, the development of any teaching practice that is not thoroughly grounded in research is analogous to building a new house on a sand dune; there is not enough stability or support to ensure longevity and viability. Theory development without practical suggestions may be a nice intellectual exercise, but few, if any, classroom teachers have the luxury of indulging in strictly theoretical pursuits. Any useful document needs to have practical and positive implications,

based on theory and research, for the classroom and for student learning.

This document contains a range of strategies that have proven to be successful in specific learning situations. However, not all strategies will be appropriate in all learning situations; each teacher's professional discretion will dictate the selection and use of any pedagogical strategy. The more opportunities and learning avenues that we, as teachers, provide for our students, the more successful their learning will become. We are bound to find something that complements each student's learning style.

Memory

Background Information

Memory: What Is It?

Teachers know that memory is a crucial aspect of students' educations. However, defining the term "memory" is more difficult than recognizing its importance. Sousa (2001a) defines memory as the process by which we acquire new information, knowledge and skills for future use. Levin (Hwang and Levin, 2002) defines memory as the 3R's of remembering: Recoding, Relating, and Retrieving. John (1993) postulates that memory is the prerequisite for all higher learning, and it imparts meaning to all human existence. Jensen (1998) states that memory is a function

of the retrieval process; if one cannot retrieve information, how does one know one knows something? In short, the term "memory" implies that information must enter the brain, get stored, and be retrieved at appropriate times for meaningful future use.

At present, neuroscientists cannot categorically state exactly how human memory systems work; however, research and intuition have led to a functional understanding of memory systems. It is important to remember that the following description of memory function is just that: it describes the function of the various memory systems, and not their locations in the brain. There is no distinct "memory center" in the brain (Wolfe, 2001a).

To understand brain and memory functions, one should have an elementary understanding of the neuronal make-up of the brain. The brain may be thought of as a series of neurons, or brain cells. Each neuron has an axon, through which chemical and electrical messages leave to communicate with the dendrites on an adjacent neuron. It has long been postulated in the scientific community that one cannot grow new neurons, although recent research tends to put this assumption in question (Barinaga, 1998). However, one can grow new dendrites through experience. If one uses a tree analogy, the neuron would be like a tree in a forest;

prevailing academic thought would suggest that the number of trees is constant (Wolfe, 2001a). However, each tree can grow an unlimited number of branches, or dendrites; the more dendrites, the more connections between neurons, and the greater the memory capacity (Wolfe, 2001a).

Please see Appendix C for a graphic representation of a neuron, axon and dendrites.

Sensory stimulation causes the neurons to fire, making neuronal connections, which underlie all memory processes. If that particular system of neurons does not fire again, the memory will decay over time. However, the neurons stay in readiness, or anticipation of firing again, for a period of days. If the pattern of firing occurs again through rehearsal and practice, the potential for those neurons to fire again in the same pattern increases, therefore increasing the chances of memory retention. The tendency for groups of neurons to fire together after practice is referred to as "long-term potentiation"; if one of the neurons fires, they all fire, forming a memory trace or engram. In Pat Wolfe's (2001b) words, "Neurons that fire together, wire together" (p. 6). The key to successful wiring is successive firings through practice, rehearsal and elaboration (Sousa, 2001a; Wolfe, 2001a).

There are three distinct memory systems operating in our brains at any given time. The sensory memory acts as a sieve for the bombardment of sensory information reaching our brains. All information reaching the brain enters through one or more of the sensory channels (sight, sound, smell, taste and/or touch). The sensory memory discards approximately 99% of sensory input; otherwise, our brains would be overloaded if we took notice of all sensory input. The remaining 1% of information is initially processed and sent to the working memory; this 1% is comprised of the sensory data from the environment that captures the brain's attention well enough for the individual to become consciously aware of it (Neill, 1998; Wolfe, 2001a). There are tremendous educational implications involved in the retention and discarding of sensory stimulation by the brain; these will be discussed in the section on attention.

The second type of memory, the working memory was once referred to as "short-term memory". Working memory is the site of conscious mental activity; information from either the long-term memory or the sensory memory can only be used in an activated state in the working memory, hence its name. It continually monitors information received from the sensory memory, simultaneously processing, prioritizing, editing, focusing and shifting attention to the important,

interesting and familiar information. It also retrieves information from the long-term memory, allowing the learner to integrate current perceptual information with stored knowledge, and to consciously manipulate the amalgamation of "new and old" to ensure its storage in long-term memory.

As powerful as the working memory is in the memory system, it does have some definite limitations. Information remains in the working memory for only 15 to 30 seconds unless active manipulation and processing of this information occurs. It is difficult, if not impossible, to process two trains of thought simultaneously, especially if both involve the same sensory modality (e.g., one can only hear one conversation at a time, even if two are occurring simultaneously). Finally, the capacity of the working memory is limited to approximately seven, give or take two, items. This is called the M space (or Memory space), and it varies with age. Younger children (aged five years) have M spaces of 2 plus or minus 2 chunks, while older children (eleven years of age) have M spaces of 5 plus or minus 2 chunks. At approximately the age of fifteen, students acquire M space capacity commensurate with adult capacity (Jensen, 1998). Once M space capacity has been reached, there is no more capacity for remembering; the working

memory must either discard the information (forget) or transfer the information to long-term memory (learn).

There are two important educational implications with respect to memory capacity in students. First, younger students cannot be expected to remember at the same levels as their adult teacher (Ramissetty-Mikler, 1992). Secondly, although the number of chunks tends to remain static, the size of each chunk can increase, thus effectively increasing the memory capacity (Cuasay, 1992; John, 1993; Sousa, 2001a; Wolfe, 2001a). Chunking will be discussed in a later section.

Long-term memory is thought to have unlimited capacity (John, 1993). It is the repository for storing information for, as its name implies, long periods of time. Information that is stored in long-term memory tends to be relatively permanent, but may or may not be entirely accurate. Long-term memory operates on the principle of redundancy, or "keeping a little bit of everything everywhere" (Cuasay, 1992). When one retrieves information from long-term storage, it is a time-consuming process to amalgamate "the bits" of information (this explains why providing adequate response time is critical in the learning process); however, this process tends to insure that, regardless of trauma or time, some part of the specific memory has a high

chance of being retrieved. When a learner retrieves information from long-term memory, and activates it in the working memory, that information is essentially relearned as it is reprocessed (Sousa, 2001a; Tunstall, 2001b). This has far ranging educational implications; as students retrieve past learning to amalgamate with new learning, they are relearning the previous learning, thus strengthening those neuronal connections, and increasing the chances of permanent retention. This explains why revisiting, reviewing, rehearsing and reprocessing are essential educational prerequisites for permanent learning.

Long-term memory has two main subsystems: the declarative (conscious and explicit) and procedural (unconscious and implicit) systems. The declarative subsystem is comprised of semantic (knowledge of facts and data) and episodic (memory tied to episodes and events in one's own life) memory systems. The procedural subsystem deals with the knowing "how" to do something rather than knowing "what" (the purview of the declarative subsystem). It is comprised of skills, which tend to become automatic with practice, and can be motor skills, such as riding a bicycle, or non-motor skills, such as reading, and priming, in which memories are unconsciously influenced by past

experiences and emotions (Cuasay, 1992; Neill, 1998; Sousa, 2001a; Wolfe, 2001a).

Please consult Appendix D for a graphic representation of the functional memory systems in the brain.

Memory System Control Processes

Memory system control processes alert the brain to important incoming information, and assist in the organizing, retention and retrieval of memories.

There are five separate memory control processes:

- Attention - allows the learner to select a subset of information entering the sensory memory to be processed into the working memory. This is often a subconscious process, although the learner can exert executive, or conscious, control in this selection process.
- Encoding - allows the learner to store memories in any of the three memory systems; organization or encoding of incoming information is the key stage to successful recall or retrieval.
- Rehearsal and Practice - allows the learner to process and reprocess information so that it will be encoded in long-term memory. Although rehearsal does not guarantee long-term storage, the lack of rehearsal virtually guarantees that information will not enter

long-term memory. Rehearsal can be categorized by time (initial and secondary) and type (rote and elaborative). Initial rehearsal takes place when the information first enters the working memory; secondary rehearsal occurs when the learner processes the information, by making personal sense of it, elaborating on the details, and assigning value and relevance to the learning. Rote rehearsal is appropriate when the learner needs to learn the information exactly as it was presented (e.g., mathematical facts), while elaborative rehearsal is appropriate when it is important for the learner to make links and connections between new and old learning, (e.g., personalizing the learning with respect to one's experience and interests). The nature of the learning task determines the type of rehearsal that is most effective.

- Retrieval - allows the learner to bring information from long-term memory to working memory to activate it. Every time the learner retrieves memories from long-term memory for activation in the working memory, the learner, in effect, relearns the information by strengthening the memory trace and increasing the chances of future retrieval. The brain uses two

methods for long-term retrieval. Recognition involves matching external stimuli with stored information. During recall, cues and hints are sent to the long-term memory which then searches for and retrieves information, consolidates it, and sends it back to the working memory; this process is more complex than the recognition process. Retrieval in either form is dependent upon consolidation time, or the period of time necessary for new information to become solidly entrenched in long-term memory. Unfortunately, there is no set period of time to ensure consolidation; once again, this is an important educational issue. If insufficient consolidation time is given to students when learning new information, both new learning and old learning may be disrupted or compromised.

- Metacognition - allows the learner to monitor the memory system and learning, to set goals, to select strategies, to monitor progress and to adjust learning behaviours (Neill, 1998; Ramissetty-Mikler, 1992; Sousa, 2001a; Wolfe, 2001a).

Visual and Auditory Memory Channels

The two most common sensory intakes of information, especially in a classroom setting, are the visual and auditory modalities. Visual memory is generally stronger in

most people than is auditory memory; visual stimuli are relatively permanent and can be repeatedly processed and verified, if necessary, while auditory stimuli tend to be transient with generally only one chance to process the message (Tunstall, 2001b; Wolfe, 2001a). However, most classrooms tend to be more auditory than visual; they are "talking" and listening places more often than they are "looking" or viewing places. This can have serious ramifications for those students with auditory processing or memory deficits.

Usage of Memory Strategies

There are definite advantages to teaching students how to effectively use memory strategies. If students can memorize basic information in a more efficient manner, they then have more working capacity remaining to complete higher order thinking activities (Higbee, 1977). Students will better remember those facts necessary for reasoning, understanding and justifying conclusions reached while pursuing higher order thought processes, such as synthesis, analysis and evaluation, the hallmarks of educated thinkers.

Memory strategies are effective because they provide a framework for the learner to create semantically and visually meaningful associations between new learning and

old learning; they change the unfamiliar to the familiar, making it easier for the learner to accurately recall the new information (Mastropieri, Scruggs, & Levin, 1987). If used well and thoughtfully in a classroom setting, mnemonic strategies combine principles of good pedagogy, good psychology and good information processing strategies; they are substantial memory triggers that can benefit all students.

These strategies aid students with learning disabilities or difficulties more than those students who are academically advanced (Moely et al., 1992). It is thought that capable students have already developed some form of effective internal strategy use and therefore do not benefit as much from direct instruction of strategy use. However, mnemonic strategies are useful for all students, regardless of the presence or absence of learning difficulties (Mastropieri & Scruggs, 1998).

In order for strategy usage to be effective in a learning situation, the students must have a well-defined idea of how to implement a strategy. When teaching students how to effectively use memory strategies, the issues of when and how to use the strategy, when and how to modify the strategy, and maybe most importantly, when not to use the strategy, must be directly addressed with the students

(Kail, 1990). However, knowing the "what", "when" and "why" of strategy usage is necessary, but not sufficient, for students; they also need to have a firmly entrenched sense that the strategies work to facilitate effective learning (Pressley, Forrest-Pressley, Elliott-Faust, and Miller, 1985). If a student feels that strategy use does not facilitate learning, then he/she is unlikely to implement that strategy in future learning.

Students of all ages benefit from direct strategy instruction. Younger students do not systematically encode and organize incoming information in a learning situation (Ramissetty-Mikler, 1992). Without an established retrieval path, recall of information is sporadic; this may explain the phenomenon of "one day they know it, the next day they don't" observed by many teachers in primary classrooms (and possibly in successive grade levels as well). As well, younger children may lack the vocabulary and insight to accurately describe their internal mental procedures (Moely et al., 1992); as teachers, we cannot assume the lack of strategy use, or potential strategy use, by younger children, merely because of their lack of ability to verbalize their mental processes. Children younger than eight years of age are unlikely to use specific strategies unless they have received explicit instruction and guided

practice. Children from eight to ten years of age begin to use basic rehearsal strategies independently, but do not use elaboration strategies without prompting. Children older than ten years of age begin to develop more sophisticated rehearsal and elaboration strategies, based on their perceptions of the salient characteristics of the information to be remembered (John, 1993).

Tunstall (2001a) posed an interesting question with respect to strategy use with individuals with learning problems: Should the majority of effort and energy be put into skill development (to remediate the learning deficits) or into compensatory strategies (to develop alternative pathways to bypass the deficit area)? Although her population of study was not in the classroom (she researched the treatment of brain injuries), her findings seem to be applicable in any learning situation. She recommended that the majority of the educational time and energy should be devoted to skill development, with some compensatory strategies being provided; if progress was not forthcoming, then the balance of time and energy invested should be shifted to an emphasis on compensatory strategies. In other words, the first option of choice is the development of a skill set in the learner, but if this is not successful over time, then compensatory strategies

should be developed. Intuitively, this answer seems to transfer into the classroom setting. As teachers, our first inclination is to help students reach an educational goal by the most direct method possible (the development of knowledge, skills, and attitudes); for some students, a more circuitous route must be taken (the development of strategies to circumvent a learning difficulty). It is the professional responsibility of the teacher to decide which option is preferable for every student with learning difficulties, keeping in mind that learning by all students is the long-term universal goal in any classroom.

There are four main points of agreement in all of the research on the use of memory-enhancing strategies. First, it is good for all learners; no student will be harmed by direct instruction in strategy use. Every student has the opportunity to benefit from discovering that the process of remembering is not a magical process available only to capable students. Second, effective strategy use always links new learning to prior knowledge in a meaningful and relevant way; it is critical to remember, as a teacher, that the meaning must connect to the students' frame of reference. Third, the goal of all strategy instruction is the eventual generation and use of strategies independently by students; most students will need direct instruction,

guided practice and feedback to achieve this goal. Finally, and maybe most importantly, is the fact that the use of good memory strategies frees up the working capacities of students so they have the energy to deal with the "big ideas" of learning, rather than with isolated and disconnected facts. A good memory is not an end in itself; it can be thought of as a toolbox to facilitate the building of higher order thinking skills.

