

Working Memory

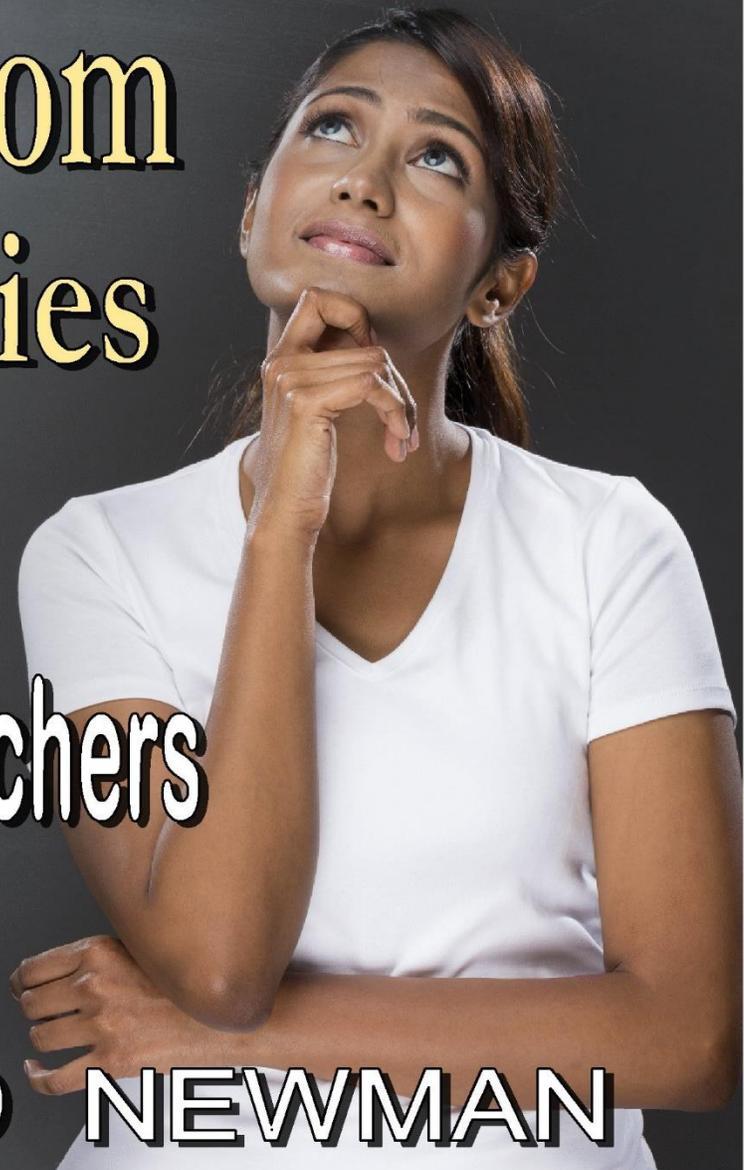


Classroom Strategies

FOR

School Teachers

DAVID NEWMAN



Working Memory

Classroom Strategies for School Teachers

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Speech-Language Pathologist



A Friendly Reminder

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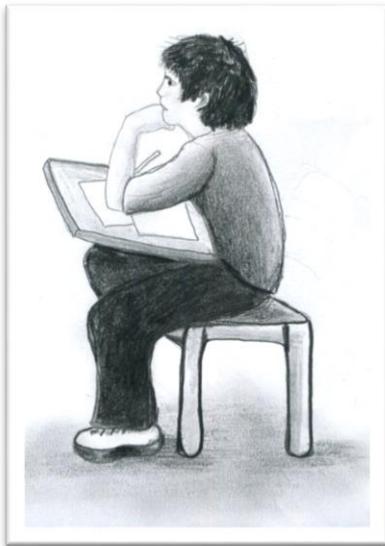
However, I do give permission for class teachers or speech-language pathologists to print and copy individual worksheets for student use.

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What is Working Memory?

Working memory is the ability of individuals to process and shape incoming auditory information in a short amount of time. A useful analogy to help explain working memory is to describe it as a mental note pad, similar in function to a post-it note (Gathercole, 2008), where a message is mentally jotted down to be used quickly.



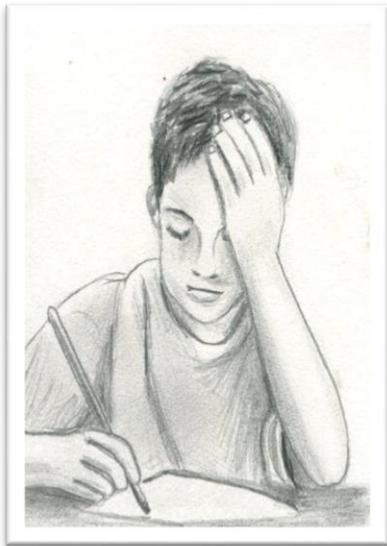
Working memory operates on a similar basis. Working memory requires the ability to store information just long enough to work or manipulate it before it vanishes