General principles for improving memory or "Tools for the Toolbox"

- Increase attention. One cannot learn what one did not pay attention to in the first place! Some suggestions for strategies to increase student attention are outlined starting on page 110.
- Use an external memory system for some memory tasks; decide which tasks are not worth the time and energy necessary to utilize mental memory strategies. In those cases, write things down or use an environmental cue.
- Enhance meaningfulness. The higher the relevance and connection to students' lives and prior knowledge, the higher the likelihood that the learning will be retained over time. The higher the number of connections that are made between "new" learning and

"old" learning, the more likely the new learning will be stored in multiple networks, which increases the chances of its retrieval at appropriate times.

- Use a multi-modal approach. The use of visual, auditory and kinaesthetic modes enhances learning. It is believed that the chances of retrieving information at a later date are proportional to the number of ways that the information was received and processed. When information is presented in auditory, visual, movement and print channels, learning is maximized (Petterson, 1995; Sylwester, 1995).
- Minimize interference. Avoid digressions when studying new information. Concentrate on the critical and essential features of a new topic, so as not to overwhelm students. Ensure all examples used are correct, now and for the future. One striking example of a non-instance is telling primary math students that you cannot take a big number from a small number, which is incorrect at an algebraic level.
- Promote active manipulation. Ensure students are doing more than just listening; manipulation of objects, vocabulary and ideas strengthens the neural connections necessary for good memory development.

- Promote active reasoning. Have students actively process new material to ensure consolidation with prior knowledge and the formation of new memory pathways.
- Inform students of the rationale behind learning new material, and the rationale for strategy use. The student must be familiar with the purpose and rationale for using any strategy; knowledge of "what" and "why" is often crucial to learning "how" to do something (Kail, 1990).
- Provide instruction. The majority of students require direct instruction in how to implement any strategy; this stage needs to be very transparent with no "mystery" left in the student's mind, as to either methodology or effectiveness. Direct instruction, modeling, practice, timely feedback and evaluation are crucial steps in any learning process.
- Increase the amount of practice and rehearsal. The learner also needs explicit instruction about instances of use (e.g., when is this strategy effective?) and non-instances of use (e.g., when should I select an alternative strategy?), practice and immediate feedback on performance (Kail, 1990).

- Give positive reinforcement. Concentrate on growth and progress. Learning success needs to be directly related to, or attributed to, strategy usage and learner actions in order to foster future strategy usage on an independent level by the student.
- Use visual associations, as they are often more effective than semantic associations in isolation (Higbee, 1977). This fact makes intuitive sense, since humans have only possessed the faculty of language for a small percentage of our time on this earth. However, the cardinal rule of memory is "the more ways the information is processed, the higher the chances of retrieval"; the use of visual, semantic and any other modalities in the encoding process assists the learner.
- Integrate action and motion into the visual associations between items to be learned and the mnemonic hook. Mere proximity of visual elements is not sufficient. There must be interaction between the different aspects of the visual scene; research indicates that active visualizations produce better retention and retrieval rates than do static visualizations. The images must be strong, clear and detailed. When forming visualizations, motion of some

of the elements, substitution or inversion of elements, or exaggeration of size or distinguishing characteristics can help to reinforce the image in the learner's mind by processing the essential elements of the visualization (Higbee, 1977).

- Provide a safe and secure learning environment for every student. Emotion is critical to the memory process. If a child is experiencing negative emotions, such as worry, anger or fear, then part of that student's working memory is occupied by those intrusive thoughts; therefore, less capacity can be devoted to learning at any given time (O'Neil, 1998).
- Provide a variety of opportunities and prompt levels to develop independent strategy use and generation in students. In educational settings, those strategies which are personalized (e.g., developing one's own mnemonic cues, etc) are more effective in remembering but are significantly less time efficient than when the cues are given externally (Mastropieri, Scruggs, & Levin, 1985; Sharifian, 2001). Maintaining a balance between time efficiency (external prompts) and process efficiency (remembering due to one's own efforts) is one requirement of a teacher as a professional. The age of the learner is crucial to determining the

balancing point in the level of internal or external prompts; the younger the child, the more external the strategy usage and direction that is required.

- Remember that a valuable educational dictum is to "ask hard questions about easy material"; this allows the student to develop process skills without getting bogged down in the content (Cuasay, 1992).
- There is a direct relationship between the primary teaching method employed and the average level of student retention over a 24-hour period. Although the lecture method is popular in classrooms, it is not an efficient method to promote long-term student retention; on average, only 5% of new material is recalled one day after its introduction (Sousa, 2001a). This is primarily because the lecture method involves little or no active student participation and rehearsal. The most efficient method to ensure information recall is to prepare to teach the information to another person; this method results in a 90% retention rate over a 24-hour period. Please see Appendix E for a graphic representation of Sousa's learning pyramid.

Memory Strategies

Memory strategies can be classified as general (covering a variety of subject and grade levels) or as specific (to a subject or grade level). The following memory strategies have been organized from the general to the specific. The general strategies are transferable across many learning situations, and tend to be more philosophical and global in nature. There are five categories of general strategies: Mnemonics, Associative, Visual, Auditory, and Temporal/Environmental. The specific strategies are subject related, and can be adapted quickly for classroom use; the three categories of specific strategies are Reading, Spelling and Mathematics. There is certainly some overlap between the various categories; it is possible the author's categorization may not correlate with the reader's categorization.

General Memory Strategies

Mnemonic strategies.

The term "mnemonic" is derived from the Greek goddess of memory, *Mnemosyne*. A mnemonic strategy is one that organizes information in a way that it is likely to be remembered (Wolfe, 2001a). A mnemonic strategy is a systematic procedure for encoding information so that it will be easier to retrieve, or remember; retrieval routes

are systematically integrated into the learning of the content (Mastropieri and Scruggs, 1998; Scruggs and Mastropieri, 1992). They have been proven over time to be effective learning strategies (Bellezza, 1987), even though they may appear to be mere "tricks". Their novelty appeals to students, while at the same time they reinforce the principles of good learning (organizing and processing information so that it can be retrieved when necessary). In effect, mnemonics give the brain the associations and links that are necessary for retention of new information, by creating a selective focus for encoding and retrieval (Mastropieri, Scruggs, & Levin, 1987).

There are three distinct steps in teaching students how to use mnemonic strategies. First, the student has, or more likely is given, a framework for remembering. Then the student is taught how to associate new learning with the internalized framework. Finally, cues in the framework or the environment aid the learner in recalling the information (Pressley, Forrest-Pressley, Elliott-Faust, & Miller, 1985).

Keyword strategy: This strategy is useful in the acquisition of second language vocabulary, primary language vocabulary, prose, specific locations on a map and content areas. It is useful in any associative task, in which two

pieces of information (e.g., a vocabulary word and its definition) are required learning (Higbee, 1977). This strategy creates a semantically meaningful connection between old learning and new learning; it creates a concrete proxy for the unfamiliar, often abstract, new term, which is then shown interacting with the definition in a meaningful, and hopefully memorable, situation (Uberti, Scruggs, & Mastropieri, 2003). This method has proven to be effective with students with learning and/or language disabilities (Scruggs and Mastropieri, 1992) and to enable students to perform with higher levels of recall and comprehension (Mastropieri and Scruggs, 1990). The two keywords need to be linked in some meaningful way; this is one case in which "bizarre" may work to the learner's advantage. For example, to remember the definition of 'allegation', think of a man, Al, pulling another man's leg, yelling "I know you are guilty". This visualization demonstrates the meaning of the term and incorporates two or more disparate elements interacting with each other. Another example is the word 'carline", an old English word for 'witch'. The keyword would be 'car', and the visual image would include a car, with a witch as its driver, driving down the line on the road. It is a good rule of thumb, if using this strategy, to use the first keyword

that comes to mind; it is also likely the first word that will come to mind during the retrieval phase, thus increasing the chances of a successful memory.

There are eight general steps involved in the use of the keyword strategy:

1. Pick the salient detail(s) to be remembered from the new information.
2. Access an appropriate concrete word from one's personal lexicon.
3. Generate an image involving the keyword.
4. Generate and retrieve the visual image.
5. Combine the new image with the salient details to be remembered in an interactive form.
6. Utilize an environmental cue.
7. Associate the constructed image with the environmental cue.
8. Respond with the required information.

The first five steps correlate with the storage and encoding phases of memory development, and the last three steps correlate with the retrieval phase (Turnure & Lane, 1987).

ITFITS strategy: When learning new vocabulary and definitions, this strategy gives the learner specific steps, in mnemonic form, to follow to ensure retention of

the new learning. This strategy is directly related to the keyword strategy (as outlined previously), but it is represented by an acronym.

I - Identify the term to be learned.

T - Tell the definition of the term in your own words.

F - Find a keyword that you can easily associate with the new term.

I - Imagine the keyword and the definition interacting.

T - Think about the definition and the keyword.

S - Study the association until retrieval becomes automatic (Mastropieri & Scruggs, 1998).

Method of loci: There are two distinct stages in the implementation of this strategy. First, memorize a series of spots or loci in a familiar environment; practice the sequence of encountering these loci until you have overlearned them to the automatic stage. Next, associate the items to be remembered with the loci in your familiar location. When you have a list of things to remember, mentally place each item to be remembered at one location on your mental tour (Higbee, 1977). For example, to remember the three memory systems (sensory, working and long-term), using the first three loci on my personal map (walking up the driveway, walking up the steps on the front

porch, opening the front door), I would make the following associations: the concrete driveway feels rough (feeling is a sense), and thus the driveway is associated with sensory memory; it requires work to walk up stairs, so the stairs are associated with working memory; the front door has been on the house for a long time, so it can be associated with long-term memory. To remember the three memory systems, my mind would take a "mental walk" through my loci, make the connections, and remember the required information. This strategy can also be used in a novel study, by placing each character on a location (loci) on one's personal map; to enhance comprehension, each character can be visualized interacting with that location in a way consistent with his/her story behaviours (Kelly, 1994).

Peg word strategy: This strategy is good for remembering lists of items. The learner develops a list of digits and rhyming words; these lists are easy to remember because they mirror the childhood song of "The Ants Are Marching" and the nursery rhyme "One, Two, Buckle My Shoe". The exact rhymes are not important, but consistent pairings are crucial. One suggestion for a list is:

one - bun

two - shoe

three - tree

four - door

five - hive

six - sticks

seven - heaven

eight - gate

nine - line

ten - hen.

To memorize a list of information, the learner actively integrates the list to be remembered with the list of peg words; the peg words serve as "hooks" or mental pegs on which the information to be remembered is hung. For example, to remember that Brazil's exports are rubber, sugar, gold, diamonds and coffee, the learner would associate each of those exports with a peg word in an active visualization. Rubber and bun could be visualized as a rubber bun bouncing down the street, sugar and shoe could be visualized as a shoe overflowing with sugar, gold and tree could be visualized as golden apples falling from the tree, diamonds and door could be associated with a diamond doorknob glittering on the door, and coffee and hive could be associated with little bees taking a coffee break in the hive. Although these associations seem nonsensical, they will be memorable if there is a strong visual image with either movement or interaction between the elements.

This strategy can be used in conjunction with the keyword strategy, or any other strategy, for more complex memory tasks. As well, the use of colour in the visualization process can add complexity and memorability to the mnemonic.

This strategy has the obvious disadvantage of being limited to ten items. To extend the capability of this strategy to twenty items, a separate visual is made, dependent upon the digit in the ones place. 1_1_ is a pencil, 1_2_ is the neck of a swan, 1_3_ is the tines on a pitchfork, 1_4_ is the bases on a baseball diamond, 1_5_ is the fingers on one hand, 1_6_ is a half dozen eggs, 1_7_ is represented by the days of the week on a calendar, 1_8_ is represented by octopus legs, 1_9_ is the number of baseball players on the field, while _20_ is comprised of all fingers and toes. It will be noted that the first ten associations utilize rhyming (auditory) cues, while the second ten employ visual cues (Higbee, 1977).

Link system: This strategy works especially well with lists of things to be remembered. Link the first two items on the list visually and actively. Then link items two and three together with active and visual connections. Continue to do this, linking each two successive items in the list. During

the recall phase, remembering item one will trigger remembering item two, and so on until the list is complete.

Narrative link system: This technique is similar to the above link system, but the items to be remembered are embedded into a narrative story; the flow of the story allows the learner to progressively move through the information. This strategy works well with information that has separate ordered parts, such as learning the provinces and capitals from the west coast to the east coast, lists of names, the important parts of speeches, major events in novels, or any serial learning task. Visualization strategies can be incorporated effectively into this strategy.

Narrative chaining: To embed facts, use a story structure. This strategy depends upon the learner's familiarity and proficiency with narrative story structure, so it may not be the strategy of choice for every student. This strategy is effective with sequential information or historical information. The effectiveness of this strategy is time-tested, as a common student perception is that the best history teachers are the best storytellers; they take a seemingly disparate and infinite number of facts and dates and weave them into a compelling narrative. To remember this information, the learner simply needs to replay the

story in his/her mind, relying on his/her prior knowledge of how stories work.

Reduction mnemonics: These include the use of acronyms and acrostics, both techniques in which large bodies of information are condensed into easily remembered sequences of letters or sentences. Some common acrostics and acronyms are:

- To remember the five Great Lakes, remember the word HOMES (Huron, Ontario, Michigan, Erie and Superior). To remember the lakes from west to east orientation, remember Sam's Horse Must Eat Oats.
- For biological classification of living things, remember Kind Pigs Only Care For Good Slop to remember Kingdom, Phylum, Order, Class, Family, Genus and Species. Alternatively, the mnemonic sentences King Philip Came Over For Good Soup, King Philip Came Over For Grandma's Spaghetti and Kids Prefer Cheese Over Fried Green Spinach also act as acrostic memory aids.
- To remember the order of operations in a mathematical equation, remember BEDMAS (Brackets, Exponents, Division, Multiplication, Addition, and Subtraction).
- To remember the order of colours in the spectrum remember Roy G. Biv or ROYGBIV (Red, Orange, Yellow, Green, Blue, Indigo, and Violet).

- To remember the order that sharps are entered in the key signature, remember Frederick Charles Goes Down And Ends Battle (F, C, G, D, A, E and B; reverse the order for entering flats into the key signature).
- To remember the order of metric prefixes from largest to smallest, remember King Henry Doesn't Mind Drinking Cold Milk (Kilo-, Hecto-, Deca-, Measure (unit of measure, e.g., gram, meter, litre), Deci-, Centi-, and Milli-.)
- To remember the spaces on the treble clef, remember FACE, and to remember the lines, remember Every Good Boy Deserves Fudge (E G B D and F); both of these mnemonics work from the bottom of the staff to the top.
- To remember the order of the planets, from the sun outward, remember My Very Excellent Mother Just Served Us Nine Pizzas for Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto.
- To remember Roman numerals, first have the students look at the pattern of the "marker" numbers: 1 (no zero), 5 (no zero), 10 (1, one zero), 50 (5, one zero), 100 (1, two zeros), 500 (5, two zeros) and 1000 (1, three zeros). The first three Roman numerals can be remembered as I Vant Xrays (especially if said in a

Count Dracula type voice). The next four in the series are represented by Lucy Can't Drink Milk. It is then easy to remember that 1=I, 5=V, 10=X, 50=L, 100=C, 500=D, and 1000=M.

- To remember which ancient philosopher influenced which other philosopher(s), think of Socrates, Plato and Aristotle sitting in a SPA together. Socrates was born first (469 B.C.), Plato was born next (428 B.C.) and Aristotle was born last (384 B.C.).
- Although this is not strictly an acronym, it does rely on letter clues within the vocabulary word; stalactites are stuck to the ceiling, while stalagmites are stuck to the ground.

Rhyming: Integrating information to be learned into rhyming form is effective because if one forgets the information or gets it wrong, one merely needs to start the rhyme again. As well, each line is an auditory cue for the next line (Sousa, 2001b). Some common rhymes are:

- To remember the number of days in each month, a familiar rhyme can be utilized:

  "Thirty days hath September,
  April, June and November,
  All the rest have thirty-one,

Except poor February alone with twenty-eight days clear

Or twenty-nine in each Leap Year."

- To remember the fate of Henry VIII's six wives, use the rhyme,

"Divorced, beheaded, died;

Divorced, beheaded, survived."

- To remember the rule for dividing by fractions, use the rhyme,

"The number you are dividing by,

Turn upside down and multiply."

- To remember the safe order of combining water and acid, use the rhyme,

"May her rest be long and placid,

She added water to acid,

The other girl did what she oughter,

She added the acid to the water."

Mnemeric strategies: This strategy may be helpful for remembering dates of important events; mnemeric refers to mnemonics dealing with numbers. Having a concrete strategy to remember abstract dates may help students to free up some working capacity, so that they can deal with the bigger issues, such as cause and effect, ramifications of certain actions, temporal comparisons, etc. This method is

a combination of the keyword, peg word and method of loci strategies. There are three settings for each date. The century setting incorporates people who would be stereotypical of that century: the 1700's are represented by royalty, the 1800's by a cowboy, and the 1900's by an astronaut. Associations could be generated for other centuries, as long as human representations are provided for each time period (to ensure continuity in the visualization). The decade setting incorporates the months of the year, with a visual representing each month. The digit 0 is represented by December (Christmas), 1 by January (New Year's baby or party), 2 by February (Valentine's Day theme), 3 by March (St. Patrick's Day theme), 4 by April (umbrella and rain theme), 5 by May (flowers and spring growth), 6 by June (end of school symbolized by report card or graduation mortarboard), 7 by July (Canada Day theme), 8 by August (swimming pool) and 9 by September (autumn theme). The year setting is symbolized by the one-is-a-bun peg word method (Hwang & Levin, 2002). To remember that 1867 was the year that Canada became a country, the student would visualize a cowboy (1800) walking out of school holding a report card (June as the sixth month) looking up to heaven (the peg word for seven is heaven), celebrating the birth of Canada (possibly with

a cartoon balloon saying "Happy Birthday, Canada"). Although this method seems cumbersome, it does add concrete elements to a concept that may otherwise seem abstract or inconsequential to students.

Another method for remembering numbers such as dates or numerical values involves attaching a sentence with a specific number of words with specific numbers of letters in each word. For example, to remember that William Shakespeare was born in 1564, one could remember the phrase "I wrote Hamlet well", in which the number of letters in the first word correlate with the first numeral, the number in the second word correlate with the second numeral, etc. Using the above example of 1867 as the beginning of Canada, one could remember the phrase "I remember Canada fondly" to remember Canada's date of Confederation.

The above strategy works well with any number that a student may be required to memorize. The number pi can be remembered with the phrase "How I wish I could calculate pi", 3.141592.

Stop, look, listen, link and write strategy: Many people have trouble remembering the names of new people that they have met. One theory is that most of us are so nervous, worrying about what we will say next, that our working memory is too overloaded to remember a name after an

introduction. One strategy for overcoming this problem is to initiate the above strategy when meeting new people, allowing the working memory to process the new information and move it into long-term memory storage. The steps are:

- Stop and focus on the other person and what they are saying, rather than on the fear of forgetting the name.
- Look for distinguishing characteristics of the person that you can visually associate with the person's name. If the person has a nametag, read the name several times; this activates the visual memory as well.
- Listen and concentrate on hearing the name correctly. Ask for clarification if you are not sure; asking the correct spelling of the name can add another dimension for retrieval.
- Link the person's name with another piece of salient information, such as any distinguishing characteristics or unusual spellings. Make this an interactive image in your mind.
- Write; this step is optional. Carry a small notebook to copy down important information about each person that you meet, including the time and location of your meeting (Kelly, 1994).

Although this may seem like a strange addition to a manual on school strategies, there are students who have a difficult time remembering other students' names, or the names of adults in the school. This strategy, or a variation, may be effective for these students to recall names of people in their school environment. For younger students, a visual mnemonic could be constructed representing the above five steps (stop symbolized by a stop sign, look symbolized as eyes, listen symbolized by ears, link symbolized by a chain link, and write symbolized by a pencil). This five-step mnemonic could be utilized in a variety of learning situations, and not solely for remembering names.

Associative memory strategies.

Metaphor and analogy use: Both of these strategies compare new and unfamiliar information to prior learning and knowledge, or the familiar (Sousa, 2001a). They are effective when the information to be learned is either too abstract or too complex to comprehend easily. A metaphor uses a word, phrase, object or concept to suggest a comparison with another object or concept; for example, "life is a journey, not a destination". An example of a powerful learning metaphor is the "If The World Were A

Village of 100 People" project. It is difficult to comprehend that six billion people inhabit our world and the magnitude of the implications of inequality in various regions of the world; however, if one uses the metaphor of a village of 100 people to represent the world population and demographics, it is much easier to understand the global situation.

An analogy compares a partial similarity between two dissimilar objects or between a concept and an object. A sieve could be used as an analogy for the sensory memory, since the sensory memory's function is to "strain" out irrelevant data and pass on relevant sensory input to the working memory; although many people might not be familiar with memory systems, most people would understand the function of a sieve, thus creating a connection. Although these are powerful learning tools, it is essential to ensure that the metaphor or analogy is accurate enough that faulty or inaccurate learning does not occur, and to ensure that the analogy or metaphor will be meaningful to your students (having meaning to you as a teacher is not sufficient).

Verbal and written elaboration: Verbal elaborations enable students to process and link new information more fully by increasing the associative learning that takes place.

Answering elaboration questions, posed by the teacher, a peer or oneself, forces the student to process these elaborations or connections with increased semantic depth. It is important to give students adequate response time. When expected to complete complex thinking tasks, students need enough time (possibly fifteen to twenty seconds) to process the question, retrieve the appropriate information from working memory and/or long-term memory, make connections and associations, and then verbalize the answer to the original question. It seems like a large task for the second or two that most teachers allot for wait time. As a matter of fact, Kline (1995) states that teachers answer about two-thirds of their own questions!

Paraphrasing is an effective rehearsal strategy. Paraphrasing requires the learner to selectively focus on the most important information, reconfigure and restate the new learning in his/her own words, or personal lexicon, in the context of his/her prior personal learning. Accurate verbal paraphrasing allows the student the opportunity to take in the information, process it cognitively, and personalize it. It also has the distinct advantage of utilizing the auditory modality; it affords the student the chance to "hear" him/herself think, possibly leading to

clarification and expansion of the student's original understandings.

Written paraphrasing affords the student the same opportunities as verbal paraphrasing, except that it augments the processing depth and breadth by adding a tactile or kinaesthetic modality, rather than the verbal modality. However, for some "self-talkers", the auditory modality may still be there as they "talk themselves through" the writing process. Written paraphrasing does not mean taking notes off the board; note taking is a visual-motor activity, utilizing fine motor control and near point-far point transcription skills. Written paraphrasing involves the students taking information from one or several sources (auditory, such as a lecture, or visual, such as a textbook) and portraying their learning through a variety of means on paper. Two-sided notes, semantic maps, charts, graphs and illustrations are all means through which students can demonstrate their depth and breadth of learning. For further information on this technique, refer to the section on Visual Organizers on page 56.

Exit cards are another method for students to succinctly state their understanding and learning of a topic. This strategy can be used as a quick assessment of student learning, or it can be used to help students learn

how to distill new learning down to the basic, or essential, understandings. Each student is given an index card shortly before the end of the class; as its name implies, a student cannot exit from the classroom without completing a card. There are several ways for students to demonstrate their learning on these cards. One common method is the "3-2-1" strategy, in which the teacher gives the student the following framework (or a variation, depending on the age of the students, and the topic of study):

On your card, list:

- The 3 most important facts you need to know/have learned about this topic.
- 2 ways that this new information relates to past learning.
- 1 important question that you have that hasn't been answered yet.

A variation on the above strategy involves the students answering three generic questions:

1. What did I learn today that relates to [the specific outcome or topic of study]?
2. How does this new learning connect to or relate to what I already know about [the specific outcome or topic of study]?

3. How can this new and old learning help me in the future?

Alternatively, the students can be instructed to use only one side of the card, and ensuring that it is legible without a magnifying glass, write about (or illustrate through graphics, diagrams, or charts) the new learning. Since space is limited, it should be stressed that the important and essential information must be communicated first, and that details and interesting facts can only be accommodated if there is sufficient space.

The above strategy is effective for several reasons. It is an activity that is designed to give students the time and the forum to process new learning, which research indicates is essential for long-term retention. It allows the student to personalize and rearrange the new learning, in the context of prior learning and understanding. Finally, a well-designed exit activity allows the student to focus on relationships and patterns, to relate new learning with old learning, and to predict potential avenues of use for the new information. There is an educational adage that "the best learners are those people who ask the best questions"; this strategy affords learners the opportunity to develop and practice this skill as well.

There are many other ways for students to paraphrase and reformat their learning: information that needs to be remembered can be reinforced through conversations, debates, role-playing, simulations, games, activities, films, or novels. Often valuable learning at teacher conferences happens around the coffee table at break time, as teachers take the opportunity to participate in professional conversations; teaching students how to conduct learning conversations could be a valuable use of both student and teacher instructional time. Debates give students the chance to examine both sides of an issue, as well as the opportunity to develop prediction skills (in order to argue against the opposing view successfully) and succinct, precise verbalization skills. Role-playing and simulations afford students the opportunity to mentally enter another environment or mindset, enlarging their viewpoints of the world and its inhabitants.

Questioning techniques and strategies: There is no shortage of research and information on effective questioning strategy use in the classroom; there is a plethora of information available in any academic library for those teachers who wish to enhance their knowledge and skills in this area of pedagogy. The following strategies are a small sample of available strategies that may enable students to

develop stronger discussion skills, and thus provide stronger memory pathways, in the classroom.

1. Always phrase questions in the classroom with respect to the desired learning outcomes, rather than with respect to the learning activities completed in the classroom. For true learning to have occurred, the student must be able to relate learning to the "big idea" of the topic of study, rather than limiting his/her understanding to the specifics of the activity. This questioning focus allows the student to demonstrate understanding of the underlying concepts and their relationships, rather than demonstrating rote regurgitation of the activity alone (Sousa, 2001a).
2. When questioning students, use a variety of vocabulary terms and phrases; this provides the learners with a bank of cues to stimulate retrieval. Some students may need a very transparent process when hearing interchangeable vocabulary; for example, many elementary students do not equate the terms "subtraction", "minus", and "take away" with a wide variety of verbs indicating removal (ate, lost, gave away, spent, etc.) of items. These students need to repeatedly hear a variety of synonyms with respect to

subtraction, both to cognitively equate the terms and to develop a variety of retrieval paths in long-term memory (Sousa, 2001b).

3. Practicing teachers know that asking questions in the classroom is a very tricky balancing act. Open-ended questions promote the best learning, through generation and identification of relationships; however, for some students, open-ended questions are too nebulous to answer, and therefore anxiety producing. However, some students' thinking processes will be severely limited if the questions are too narrow, and valuable learning opportunities may be missed. The perfect mix of questions would involve several levels of specificity with a variety of synonymous terms, focused on enabling students to generate meaningful understandings of the topic of study; questioning in the classroom is truly a professional, and extremely difficult, undertaking.

Chunking: The use of chunking can subsume a large number of information items at one time. This technique increases the processing capability of an individual's working memory by relating "chunks" of information, rather than individual items, to each other and to prior knowledge in a meaningful way (Cuasay, 1992). As the size of each chunk increases,

the more the learner can remember. As mentioned before, the average learner can remember approximately 7 plus or minus 2 chunks (hence the origin of seven digit phone numbers). It is theorized that experts in a field, because of their experience and practice, organize information into bigger chunks, while novices, because of their lack of prior knowledge and connections, tend to remember isolated bits of information (Sousa, 2001a).

Students can be taught to chunk information based on categorization, similar properties such as colour, size, shape or texture, functions, origins or definitions. To return to the memory system example (p. 31), it is easier to remember the various elements in each of the three memory systems if one chunks, or adds details, to each of the systems. The long-term memory system is comprised of both declarative and procedural subsystems; rather than trying to remember these three items separately (as three chunks of information), it helps to chunk them together so that they are remembered as one larger chunk of information. This leaves a greater functional capacity available either to remember the other two memory systems (sensory and working) or to remember the various types of procedural and declarative memory types.

Students have the opportunity to chunk information constantly at school. Telephone numbers, locker combinations and computer game patterns (commonly referred to as "cheats" in the computer gaming world) are all examples of chunking information for better retention and recall. Common spelling patterns are often chunked. Rather than remembering the common spelling pattern "t-i-o-n" as four separate pieces of information, it is more efficient and effective to remember it as the sound "shun", while saying the four letters quickly (almost as one word). This technique reduces the capacity requirements from four M spaces to one M space. Students also chunk sound groupings together when reading, especially multi-syllabic words; rather than reading "retrieval" as nine separate decoding chunks, a good reader will chunk the word into re/triev/al or three chunks. Jennings (2000) states that poorer readers, the readers who do not chunk words while decoding, have forgotten the first part of a long word by the time they have reached the end of the word. Understandably, decoding, reading and comprehending text are very difficult processes for some readers.

Cumulative rehearsal: This strategy works well with information that needs to be remembered exactly as it was presented, such as memorizing a poem. This strategy

involves breaking the information that is to be remembered into distinct parts. Rehearse and practice the first part; when you are proficient with the first part, rehearse and practice the second part, making sure that you are reviewing the first part that was memorized. When you are comfortable with the first two parts, continue with the third, reviewing the first two parts. Continue in this manner until the whole of the information has been committed to memory.

Visual memory strategies.

Journal writing: Well-crafted journal activities are very valuable in educational settings; they allow students the forum to think, question and express new learning and thoughts, recognize patterns, compare and contrast ideas, discover relationships and discrepancies, and keep track of the breadth and scope of their learning. Research does show that drawing and writing about a topic helps to fix that experience and information in a student's long-term memory (Hammond, 2002). However, in order to make this strategy a valuable learning experience, several recommendations are suggested:

- Model effective journal keeping by writing in a journal yourself. Talk to your students about how you

go about keeping a journal, what problems you have encountered and how it has aided your learning.

- Develop your class's rules for journaling with your students. Your rules may be as simple as "Everyone must write for five minutes a day."
- Write the "everyday" journal entries from the back to the front of the journal. For those "big ideas" or insights, work from the front to the back. Your journal is complete when the two sections meet in the middle; it is then time to start Volume Two.
- To stimulate writing, have a selection of "starter activities" to get past the anxiety of starting on an empty page. The students can frame their page with a design of their own creation; alternatively, they can trace a shape several times on the page, and then write their entry within the outlines of the tracings, or use one of an unlimited number of creative beginning points. Creating a starter activity that correlates with the topic of the entry or is a novel approach may help to motivate reluctant writers.
- Invite, but do not mandate, students to share their journal entries with their peers.
- Discuss metacognitive journal questions with the class, possibly using your own journal as a reference.

Some sample questions could include "Has my journal helped me to think more flexibly, fluently and/or creatively?", "Have I taken any risks in my journal writing?" and "What do I like most (least) about my journal?"

Visual organizers: Visual organizers assist students to organize information into a meaningful visual whole. There are several forms that have proven effective in the classroom:

- A flow chart is helpful for visualizing each step of a process, such as math processes, steps in experiments, how a bill is enacted into law, etc. In a standard flow chart, each step is written, using only key words and phrases, in a rectangle with an arrow pointing to the next step (also written in a rectangle form with key words). Each decision to be made is written in a diamond, with two arrows extending from it. Depending on the outcome of the decision, one arrow will lead to the next step, while the other arrow leads to a different step (rectangle) or back to an earlier step in the process. The entire process is written from start to finish using a series of rectangles, diamonds and arrows (software programs, such as Inspirations or

Kidspirations assist in the development of many of these visual organizers).

- Organizational charts such as T-charts are helpful for information that needs to be classified into categories, such as biological groupings. Students can create these charts or tables using a word processing program on the computer.
- Mind maps or semantic maps organize information with the main idea in the center circle, with topics and supporting details radiating out from the center. If any of the supporting details have more than one connection, it is simple to make those connections by drawing lines between any connected ideas; this is an effective way to demonstrate interconnectedness to students.
- Visual chains are simple flow charts, with each step drawn as a single image with an arrow leading to the next image. This technique is good for simple or circular processes, such as events in nature or chemical reactions.
- Fishbone charts are graphic representations of the "backbone", or main idea, with "ribs", or supporting details, attached. One could become more creative by

listing the topic or questions being studied in the form of a "fish head".

Use of colour and shape in these visual organizers may assist some students to encode the information in a more meaningful form.

Interactive written organizers: Interactive written organizers give students the opportunity to process and consolidate information in a combined text and graphic form.

- Interactive notebooks are regular notebooks on which the two facing pages are dedicated to the same topic; the right side deals with input and the left side deals with output. On the right page, the student takes notes from an external source, such as a textbook or teacher-given notes. On the left page, the student then reprocesses this information into a graphic or different textual form; this is the place for students to process the new content. Some suggested activities on the left side include personal reaction, summary, cartoons, semantic maps, poems, metaphors or illustrations (Wolfe, 2001a).
- The Write and Draw method of processing information involves a graphic (an outline of a head works well, symbolizing the brain, or a topical graphic can be

used) which is divided down the middle. On one side of the graphic, the student writes the pertinent information about the topic of study; on the other side, the student then puts the same information into graphic, rather than semantic, form. Both of the above methods afford the students the opportunity to process and consolidate new information in a variety of forms (Wolfe, 2001a).

Intelligent flash cards: A series of flash cards is constructed around a central theme; on an index card, a key word or question is written on one side, and the target information or responses are written on the other side. The information on the second side should be limited to five to nine items (related to M space), and supplemented with visuals, shapes and colours. When studying, the student chooses five to nine cards to study at one time. When those cards are mastered, a second group of five to nine cards is studied; a review of the first group is conducted, and if any information is forgotten, that card is placed in the second group for relearning. Continue in this fashion, grouping and regrouping the cards, until the information is mastered (Tunstall, 2001b).

B/D reversals: Every primary teacher has dealt with the "b/d" reversal problem. Children spend many hours, in

environmental learning, figuring out that a chair is a chair is a chair, regardless of its orientation in space; an upside down chair is still a chair. Then we seemingly change the rules, because a backward "d" is not still a "d". It is understandable that some younger students cannot remember the orientation of letters; not only is a specialized set of rules being applied, but it is happening in a very abstract symbol-based learning situation. The following strategies have proven effective with this academic problem:

- The word "bed" may be a visual reminder for some students, as they are familiar with the concept of a bed. The letter "b" comes before "d" when one says the alphabet, a fact that most primary students have mastered. Using the bed analogy, the "b" comes first, and is the "pillow by the headboard", the "e" acts as the mattress, and the "d" acts as the "foot rest and footboard".
- The student can form the letters "b" and "d" with his/her thumbs, forefingers and middle fingers in alphabetical order from the left hand to the right hand. If one forms a loop with the forefinger and thumb on each hand, and then has the middle finger (and possible the other two as well) stand straight

up, the student has formed the letters "b" (left hand) and "d" (right hand).

- An auditory mnemonic hook for distinguishing "b" and "d" has also proven effective. Even if a student has difficulty visually discriminating between the two letters, he/she can probably generate the sounds of the two letters. The letter "b" is formed by making a back first, and then a big fat belly (form the stick first and then the circle); this can be demonstrated physically by the teacher or students (be careful of your orientation to the students if demonstrating this). The letter "d" is equated with opening a door; first one touches the doorknob and then one opens the door (form the circle first, followed by the straight line).
- Use of the b/d ruler has been suggested by various occupational therapists; this strategy, like the "bed" strategy, tends to work better for visual learners. The student is given a rectangle of firm cardboard, with the longer sides running from top to bottom. On the left side of the rectangle, there is a "d" with lines demarcating the size of the letter to be made; to form a "d" the student holds the cardboard where the "d" is to be printed, and forms the stick of the

letter. Without removing the cardboard, the student finishes the circle; there is only one place for the circle, resulting in perfect "d". The right side of the cardboard has the letter "b"; the student places the "b" side of the cardboard in the desired position, makes the stick on the letter, and adds the circle. If using this strategy, be aware that it does confuse some students because the two letters are not in alphabetical order (i.e., the "d" comes before the "b" on the card). N.B. Even though this strategy is very specific to one topic, the ability to form correct letters is a visual discrimination task and as such, was included in the section on visual memory strategies. Please see Appendix F for a visual representation of a b/d ruler.

Auditory memory strategies.

For those students with auditory comprehension or short-term auditory deficits, there is a variety of approaches that may prove effective.

Classroom Directions: To enhance the effectiveness of auditory classroom directions, have the students repeat the direction quietly or silently to themselves, to a peer or to an available adult. The physical act of pulling the content of the direction from working memory and rehearsing

it stimulates accurate recall of the information. In an elementary classroom, setting up "direction pairs" of students with complementary skills may be an effective technique to increase the listening efficiency of younger students; each student rehearses with the other student in the pair, and each student then has an accessible "helper" in the case of confusion.

Clarification of a verbal message: If a student asks for clarification of oral messages, the teacher must be cognizant that there are two main reasons for this difficulty in processing; the student can have a weak auditory working memory or the student may have auditory processing delays or difficulties. If the student has a weak auditory short-term memory, the teacher must be careful to repeat the message verbatim; if any of the vocabulary is changed, it is possible that the student will not equate the two verbal messages as being the same, and this will lead to further confusion. However, if the student has difficulty processing auditory information, repeating the message verbatim will not aid in comprehension; if the message was not comprehensible the first time, it likely will not be on any subsequent repetition. For these students, paraphrasing the message and segmenting it into meaningful chunks may aid in

auditory comprehension. Many students with auditory discrimination problems are not formally diagnosed, so it may be difficult for the classroom teacher to decide on the appropriate technique. A general rule of thumb is to repeat the message verbatim the first time, and then paraphrase the content of the message in the second repetition; this should cover both eventualities with a minimum of mislearning (Tunstall, 2001a).

Auditory processing time: To allow students more auditory processing time, use a slower rate of speech (without distorting any of the sounds or words), lengthen the pauses between significant phrases, and group meaningful word units.

Eye contact: If culturally appropriate, establish eye contact with students. Explain that their "eyes are helping their ears" to understand and process the verbal message.

Actor method: Use the "actor method" when talking to students; face the students directly, and avoid dropping the volume of your voice at the end of an utterance.

Dealing with "Huh?": If a student is unsure of the verbal message, have the student verbalize what he/she thinks was said, and then augment or correct the message. Often students ask for repetition after receiving a verbal message because they are not sure of what was said, and do

not want to make a mistake or appear foolish. Building on what was processed correctly will enable the student to develop more sophisticated listening strategies, and hopefully alleviate maladaptive strategy use on the part of the student. Some students are habituated to respond to a verbalization with the response "Huh?"; providing alternative viable responses will reduce the frustration levels of adults and students alike.

Asking questions: Keep your questions simple, avoiding lengthy multi-phrased questions. Students may forget part of an involved question, due to the primacy-recency effect (see page 73); simplification and conciseness when questioning will certainly assist some students.

Gestures: Use gestures when speaking to accentuate the important information or key words. As well, changing the inflection, volume and tone of the voice helps students to identify the crucial vocabulary in the message, and to determine if the verbalization is a statement or a question.

Student "tune out": If a student continuously receives messages that are too involved or too complex to comprehend, it is highly likely that the student will "tune out" because there will be no advantage to listening.

Multiple-choice approach: Use the multiple-choice approach in helping students to remember messages. If a student needs a message clarified, a question ("Are you supposed to hand in your math book or your library book?") will often assist the student to complete the required activity. This approach narrows the field of options for the student, but still requires the student to complete some processing and comprehending of verbal information.

Quiet environment: Some students need a quiet environment with little or no competing input. This may be practically impossible in a classroom environment; headphones may help to block out competing noise, although they will also block out the teacher's voice.

Complexity of oral language: Gauge the complexity of your utterances based on the complexity of the student's language. If a student cannot produce complex sentences, do not assume that he/she can understand them when heard, especially in a classroom setting.

Speech and auditory memory: As a rule of thumb, there is a proportional relationship between a person's speech rate and the auditory memory span (Johnston and Anderson, 1998). The average student can retain in working memory the amount of information that he/she can verbalize in approximately two seconds. For those students who speak slowly, it is

possible that they cannot retain as much information in working memory as can those students who speak more quickly.

Self-talk: Teach students to self-verbalize as they work through academic problems. They can self-talk quietly so that there is a minimum of distraction and disturbance to neighbouring students. This strategy enables students to verbalize the information and to hear it; accessing two processing modes increases both memory and processing capabilities. Some common self-talk strategies include "First I need to.... Then I need to..."" until the separate steps in a task are completed, and asking oneself "What does this mean? Does it make sense?"

Younger learners benefit from hearing themselves read or pronounce words. An effective technique involves the use of PVC pipe plumbing elbows; their size is ideal for younger students to use as "telephones" while reading. The student places one end of the elbow on his/her ear and the other end by his/her mouth; when he/she reads or speaks aloud, the tube conducts the sound directly to the student's ear, enabling the student to hear him/herself clearly. This technique also reduces the distracting effects of classroom noise for the reader.

Temporal and environmental strategies.

Collegiality: Only in classrooms are individuals expected to find every answer, solve every problem, complete every task and pass every test in a solitary manner; this working environment is not representative of many real-life adult working situations. Research has demonstrated that approximately 40% of our student population learns best by working alone or in a traditional teacher-led classroom with little or no collegiality (Kline, 1995). This means that more than half of our students would be better served by having collegial learning opportunities on a regular basis (Kline, 1995). However, collegial learning situations are not synonymous with "free-for-alls"; students need to learn the rationale, the rules and the learning expectations for any collegial learning situation. The behaviours that the teacher wants to see must be modeled, reinforced, maintained and valued when demonstrated. The educational adage "If you expect to see it, expect to teach it" is appropriate.

Wait time: Wait time is crucial for processing of new information. Wait at least five seconds before asking a student for a verbal elaboration; this strategy has three advantages educationally. First, some students are slower to process information, so this gives them the chance to

finish processing the information before moving on to the next topic or question. As well, during this wait time, the information is being held in the student's working memory for a longer period of time, leading to further processing and higher levels of retention. Most importantly, it is a time consuming process to retrieve pertinent information from long-term memory, reprocess it in light of new learning, and then formulate a response; if we as teachers wish to foster complex thinking, adequate time must be allotted for students to complete these complex intellectual tasks (Pressley & Bryant, 1982; Sylwester, 2000).

Rehearsal Schedule: The ideal learning pattern, with respect to brain research on processing time, consists of the following steps:

- immediate rehearsal upon presentation of new information
- elaborative rehearsal approximately ten minutes later
- review approximately one hour later
- a short review after 24 hours; research also demonstrates that REM sleep cycles are times that new information is "locked" into the brain and that sleep is crucial for memory development
- a short review about one week later

- a short review about one month later.

In mnemonic terms, this is an easy cycle for teachers to memorize. Immediate (now and in ten minutes; you notice that the capital I on Immediate looks like the numeral 1), 1 hour, 1 day, 1 week and 1 month rehearsal schedules give your students the chance to increase their retention from about 22% in a traditional "teach and move on" situation to about 88% in a situation with structured review and elaboration (Kline, 1995).

To minimize mislearning of similar concepts: Research shows that inaccurate learning can occur when two similar concepts are taught concurrently (Carnine, 1998). Since the brain categorizes new information on the principle of sameness, similar concepts presented at the same time can be incorrectly categorized; educational "scrambling" can occur with some students. Teachers have observed this phenomenon when teaching latitude and longitude (even when using a mnemonic to talk about the "long" lines in longitude) or the concepts of perimeter, area and volume. To eliminate or minimize this mislearning, the following general guidelines can be followed:

- Separate the introduction of the similar concepts over time. Stress the visual discriminants of each of the concepts; this should take precedence over the

auditory discriminants. Demonstrate how they look different rather than talking about how they are different.

- Highlight the differences between the concepts.
- Select examples that do not have unintended samenesses. These examples must be unambiguous and very clear.
- Select examples that show unintended samenesses, and demonstrate why they do not follow the rules and why they should be rejected as good samples.
- After a period of time, teach the second similar concept. Review the learning of the first concept, stressing essential characteristics of the first concept. Teach the second concept, stressing how it is different from its counterpart, and then give examples and non-examples (Carnine, 1998; Sousa, 2001a).

Pulsed learning: A pulsed learning schedule, alternating between periods of focused activity followed by a more diffuse, less structured activity, follows the natural rhythms of the brain (Fitzgerald, 1996). According to Eric Jensen (1998), the period of focused learning should not be too long; a rule of thumb is to add two minutes to the age of the learner, to a maximum of 25 minutes, to obtain the maximum number of minutes that typical learners can benefit

from intensive learning activities. The less structured activity times are not "free time" but should be time allotted to students to personalize their learning through discussion, writing, reformatting, or direct manipulation of the new ideas. This may be thought of as "instructional down time" but certainly not as "learning down time" (Fitzgerald, 1996).

Informal test of long term storage: Research shows that the majority (70-90%) of new learning is lost within one day. If new learning survives this critical period, it is probably destined for long-term storage (Sousa, 2001a). To test for retention, while still giving the students time to consolidate and process the new information, administer a short test 24 hours after the learning has occurred. Be careful to test precisely the information that needs to be retained, and that there is no forewarning of the students. If students review right before the test, they are utilizing working memory, and not long-term memory, when completing the test; therefore, you will not be assessing long-term retention. This approach is not punitive, as may be the connotation of a "surprise quiz", and should not be used as a classroom management technique. This strategy could assist students to self-evaluate their own learning, or to provide direction for the teacher about the possible

need for reteaching or review of the concept. Being transparent with your students helps them to understand the rationale behind your occasional pop quizzes (Sousa, 2001a).

Primacy-recency effect: This has also been referred to as the beginning-end-middle effect. As learners, we tend to remember best what was presented at the beginning of the learning session (primacy), and we remember second best what was presented at the end of the learning session (recency). Information presented in the middle of the session tends to be remembered the least effectively; the middle section of a learning session is, in effect, a "down time" for effective learning (Fitzgerald, 1996; Jensen, 1998; Sousa, 2001a). Brain research indicates that there is a very good reason for this phenomenon; the first few items of information presented are well within the learner's M space of 7 plus or minus two 2 chunks, so it is retained. However, while the learner is processing and rehearsing this new information, the middle part of the lesson is lost as the learner has used up most of his/her functional learning capacity, and has no more working memory capacity remaining to deal with additional information. The information that is presented last is encoded by the working memory because the first chunks of information have

been sorted, processed and stored; there is now M space available again for those last pieces of information.

This phenomenon has tremendous implications for teaching and learning schedules. In a typical 40-minute period of learning, the first ten minutes and the last five minutes tend to be the most productive times; learning efficiency and effectiveness decrease steadily after the first ten minutes until it increases again for the last few minutes. New information should be presented within the first ten minutes of learner focus on the teacher, and then closure should take advantage of its powerful position in the learning schedule. The central "down time" activities should center around practice and review, or other processing activities.

There are several events that should NOT happen during either of these two most productive learning times. Often the first part of any class is consumed by organizational tasks, such as collecting homework, hot dog money, agendas etc; by the time the learning should start, the class is in the central "learning abyss". As well, information that is provided during this time is the information that tends to stick in the learners' brains, which is not advantageous if the information is erroneous. A prime learning time is not the time for brainstorming activities, since many of the

contributions are based on what the students think they know, and their contributions may or may not be factual; this is a prime time for mislearning to occur, if erroneous beliefs are presented during the brainstorming. As well, a class is often rewarded for hard work by getting the last five minutes as free time; prime learning time is then being devoted to a non-educational activity (Sousa, 2001a).

To remember prospective tasks: To remember to do something in the future, such as bringing art supplies from home, there are effective strategies other than writing a note to oneself. Choose an object that you often notice and that you expect to see in a certain spot, such as a watch. Move your watch from one wrist to the other slowly, while you recite the one thing that you wish to remember to do. Every time during the day that you notice your watch in the "wrong" place, remember what you need to do; at this stage, talking quietly to yourself may help to reinforce that memory. This technique is effective if used occasionally or if different objects are used as memory cues. If you consistently use this strategy with the same memory aid, it will lose its novelty effect, and thus its effectiveness (Tunstall, 2001b). Students could employ a variety of memory aids, such as wearing a hat backwards, putting a small stone in a pocket, or untucking a shirt (or

alternatively, tucking it in, if that goes against convention).

Subject Specific Strategies

Reading strategies.

Theorists and researchers on the development of viable reading strategies have published a vast number of resources outlining information, strategies and theory on this topic. The following is a very small sample of some strategies that may prove useful in a classroom with those students whom the teacher suspects, or knows, are experiencing difficulties with the reading process because of memory difficulties.

Phonemic chunking: Keeping in mind that the working memory is only efficient with approximately seven chunks of information at any given time, teachers of reading must teach students to meaningfully group phonemic chunks of sounds. For example, the word "information" has eleven letters, far exceeding most learners' M space capacity. However, when one "chunks" the word into meaningful sound units (these do not necessarily need to be traditionally correct syllables, as long as they do not impede the decoding process), the learner now needs to remember four sound units (in/form/a/tion). Ideally, the learner can capably handle processing these four units of information,

collating them into an intelligible whole. Poorer readers have often forgotten the beginning of the word by the time they have decoded the end of the word, as the number of individual information units exceeds the available M space capacity (Jennings, 2000).

Eyes and ears: The "eyes and ears" strategy has been successfully used in remedial reading classes by the author. Two students pair up to read a selected text. One student acts as the "eyes", reading the text on the page, while the other student acts as the "ears", listening to the text that is read by the "eyes". The "ears" do not look at the text; auditory clues are the focus of attention for the "ears". When the "eyes" partner encounters an unfamiliar or undecodable word, the "ears" contributes possibilities, based on the context and semantics of the passage. Then both the "eyes" and "ears" confirm the veracity of the prediction; if it is correct, they continue reading, but if the offered word is incorrect, they continue to offer suggestions until the correct vocabulary word is determined. The two partners change positions, so that each partner has the opportunity to develop a variety of skill sets inherent in the reading process. Research on M space offers an insight as to why this strategy is successful with some students. While the "eyes" are

reading, comprehending and decoding text, it is likely that the working capacity is being overloaded (Neil, 1998); the capacity of the "ears" partner is not being overloaded by text demands, so that partner has adequate working capacity available to solve the riddle of "What word would make sense in this passage?". Not every student in a classroom requires the use of this strategy, but for those students who are so overwhelmed by text decoding that their comprehension suffers, this may be a viable approach.

Reciprocal reading pairs: Reciprocal reading partners have also proven successful in fostering comprehension and retention of written material (Palincsar & Brown, 1984). When using this technique, a student-student or student-teacher pair processes text reciprocally. Each partner takes a turn leading a dialogue about the text, following reading of the text. The key activities in this strategy revolve around generating summaries of the material being read, developing questions on the text (concentrating on the "big ideas" in the text), clarifying any areas of confusion, and predicting. This discussion format allows the student to clarify any misconceptions, relate new learning to past learning and to personally interpret and consolidate the new learning, all crucial elements for long-term retention. This happens, in part, because the

learner has the opportunity, through the discussion format, to bring information constantly into the working memory, where it is relearned; the more often the information is actively brought into the working memory, the higher the chances of permanent retention (Palincsar & Brown, 1984).

Lip reading: Many students move their lips when reading independently. John (1993) postulates that some students derive specific benefits from "lip reading". This approach may serve to give the reader additional channels of encoding; there is a tactile, or kinaesthetic, avenue through muscle movement, but there may also be access to the auditory channel as well, as the reader can "hear" the reading in his/her mind.

Building a sight word bank: An adequate sight word bank is a necessary precondition for students to begin using both decoding and contextual strategies when encountering unfamiliar words in a reading passage. The sound-symbol connection is a rather abstract tenuous connection for some beginning readers. The addition of concrete rehearsal and retrieval cues provides another avenue of encoding for these beginning readers. The 4Blocks program and the Animated Literacy program both do an excellent job of adding visual, auditory and kinaesthetic elements to the

task of reading (both of these programs are copyrighted, and commercially available).

These elements can be added to the reading program without purchasing commercial materials. Sight word hopscotch can be used either indoors or outdoors. Sidewalk chalk and a hopscotch frame are used outdoors to make a rehearsal grid for those common sight words; the student needs to read the word each time he/she lands on that square. Hopscotch grids can be marked off in the classroom with masking tape or onto large sheets of plastic. If using plastic sheets, the words can be printed right on the plastic; if using the floor, the words can be written right on the floor tiles with erasable markers. A variation on this strategy is to have a sight word walk constructed with masking tape or chalk squares on the ground, and the sight words written in each of the squares. The students walk around the path, practicing the words; the words can be written on sheets of paper or manila tag for this activity, and then the order of word presentation can be changed.

Individual word rings have also been effective with younger readers. Each student has a metal shower ring with colour-coded vocabulary words; words can be colour-coded according to theme or holiday, or by whether they are "memorizers" (definite sight words like "does", "said" and

"could") or if they are "sounder-outers" (words that can be decoded phonetically). Each time the student reads the words on the ring to an older person (this can be a good reading activity with younger readers and older student tutors), he/she receives a stamp or a check mark on that word card. After a predetermined number of checks or stamps, the student gets to remove the word from the ring, as he/she has demonstrated mastery. It is very motivating for students to remove the words, and to watch the number of words on their ring decrease as their sight word reading competence increases.

To remember story events: Define the gist or main idea of the story read or heard to date; this can be done independently, with student partners, or with an adult assisting an individual. Distill the whole text down to its significant parts or the main events. Sequence the story events either chronologically (most usual) or by their level of importance to the story line. Index the story with "mental cue cards", visualizing each main story event in an active manner. Research shows that interaction between elements of a visualization help the individual to recall the image more accurately (Higbee, 1977). Tell the story to another person; if the teller has missed significant story events, or has recalled them inaccurately, a discussion can

take place at this time. One option for assisting the teller is to give the teller some recall cues, such as "What happened after [story event} and before [story event]?" or "What about [keyword of missing event]?" Extend or amplify the story, by making predictions for future events, by ascribing motivations to certain character's actions, or by inferring character traits based on the characters' actions. It may be beneficial for some learners to make visual cue cards, outlining story events in order. It may also be beneficial for those students with comprehension difficulties to recap the narrative after reading only short passages, rather than after an entire chapter (Sylwester, 1995).

Verbal rehearsal when reading: After reading a short passage, the student stops and talks to him/herself about what has been read; quiet self-talk seems to be the most effective, as the student can "hear" him/herself think, engaging two modalities at the same time. Alternatively, the student can be instructed to run a "movie" in his/her head about what has been read. This technique is not as effective as verbalizing (possibly because it is such an internal activity that the student receives no feedback about the veracity of the visualization), but when used in

conjunction with self-talk, it has been proven to enhance memory and comprehension (Rose, Cundick, & Higbee, 1983).

Letter-Sound Correlations: Sound symbol correlations can be very abstract and intangible for some beginning readers. To reinforce the common sounds for each letter in the alphabet, the following visual, auditory and kinaesthetic cues have proven successful (note that the visual configuration of each letter is correlated to the sound of each letter, and not its name):

a - the "crying" letter. Every time it opens its mouth, it cries "aaaaa" (its mouth is the top part of the letter "a" in a traditional typeface).

b - you see the back first, and then the big fat belly (see the section on b/d reversals on page 59).

c - the "cookie" letter. C started out as an entire cookie, but it was so delicious, that you had to take a bite out of it, leaving the "c" shape.

d - to open the door, you must touch the doorknob first, and then the door opens (see the section on b/d reversals on page 59). The cues for "b" and "d" are one way for the students to both distinguish and form these two very confusing letters.

e - the "smiling elephant" letter. If you grin as widely as you can, and breathe out of your mouth, the short

"e" sound comes out (many younger children have a very difficult time distinguishing between the short "e" and short "i" sounds; this is one cue that may help them to produce the correct sound).

f - the "finger" letter. If you bend your left pointer finger, and cross it with your right pointer finger, you have just made an "f".

g - the gorilla letter. A smiling gorilla face can be drawn in the circular part of the "g", and then the gorilla's tail helps it to hang from the trees (this is a case of teaching misinformation, since gorillas do not have tails, but the author has not found a suitable replacement for this cue).

h - the "tired" letter. Place a chair at the front of the class, ensuring that it is oriented in the shape of an "h" according to the students' perspective. Take turns being very tired, and flopping down into the "tired chair" saying the "tired sound" of "h" (as in the initial sound of horse).

i - the "pig" letter. If you push up the end of your nose into a pig snout and breathe out through your mouth, you make the short "i" sound. This approach helps the students to differentiate between the short "e" and "i" sounds; this sound is easier to make than the "e" sound, so

students may distinguish this sound first and then move to the short "e" sound after a suitable period of time.

j - the "jumping" letter. It jumps on its foot that goes below the line.

k - the "kicking" letter. This is a magical letter that can kick both its feet at the same time.

l - the "lazy" letter. It just stands around all day, doing nothing, but it does stand up straight.

m - the "delicious" letter. A lower case "m" when drawn with an ice cream cone below it looks like a double scoop cone, which is, of course, delicious, leading to the production of the "mmm" sound.

n - the "nose" letter. If you bend over at the waist, to touch your nose to the ground, you look like an "n".

o - the "spoiled" letter. Young children love this sound, because they get to put their hands on their hips, stomp their feet, and make the short "o" sound (for an extended period of time, at least a few seconds).

p - the "puff" of air sound. This one can be extended so the students are "puffing" pink and purple plumes (extending vocabulary) away from their faces. They can also feel the puff of air on the palm of their hands if held in front of their faces.

q - the "not so brave" letter. It will not go anywhere without its very best friend, the "u". The "q" is "quite quiet" especially around the "queen" (this is not a strong relationship; "q" is not encountered very often by younger readers so they have some developmental time to develop this particular sound-symbol association).

r - to "rev" up the engine on a car, you put your foot on the gas and the car makes the "r" sound.

s - the "snake" letter, that looks and sounds like a snake.

t - the "telephone" pole letter. This is getting less relevant to students since most wiring is underground, but they can see the "t" shaped poles and wires on the highway. You cannot make a "telephone" call without the letter "t", because there would be no wires to connect you with the other person (with the exception of cellular phones).

u - the "tummy" letter. If you gently push your tummy right below the sternum, the only sound you can make is the short "u" sound (students often confuse the short "o" and "u" sounds auditorially; this gives them a way to distinguish between the two).

v - the "valentine" letter. If you add two semi-circles to the top of a "v", you have a valentine heart.

w - the "water" letter. The letter "w" can hold water; it can hold hot water in one side and cold water in the other.

x - the "kissing" letter. If you say the word "kiss" as fast as possible, you have just made the sound that the kissing letter makes.

y - the "yawning" letter. It is at the end of the alphabet, so it gets very tired waiting for its turn. It looks up at the ceiling, opens its mouth, and yawns very widely, making the "y" sound.

z - the "buzzing bee" sound. As a bee travels from flower to flower, in a "z" pattern, it buzzes happily because it is gathering nectar to make honey.

Regardless of the system that is used to relate the sounds and symbols of the alphabet, the students will progress through definite stages of capability. At first, the teacher will need to provide complete prompts; then the level of prompts can be reduced to a key word or an action, and finally the students should be using their own internal prompts when encountering print (Jensen, 1998).

Spelling strategies.

The skill of spelling accesses the visual memory, while phonemic processing accesses the auditory memory (Jennings, 2000; Tunstall, 2001b). There are several

strategies and manipulatives that can be incorporated into the spelling program to develop effective spelling skills.

The OAR strategy: The OAR strategy is an acronym for:

- Observe the word, using as many senses as possible.
- Associate the word with its meaning.
- Review the correct spelling of the word frequently.

The See Say Cover Write Check strategy: Another rehearsal strategy for spelling vocabulary is the five-step See Say Cover Write Check approach. Each word is written on a card; the first letter is written in green (to start the word), the middle letters are written in black, except for exceptional letters or combinations that are written in a personal colour choice, and the last letter is written in red (to stop the word). The student looks at the card, noting the colour and letter combinations; some students may find it helpful to look at the card in either the upper left or right corner of their visual fields. The student concentrates on imprinting the visual look of the word in the "blackboard of the mind" while closing his/her eyes. While reading the mental blackboard, the student says the letters of the word both forward and backward, checking the card. The student then covers the card, writes the word and checks it against the master card. When the word is mastered, the student then proceeds to another word, being

careful to review the first word at some point in the study time.

Alternate spelling practice materials: Spelling practice using pencil and paper can become very tedious to students. It is very daunting to correct written work; erasing and rewriting is very frustrating and overwhelming to many students. There are other strategies that are more fun (because they are novel) and less overwhelming; they also involve kinaesthetic and tactile processing channels, which can lead to improved retention.

- Gel bags are an effective and economical way to practice spelling vocabulary. Buy a large container of inexpensive brightly coloured hair gel. Pour some of this gel in a zippered plastic bag and press the air out of the bag; close the bag up, ensuring it is very well sealed. The students can then practice spelling words or math facts by using this bag in the same way as a "magic slate"; they use their fingers to "write" on the bag, and then can erase their answers by smoothing the bag. The same effect can be attained by using a combination of cornstarch, water and tempera paint, mixed to a gel-like consistency.
- Sandpaper letters are an effective tactile reinforcement for learning spelling combinations. A

selection of lower and upper case letters can be cut out of sandpaper, and then arranged when spelling words; the student can trace the letters in each spelling word, feeling the texture of the letters. A work experience student or parent volunteer could complete this task; be careful that the letters are reversed when traced on the back of the sandpaper. Alternatively, each student could be given a sheet of sandpaper, and "write" their spelling words on the paper using their "pointer finger pen".

- Line the inside of a shoebox lid with bright or fluorescent paper, gluing it down securely. Pour salt into the lid, making a thin layer. The student can then write spelling words or math problems in the lid using his/her "pointer finger pen"; the writing stands out against the bright background. The student shakes the lid to erase the work, and the lid is ready to use again. Short grain rice also works with this technique; avoid solids such as flour, as they tend to become air-borne too easily, and can cause respiratory difficulties with some students. When the student is finished with this activity, he/she can carefully dump the rice or salt back into the shoebox and place the lid on top.

- Younger students love the "Flip your Lid" strategy. Each student gets an ice cream pail lid, flipped upside down, an erasable marker and an old sock (placed on the non-dominant hand). The student writes on the lid with the marker, holds the lid up for teacher confirmation (the "Flip your Lid" section of the activity), and then erases the work with the socked hand. This strategy works well with any drill activities that students complete in a classroom; it has the advantages of being fun and novel, as well as drastically reducing paper usage.

Spelling mnemonics: Specific spelling mnemonics are very useful for students, especially for those words that require some form of memorization because they do not follow any obvious phonetic rules. Some mnemonics that have proven successful with students are:

- friend -a friend to the end
- 'i' before 'e' except after 'c', and when saying 'a' as in neighbour and weigh, and weird is just plain weird!
- separate- There once was a young man named Sep who was terribly afraid of rodents, especially rats. One day the neighbourhood bully sneaked up behind him and yelled "Sep a rat!" and of course, Sep yelled "eeee".

- believe- the word believe has a lie in it, so don't believe it!
- necessary- it is necessary to wear 1 collar and 2 socks to be completely dressed
- grammar- bad grammar will mar the meaning of a sentence
- cemetery- she screamed "e e e" as she ran past the cemetery
- great - ice cream is great to eat
- grate - there is a rat in my grate
- dessert - we have strawberry shortcake for dessert; Dessert is bigger in the middle than the desert - you will be too if you eat too much dessert. Alternatively, everyone wants two helpings of dessert, but no one wants to go to the desert more than one time!
- when two vowels go walking, the first one does the talking (and the second vowel is shy, saying nothing)
- Miss Pell never misspells
- stationery goes in envelopes; stationary just hangs around, doing nothing
- to spell loose rather than lose, remember "loose as a goose"

- to spell the word petal, remember "I am allergic to animals, so my pet Al is a flower"
- to spell the word attendance, remember that you dance into (or maybe out of) school every day
- to remember that there is more than one "r" in the word terrific, remember Tony the Tiger saying "Terrrrrrrrrrific"
- the word possesses possesses five s's
- the word tendency has rhyming syllables, i.e., ten and den, and not ten and dan
- the principal is your pal
- February and Wednesday are much easier to spell if you say them incorrectly to yourself, emphasizing the traditional trouble spots (i.e., Feb-roo-ary and Wed-nes-day)
- the leaves fall off the tree in autumn; there is a bucket on either side of the tree to catch the leaves
- you hear with your ear; here doesn't listen
- you see here in there, so they are both places; they're is short for they are; and their is the odd man out
- too has too many o's; the number two has three letters (odd, don't you think?); and to is the odd man out

Spelling to song: To remember how to spell a variety of words, oral spelling practice can be set to music; the most effective spelling mnemonics are tunes with which students are already familiar. For example, six letter words can be sung to the tune of "Happy Birthday" (M E M O R Y, sung four times), seven letter words to the tune of "Twinkle, Twinkle Little Star" (S T U D E N T, sung four times), and five letter words to the tune of "You Are My Sunshine" (L E A R N, sung eight times; gauge the number of repetitions on the needs of the students). Integrating movement (hand clapping, hip swaying, etc.) further strengthens these connections (Wolfe, 2001a).

Mathematical strategies.

Sine, Cosine and Tangent: the acronym SOH CAH TOA helps students remember that Sine = Opposite over Hypotenuse, Cosine = Adjacent over Hypotenuse, and Tangent = Opposite over Adjacent. Another mnemonic for these geometric relationships is:

One ancient teacher (opposite/adjacent = tangent)

Of history swore (opposite/hypotenuse = sine)

At his class (adjacent/hypotenuse = cosine).

Perimeter, Area and Volume: Students consistently confuse these three measurements. To distinguish between them, and to remember the units of measurement (in terms of exponents

and what is actually being measured), the following strategy has been helpful. Perimeter is defined as the distance a mouse runs around a figure; this mouse only runs in one direction so the distance or perimeter is measured in units with no exponents. Another mnemonic hook for the mouse/perimeter connection is the first syllable of the word perimeter; the syllable "per" can be phonetically spelled "purr", symbolizing a cat chasing the mouse around the perimeter of the figure. The word "area" has four letters in it, as does the word "tile". When computing the area of a shape, you are figuring out how many tiles would cover that shape; since tiles have two dimensions (length and width), the unit of measurement needs an exponent of 2. Volume is defined as filling up a room with sound when you turn up your stereo to the maximum volume; since the sound goes up, out and side-to-side (in three directions, to fill the room), the unit of measurement has an exponent of 3. The cue words for recall then are mouse (for perimeter), tile (for area) and stereo (for volume). Often these three concepts are taught sequentially, one after the other, in a unit on measurement; it might be wise to reconsider separating the instruction into three separate time periods, with other topics interspersed (see p. 70 re teaching similar concepts).

Multiplication Facts: Give each student a 10×10 array (for the facts from 0 to 9) or an 11×11 array (for the facts from 0 to 10), with the answers filled in; it is time-efficient, and more importantly, it ensures that the students are learning the correct number combinations. Have the students figure out how many multiplication facts they need to learn; then discuss why it is impossible to memorize either 100 or 121 separate pieces of information. Discuss the difference between rows (running from side to side, or horizontal) and columns (running from top to bottom, or vertical). Have the students select either a row or a column of facts that they already know, or can figure out quickly. They should recognize that if a column is eliminated, the corresponding row can also be eliminated. Give each student a highlighter to colour in the known facts. The following rows and columns can be highlighted:

- 0, because all numbers times 0 equal 0
- 1, because all numbers times 1 equal themselves
- 2, because they can skip count by 2s very quickly to figure out any 2 fact
- 5, because they can skip count by 5s very quickly to figure out any 5 fact
- 9, because there is a finger math exercise to compute any 9 fact quickly. Have the students lay their hands

on the desk, with their palms facing down. Then, going in the same direction as they read, have them number (mentally, or with erasable marker) their fingers from 1 on the left to 10 on the right. When figuring out any 9 fact, take the number that is not 9 and curl that corresponding finger under (e.g., in the equation 7 × 9 =__, curl the seventh finger under); the number of fingers to the left of the curled finger represents the number of tens, while all fingers to the right of the curled finger represent the ones. Have the students practice this technique, and then highlight both the 9 row and the 9 column.

- 10, because any number times 10 is that number with a 0 on the end.

At this point, have the students figure out how many facts are remaining; although the number has decreased, there are still too many facts left to memorize effectively. Then start systematically eliminating single facts, and their twins (those with reverse or commutative order). The following facts have mnemonic aids to help remember them:

- the sequential facts - 12 3 4 and 56 7 8 (12 = 3 × 4 and 56 = 7 × 8). This eliminates 3 × 4, 4 × 3, 7 × 8, and 8 × 7 from the list of facts to be memorized.

- the rhyming facts – these are the 6 × (even number) facts. 6 × 4 = 24, 6 × 6 = 36, and 6 × 8 = 48 are all facts that rhyme when you chant them; it helps to get the students to sway their hips or get another motion involved when saying these facts. The students can now eliminate 6 × 4 = 24, 4 × 6 = 24, 6 × 6 = 36, 6 × 8 = 48, and 8 × 6 = 48 from their list of prospective memorizers.

This leaves only ten facts to be memorized (3 × 3 = 9, 3 × 6 = 18, 3 × 7 = 21, 3 × 8 = 24, 4 × 4 = 16, 4 × 7 = 28, 4 × 8 = 32, 6 × 7 = 42, 7 × 7 = 49, and 8 × 8 = 64).

Long division: To remember the multitude of steps when performing long division, have the students write the following acronym at the top of the page, DMSL. D stands for Divide the number on the side (divisor) into the first one or two digits in the number to be divided (dividend) and put the answer (quotient) on top of the division sign. Then Multiply the divisor by the quotient, and put the answer under the dividend. Subtract those numbers, and bring down the Lonely number waiting next in line. Start the process over again, and keep going until there are no more lonely numbers to bring down. Another mnemonic is the "family strategy" when doing long division; Dad (Divide), Mom (Multiply), Sister (Subtract) and Brother (Bring down).

It is important to note that the terms quotient, divisor and dividend may not necessarily be used with the students while teaching, although the use of these terms is included as a learning objective in the Program of Studies for math; they are used here to describe the process.

Two Digit by Two Digit Multiplication: To eliminate directionality problems, these kinds of problems are the "bow tie" problems. For example, in the problem

$$\begin{array}{r} 78 \\ \times 35 \\ \hline \end{array}$$

the student would draw a line from the 5 to the 8, multiply the two digits, and then draw a line from the 5 to the 7, multiplying those two digits and adding any tens to be carried. Then the student would draw the other half of the bow tie, by starting with a line from the 3 to the 8, multiplying those two digits, and finishing with a line from the 3 to the 7. This strategy does not eliminate the problem of multiplying and carrying, but it does give the student a sense of which two digits to multiply in which order.

Operations involving positive and negative integers: This always seems to be an area of confusion for students, especially when subtracting a negative, or multiplying two negative numbers. One strategy involves using the analogy

of the Wild West town; the good guys are positive (+) while the bad guys are negative (-). Coming to town is always a good thing (+) while leaving the town is always a bad thing (-). When the good guys come to town (++), that is good (+); when the bad guys come to town (-+), that is bad (-). However, when the good guys leave town (+-), that is also bad (-), but when the bad guys leave town (--), that is good (+).

Another method for adding and subtracting positive and negative numbers is to use pennies. Heads are positive while tails are negative; a head always cancels out a tail. To demonstrate adding two positive numbers, e.g., 7 + 2, there are 7 heads + 2 heads = 9 heads or +9. To demonstrate adding a positive and negative number together, e.g., 7 + (-2), there are 7 heads and 2 tails; 2 heads are cancelled out by the 2 tails, so the answer is +5. To demonstrate subtracting a negative from a positive, e.g., 7 - (-2) there are 7 heads, but there are no tails to subtract; we know that a tail cancels out a head, so we can add two head-tail pairs to the equation, without changing the value. When the 2 tails are subtracted, there are 9 heads (+9) left. To demonstrate subtracting a negative from a negative number, e.g., -7 - (-2), start with 7 tails and subtract 2 tails, leaving 5 tails or -5.

Printing numbers: Numbers are very abstract symbols to many young learners, even though they may be very familiar with the amount signified by the number; a child may be able to count objects to 9 without being able to form the number 9 using a paper and pencil. The following rhymes have been used successfully in kindergarten to give a structure for number formation:

Number 1 is like a stick
A straight line down
It's very quick!

Number 2 goes around and down
And then make a line
Across the ground!

Go right around,
What will it be?
Go around again,
It's number 3!

Go straight down
Make a corner square,
Add a straight line
And a 4 is there!

Fall down the well,

Look around, you are alive

Put a lid on top

It's number 5!

A curve and a loop

There are no tricks

When learning to make

A number 6!

Across the sky

And down from heaven

That's the way

To make a 7!

Make an S and do not wait

Go back up

And close the gate

That's the way to make an 8!

A circle first

And then a line

They have to touch

To make a 9!

It's number 10

You have them all

Make a stick

Beside a ball!

When the rhymes are introduced to the students, they will need practice with both the rhymes and the number formation; some students may even require hand-over-hand assistance from an adult. It is important to ensure that the students are equating the rhyme with the correct action. With practice over time, the frequency and completeness of external cues can be decreased.

Binomial multiplication: Using the FOIL acronym may help students keep the steps straight when performing (a + b) × (c + d) operations. Multiply the two First terms (a × c), the two Outer terms (a × d), the two Inner terms (b × c) and the two Last terms (b × d). Using this strategy eliminates the opportunity to either skip or repeat any of the factor multiplication pairs.

Attention

Background Information

Fischler (1998) defined attention as a limited mental resource that can be allocated to various cognitive tasks. Petterson (1995) defined attention as mental preparedness and receptiveness, while Sylwester (2000) defined the

concept as a complex cognitive system that selects or temporarily focuses on key elements in a potentially confusing environment. An individual's attention helps that individual to maintain goal directed behaviours despite distractions. Most importantly in a school setting, attention can be affected by experience and educational interventions; this fact does give hope to teachers that their actions can influence the attention levels of their students.

Many individuals, teachers included, automatically associate the terms "attention" or "inattention" with Attention Deficit Disorder (ADD) or Attention Deficit/Hyperactivity Disorder (ADHD). It is essential to remember that both of these conditions are medical concerns; their effects are seen, often dramatically, in the educational world, but the ultimate responsibility for diagnosis and treatment lies with trained medical personnel. For the purposes of this document, the concept of attention will be limited to those issues of attention encountered by any teacher in any classroom with any group of students, and not just those students formally diagnosed with attention deficits.

Contrary to popular belief, it is impossible not to be paying attention; the human brain is always paying

attention to something, a valuable survival strategy over the course of human evolution (Jensen, 1998). In an educational context, paying attention is often related to externally focused attention (on the teacher or assigned work) rather than internally focused attention; it is possible that the students that teachers perceive as "paying attention" have merely achieved a higher level of congruity between teacher expectations and their present focus of attention.

There are three separate functional systems that regulate the attention process:

- The alerting, or vigilance system requires mental energy to suppress attention to incoming irrelevant or unimportant sensory stimuli from the environment, while maintaining sustained focus on important and relevant sensory input. Major environmental distractions may lead to an emotional arousal, which activates the orienting system, leading to a new focus of attention.
- The orienting system establishes selective attention by disengaging attention from a previous focus, and focusing on a new target. In general, attention is shifted to emotionally arousing events, or those events that sharply contrast with the current focus.

It acts as an internal spotlight, surveying the diverse sensory input arriving in the brain. The vigilance and orienting systems are inverse operations; the vigilance system focuses on a specific target, while the orienting system scans the environmental stimuli for any other potential targets of attention.

- The executive control system is dependent upon memory of past experiences to recognize the identity of the new target of attention (the foreground), distinguish its importance and separate it from the background sensory input, which is then monitored for other significant changes, or ignored if judged to be irrelevant. This system determines the significance of incoming sensory stimuli, based on previous experience and learning. This is essentially an unconscious process, except for those times in which we are confronted with an entirely novel experience; at these times, the executive control system may consciously respond by accessing the working memory. The working memory acts as a buffer to briefly attend to and hold units of information necessary for deciding on an appropriate action (Jensen, 1998; Swanson et al., 1998).

These three systems act in unison as a zoom lens, zooming in to identify and examine details in the foreground, and zooming out to scan the context or background, while assigning relative importance to a variety of sensory stimuli (Swanson et al., 1998; Sylwester, 2000). It is generally an unconscious process, although it can become a conscious process. It has been estimated that the average person decides, either consciously or unconsciously, approximately 100 000 times per day where to focus attention (Jensen, 1998). However, it is always an effortful process, especially for those students who are not naturally predisposed to pay attention to prescribed outside stimuli (the teacher or assignments) in the classroom.

Research indicates that the attention centers are located throughout the brain; there is therefore no specific attention control center in the brain (Wolfe, 2001a). Contrasts of movement, sounds and emotion consume the majority of our attention as human beings; however, the attention centers in the human brain are also susceptible to habituation, or the tendency to ignore that which has become familiar or expected. This fact has tremendous educational implications; while novelty consumes our attention, and works in the classroom to gain students'

attention, novelty soon becomes commonplace if used repetitively, and therefore ceases to become novel and attention getting.

Sylwester (1995) asserts that a crucial educational premise is that emotion drives attention, which in turn, drives learning. Adding an emotional component to teaching and learning is one of the most effective ways of securing students' attention. The brain is biologically programmed to attend first to information with strong emotional content; the brain also remembers this information longer. As teachers, one of our most important tasks may be creating that emotional "hook" for our students to become fully involved with their learning.

There are several facts about attention that are critical for every classroom teacher to know. First, paying attention requires mental energy and effort, and every human has a limited fund of this mental energy. Secondly, if the human brain cannot make sense of incoming stimuli, it will pay attention for only a finite amount of time; paying attention to something that is incomprehensible is boring and impossible to sustain for extended periods. Human beings have not survived for thousands of years by paying attention to meaningless information. In class, we, as teachers, often expect students to identify the

appropriate focus of attention (usually us), to sustain that attention for a period of time (determined by us) and to ignore other interesting and stimulating environmental input. Finally, and most importantly, remember that information must be internally processed by the learner for true learning to occur, and that this processing takes time; paying attention to an outside stimulus and processing new learning cannot happen simultaneously (Jensen, 1998). You, as a teacher, can either have your students' attention or you can give them opportunities to process new learning, but you cannot have both. It is possible that during those times of seeming inattention, your students may be learning despite your best efforts at teaching (Jensen, 1998; Petterson, 1995; Wolfe, 2001a).

McGeehan (2001) summarizes the process of attention in two pithy questions, as "asked" by the brain:

1. Does this make sense?
2. Do I care?

If the answer to both of these questions (either consciously or subconsciously) is "Yes", then the learner is more apt to pay attention; if the answer to either question is "No", then the chances of continuous attention, and therefore learning, drop dramatically.

Attention Strategies

Physical activity: Effective learning activities can almost always be made more effective if the amount of purposeful kinaesthetic activity is increased; it is difficult for a student to be disengaged mentally if he/she is engaged physically (Tucker, Weaver, & Singleton, 2000). The key to the success of this strategy is the use of purposeful activity; both fine and gross motor movements should add to the learning, and should not detract from it.

There are many examples of adding movement to learning activities to aid in sustaining attention, but also to add another sensory mode of information input. Skip counting by 2s, 5s and 10s is much more effective when using body parts in the counting process. Stamping feet or clapping hands for counting by 2s, holding up hands or feet (five fingers and/or toes) for counting by 5s, and holding up both hands or feet for counting by 10s adds to the movement and relevance of the activity. Movement aids the oral rehearsal of spelling words, with the letters in the words symbolized by an action. Letters can be categorized as tall (stand tall with hands extended to the ceiling), short (crouch down to the floor), and alligator letters (those with tails below the baseline, symbolized by clapping hand alligator jaws); as each word is spelled, the appropriate action is

made for each letter. During sustained periods of seatwork, energizing breaks can be built into the work time. Chair sit-ups (placing both hands on either side of the chair seat and lifting one's bottom off the seat, holding for a five second count) and finger pulls (hooking one's bent fingers together and pulling, stretching out the arm muscles) are exercises that facilitate muscle strengthening and may prevent students from reaching an inattentive state.

Alternate desks and seats: For those students who need to have movement built into their programs to eliminate the "wigglies", several strategies may help them to appropriately deal with the need to move. Some students need to move constantly to maintain core stability; if there is an inherent weakness in the trunk muscles, the brain unconsciously stimulates those muscles through messages to move or squirm. This need to move can be harnessed so that learning is not disrupted. A wedge seat, (an air-filled cushion) helps to minimize squirming, as the trunk muscles are constantly stimulated to maintain balance on the pliable cushion. A partially inflated beach ball achieves the same result for smaller children; it is an inexpensive experiment to determine whether this is a viable strategy for a particular student. A therapy ball is

also an effective seat for some children, preferable to a rigid chair. For those students who require actual physical movement, having two desks may be an effective strategy. As the student is working at one desk, and feels the need to move, he/she can merely pick up the learning tools and move to the alternate work site. The student will need direction and a clear idea of teacher expectations when using this or any other movement strategy as a learning aid.

Tie a yellow ribbon: Some students view a series of classroom tasks as overwhelming; it is difficult to get started if there does not appear to be an end in sight. A verbal analogy that may work with older students is the quotation "A journey of a thousand miles starts with a single step." Developing a key phrase, such as "a single step" is all the reminder that students may need to move past the "overwhelmed" phase into the "learning" phase. For younger students, having external reminders may be more useful. For each step of the task, the teacher ties on a ribbon or piece of string to the back of the student's desk. As the student completes each step, he/she removes one ribbon. The task is complete when the ribbons are gone. This strategy requires some preteaching and prelearning, but if the student uses the ribbons as a strategy and not

as a diversion, this strategy has proven useful in the classroom.

TQLR: This acronym may help students to pay attention in class. A small reminder, taped to the corner of the desk, is a discreet way to remind the student, or for the student to remind him/herself, about the steps in paying attention. The letters in this acronym stand for:

T - Tune in, or alternatively, Think

Q - form Questions in your mind on the topic of learning

L - Learn

R - Repeat the information in an alternate format, either by verbal paraphrasing or written paraphrasing.

Environment: Structuring the learning environment to optimize student attention is a fine balancing act; the ideal learning atmosphere contains both novelty (an innate attention getter) and structure (to reduce student anxiety due to the unfamiliar or unknown, e.g., what is coming next or what is expected of them). Daily schedules allow students to structure their day at school; this reduces the load on the working memory by alleviating the worry of "What is coming next?" and "What do I need to do next?" These schedules can be class schedules on the wall. Some students may benefit from having each daily activity

written on a separate magnetic strip, and then placed on the metal side of the desk; schedule changes can be quickly and easily made by rearranging the magnets. Rules and expectations for the class should be prominently displayed; for optimum student buy-in, student input is critical in the development of the rules and expectations. Some students benefit from quiet workspaces; these can be created with dividers in the room, or by having a student turn his/her desk around, facing away from the other students in the class. Nooks and crannies in the class, coatroom or hallway may be valuable "office space" for some students. It is important to note that these are in no way punitive measures; they are methods to accommodate a student's need for less distraction in a busy and crowded workspace (Marzano, 2003).

Priming: Engaging students' attention is much more successful if they are primed to pay attention. This means that they are warned or alerted that something important is about to happen. Before watching an informational videotape, the students may be alerted to watch for a certain number of important points. If there are five minutes of working time left before the end of the class, the students are informed of this. Before reading an informational passage, the students may be asked to look

for information to substantiate a certain position. In other words, the teacher is making the learning process more transparent; there is no mystery as to what is important and what requires immediate attention on the part of the student.

Non-verbal cues: Rather than listen to the teacher's constant reminders, an external cue may help a student to pay attention. Non-verbal cues from the teacher are often effective; for optimum effectiveness, these cues should be cooperatively developed by the teacher and student. Sign language is often effective; sign language dictionaries are useful in learning to use signs appropriately. Many speech and language pathologists (SLPs) are conversant in sign language; if an SLP provides therapy in your school, access his/her expertise in this area.

For students with strong visual skills, a graphic reminder may also be effective. This should be created by the student, and it should be discreet. The student can then post this reminder where it will be the most effective; if the student often looks out the window or at the ceiling while being inattentive, these sites would be the logical locations for the reminder.

Some students benefit more from peer intervention than from teacher intervention. Enlisting the assistance of a

responsible peer can often positively facilitate attention. A well-placed pat on the shoulder or quiet reminder from another student can be more effective than the same reminder from an adult; it is imperative that both students are aware of the purpose of this strategy, and the appropriate uses of it (Marzano, 2003).

Eye contact is an effective method for gaining attention; this strategy can be culturally inappropriate in some instances, so it should be used judiciously. Identify one key student in the class (this position can rotate around the classroom); when you wish to have the class's attention, establish eye contact with the key person. This person then establishes eye contact with another person, who establishes eye contact with another person, and so on until the entire class is ready to focus attention on the topic or person at hand. This has been an effective strategy in upper elementary classrooms. A contest was set up in which the length of time that elapsed between the first eye contact and the entire class becoming focused was recorded, and then the class goal was to continually reduce the number of seconds needed to achieve student focus.

Teacher proximity can be an effective strategy for encouraging attention and focus. Moving around the room stimulates attention, as movement is one commander of

attention. Also, students are conditioned to pay attention when the teacher is close.

An attention poster: Teach students what "paying attention" looks like during different educational activities. Paying attention during a class discussion looks very different from paying attention during an independent assignment. Brainstorm for various classroom activities, and then list the descriptors that would allow an outside observer to determine whether a certain individual was paying attention during each of these activities. Class posters, charts or other graphics could be used to record this information; when displayed on the wall, they serve as good reference points for students to self-evaluate their own behaviours or as reminders to students as to appropriate actions, when necessary. These attentional behaviours can be practiced in the classroom to reinforce these skills to the automatic stage.

Grandma's rule: The analogy of Grandma's rule is very simple: First we work, and then we play. This is a concept that most children can understand; as teachers, we must be careful to live up to our end of the bargain, and ensure that the students do receive play time during specified periods of the day. Remember that well structured "play time" in the classroom may very well be those times that

students process their learning for retention and deeper understanding.

Self-assessment: Focus on the positive. Have students graph the times that they are on task and paying attention. This may help both the student and you as the teacher discover patterns of attention and inattention; often being aware of a problem enables the student to enact measures to correct the situation.

At the end of an activity or the school day, have the students rate themselves on their effectiveness as learners. For younger students, a continuum of "happy faces" ranging from "great" (big smile) to "okay" (neutral mouth) to "could be better" (inverted smile) is a graphic representation that is meaningful to a student who may not yet be print-capable. A Likert scale from 1 to 4 is useful for most students; the descriptors for each number can be adapted to meet the needs of the students. "Fist to five" is also an effective way to self-evaluate in a way that teachers can assess quickly. When asked to evaluate their effectiveness, energy or effort as learners, the students respond with a range of fingers to signify their perceptions; a fist, or zero fingers, is the minimum rating while five outstretched fingers is the maximum rating. All of these strategies are more effective if students can

justify their ratings; direct instruction and rubric posters may help students to make accurate self-ratings.

Novelty: Remembering that continuous novelty rapidly becomes ordinary, the following strategies are effective, when used in moderation:

- Music, selected by either the students or teacher, may help students to maintain attention and focus on the assigned task. Classical music has been used very successfully in many classrooms; it seems to mask the "buzz" inherent in most classrooms. An important consideration is that, whatever type of music is played, it facilitates, rather than inhibits, learning.
- Guest speakers often capture students' attention; their expertise and personal experience can impart relevance and utility to the topic of study.
- Changing the quality of your voice, in terms of tonality, volume, tempo, register and accent (ensuring that you are non-derogatory), captures attention.
- Humour is a very effective method of gaining student's attention. It is imperative to ensure that the humour is appropriate and positive.
- Props and costumes, when appropriate, capture attention.

- Provide opportunities for less teacher talk and more student talk.
- Change the location of learning for a specified period of time. Go outside, trade classrooms with another teacher for the day, or have everyone switch desks for the day.
- Change roles. Trade positions with the students for a certain period of time, in which you are the student and they are the teachers. Have your students teach new concepts to younger students, or another same-grade classroom (ensuring that they have command of the topic, so mislearning does not occur). Invite your students' parents in for part of the day, and have the students teach new concepts to their parents. Trade classes with another teacher for part of the day.
- Theme days give the students opportunity for intensive and extended study on a specific topic. Pick a theme for the day; the can be related to the topic of study or it can be more general. On Skeptic's Day, everyone is encouraged to question accepted and assumed knowledge. On W5 Day, everyone is encouraged to ask reporter's questions about new information (Who? What? Where? When? Why?); a variation is W5H1 Day (adding How? to the list of questions). An Inventor Day

celebrates important inventions and their inventors, while Author Day celebrates favorite authors, novels, and story characters. A favourite theme day in our Grade 1 classrooms is Hundred Day; on the one hundredth day in the school year, the entire day is devoted to activities revolving around the number 100.

Conclusion

It is the opinion of this author that the constructs of memory and attention are inextricably linked. Attention is a prerequisite for learning and memory (remember that one cannot learn what one did not pay attention to in the first place); paying attention is related to the relevance of the current experience, which is, in turn, dependent upon retrieving information from both long-term and working memories to establish relevance. Attention and memory seem to have four common elements necessary for effective functioning: relevance to the learner; the opportunity to establish a personal interpretation through amalgamation with prior knowledge and experience; active involvement of the learner; and an intrinsic "buy in" or ownership on the part of the learner. As a result, many attention strategies are very closely related to the strategies outlined in the memory section. It is possible that if a classroom teacher

facilitates memory development through instruction, then attention strategies will also be developed.

Unfortunately, there are no magic answers or universal strategies that will ensure learning for all students; there is incredible diversity in learning styles, general ability, interests and motivational levels of both the students and adult(s) in any classroom. However, educational and psychological research indicates that there are fundamental prerequisites that are necessary in order for learning to occur. Effective pedagogy is based on proven psychological principles regarding learning.

First, the learning must be relevant to the student. It must be connected temporally to the student's life; connections to previous learning are essential, as are connections to the present or future utility of the learning. As a profession, it is possible that we need to make the learning process more transparent, and to remove the mystery of the educational process for all students by making these connections more transparent to our students.

Secondly, there must be opportunities for all students to experience success in the learning process. Students need time to process and practice new learning in a supportive environment, to build memory networks and connections between previous learning and new learning and

to make personal sense of the new learning. Direct instruction in both content and learning strategies enables students to learn not only the "what" of the curriculum, but the "how" to learn, a necessary condition for lifelong learning.

Finally, the student needs to be paying attention to relevant stimuli in the classroom, in order to ensure learning of the intended outcomes. One important facet of a teacher's job is to provide stimulating and relevant educational activities that have a high likelihood of capturing the students' attention; this is not to say that teachers are responsible solely for maintaining student attention, as students also have responsibility for their own learning.

Pat Wolfe (2001a) asserts that in order for classroom learning to be successful, the teacher must structure instruction with three questions in mind: "What is the big idea of the topic of study?", "What is the lifelong implication of this learning?" and "What is the real-life application of this learning?" Keeping these three questions in mind while planning instruction may enable teachers to structure learning activities that are of maximum benefit to all students.

The strategies and ideas in this document are by no means comprehensive; a complete listing of teaching strategies on the topics of memory and attention would be impossible to develop due to the infinite nature of the task. However, this document will be considered successful by the author if any teacher who reads it not only gains an idea or two for the classroom, but if it also stimulates the development of effective and creative ways to help students learn.

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Appendix A

Alberta Learning Special Education Categories and Codes

Severe Disabilities:

Code 41: Cognitive Disability

Code 42: Behaviour Disability

Code 43: Multiple Disability

Code 44: Physical and Medical Disability

Code 45: Hearing Disability

Code 46: Visual Disability

TBA: Autistic Spectrum Disorder

TBA: Fetal Alcohol Spectrum Disorder

Disabilities:

Code 51: Cognitive Disability

Code 53: Behaviour Disability

Code 54: Learning Disability

Code 55: Hearing Disability

Code 56: Visual Disability

Code 57: Communication Disability

Code 58: Physical and Medical Disability

Code 59: Multiple Disability

TBA: Autistic Spectrum Disorder

TBA: Fetal Alcohol Spectrum Disorder

Other Special Needs:

Code 80: Gifted and Talented

Alberta Learning is in the process of revamping the assessment and identification codes for students. All codes in the 40's series denote a severe disability, defined as a disability that has a significant effect upon the student's ability to learn and/or the level of interventions that the school must provide to ensure continuous learning progress for that student. All codes in the 50's series denote a mild or moderate level of disability; these students require less intensive interventions to achieve success in the classroom.

Students who have been formally diagnosed with Autistic Spectrum Disorder or Fetal Alcohol Spectrum Disorder can either be coded as having a mild/moderate disability or a severe disability; the severity of the condition is defined by its educational impact, and by the level of programming, supports, and services required to enable students to become successful learners.

For further information on the appropriate coding of students with disabilities, refer to the document *Assessment and Identification of Students with Special Needs: Grades 1-12 (Field Review Draft of February 26, 2004)*, pp. 47-76.

(Alberta Learning, 2004)

Appendix B

An Overview of the WISC-III Assessment Instrument

The primary function of the Wechsler Intelligence Scale for Children, Third Edition is to assess the general intelligence of children from two to sixteen years of age. Wechsler defined intelligence as the overall global ability or competence that is expressed in many ways and enables the individual to deal with and cope effectively with his/her environment. He perceived intelligence as a multi-faceted, multi-dimensional construct that predicts an individual's capacity to act purposefully, to think rationally and to function in his/her world.

The WISC-III is comprised of two domains, the verbal domain and the performance domain. Each of these domains consists of a variety of subtests, as outlined below. Assessment results are reported as verbal scores (VIQ), performance scores (PIQ) and full scale scores (FSIQ). There are also four index scores: the verbal comprehension index, the perceptual organization index, the freedom from distractibility index, and the processing speed index.

The verbal subtests are:

- Information - a measure of general cultural knowledge and acquired facts,

- Similarities - a measure of abstract, logical thinking and reasoning,
- Arithmetic - a measure of numerical accuracy, reasoning and mental arithmetic,
- Vocabulary - a measure of verbal fluency, word knowledge, and word usage,
- Comprehension - a measure of social knowledge, practical judgment in social situations, level of social maturation, and the extent of development of social conscience, and
- Digit span - a measure of short term auditory memory and attention.

The performance subtests are:

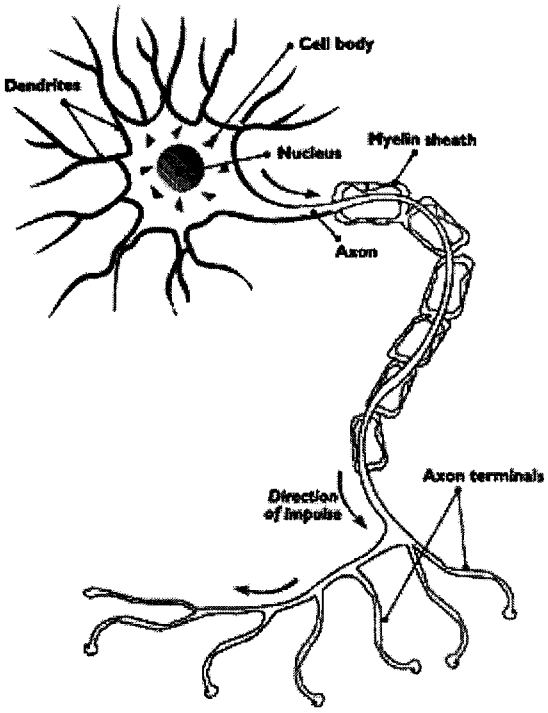
- Picture completion - a measure of the ability to recognize familiar items and their missing parts, and to separate essential and nonessential parts from the whole,
- Coding - a measure of visual-motor dexterity, associative nonverbal learning, and visual short-term memory,
- Picture arrangement - a measure of the ability to interpret action depicted in pictures, recognize story sequence and to arrange pictures in sequential order,

- Block design - a measure of the ability to analyze and synthesize an abstract design, and to reproduce the design using blocks,
- Object assembly - a measure of the ability to visualize the component parts of a concrete object and to reassemble the parts into a whole,
- Symbol search - a measure of perception, recognition and processing speed (optional subtest), and
- Mazes - a measure of planning ability, perceptual organization, visual motor coordination and self control (optional subtest).

The average score for each subtest is 10 plus or minus 2; anything above or below this range is considered a significant strength or weakness. The average full scale IQ is 100 with a standard deviation of 15 points. Interpretation and analysis of individual scores and intelligence profiles is the mandate of the psychologist administering the assessment; if an individual teacher has any questions about test results, the psychologist who administered the assessment should be contacted (Nicholson & Alcorn, 1993).

Appendix C

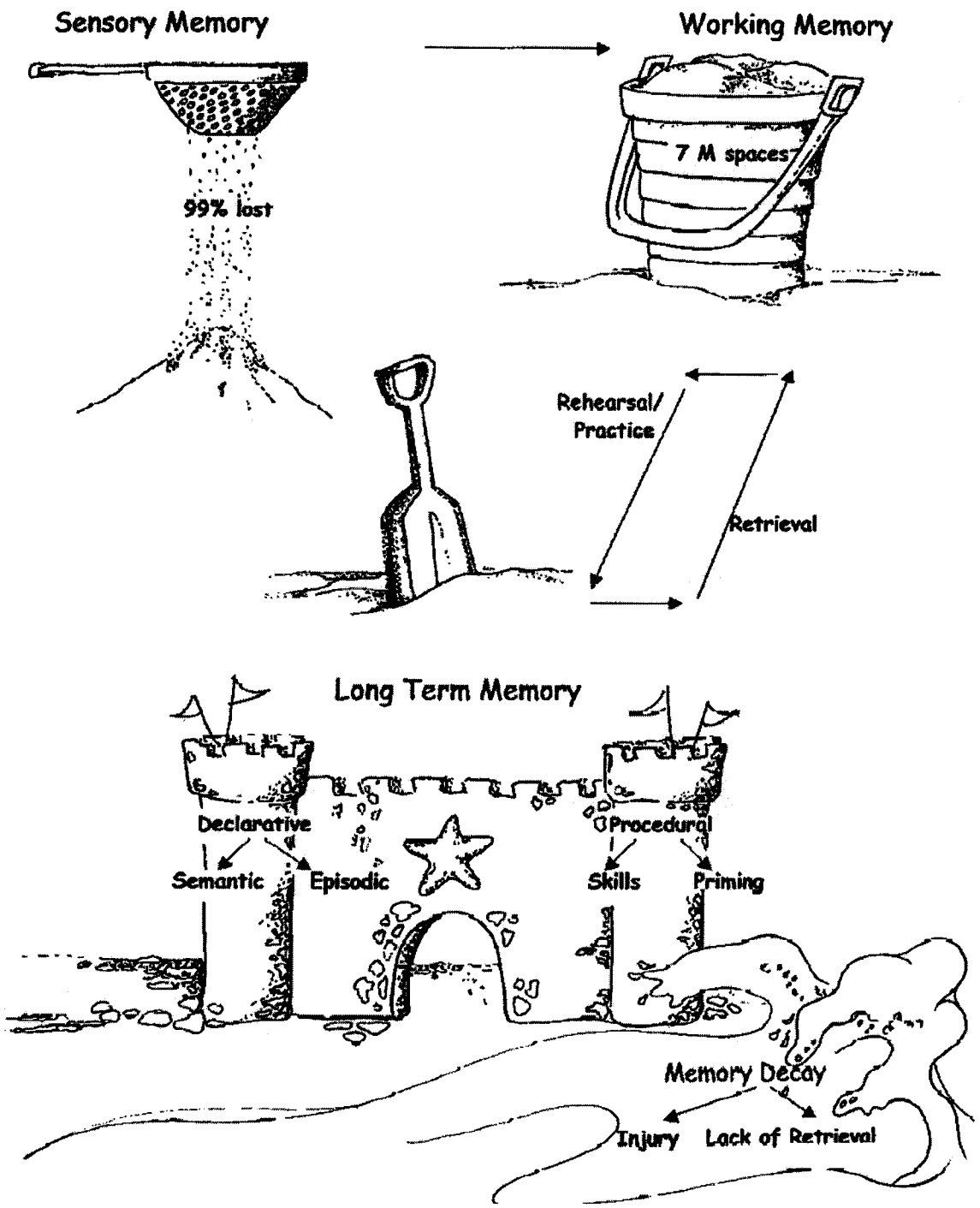
A Neuron, Axon and Dendrites



(Wolfe, 2001b, p. 5)

Appendix D

A Graphic Representation of the Three Memory Systems

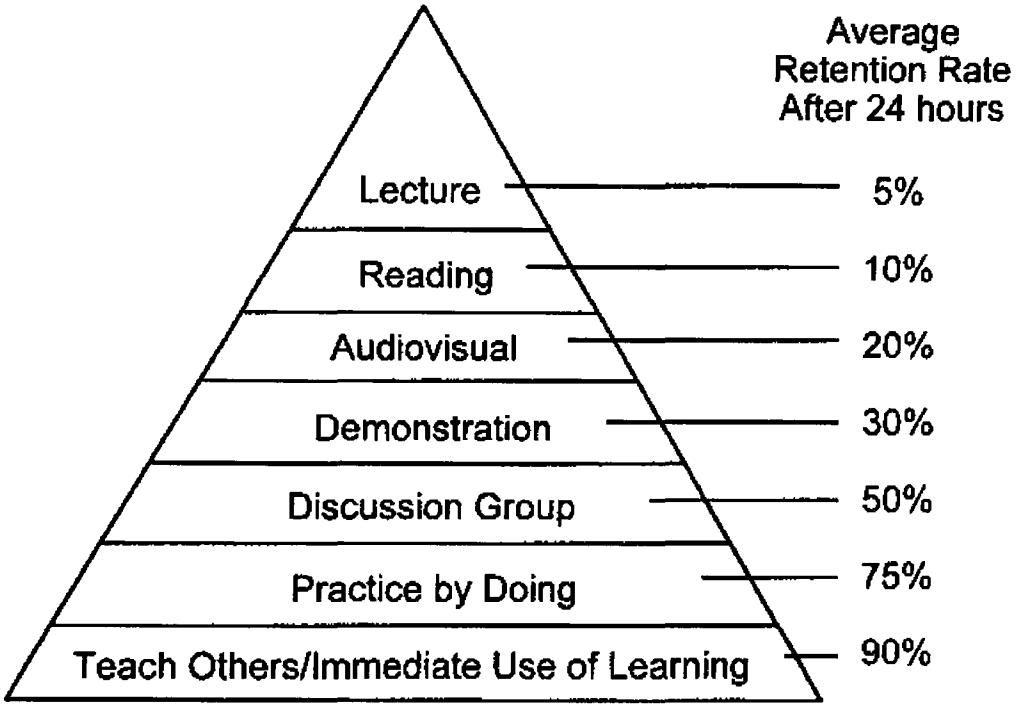


(Harrell, Parente, Bellingrath, & Lisicia, 1992; Wolfe, 2001a)

Appendix E

The Retention Pyramid

This diagram shows the average percentage of retention of material after 24 hours for each of the instructional methods.



(Sousa, 2001a, p. 95)

Appendix F

A b/d Ruler

To use this ruler, the student lines up the appropriate side of the ruler, depending on which letter is desired. The student then makes the line of the "b" or the "d", and then the circle, without removing the ruler; the edge of the card prevents the student from reversing the orientation of the letter.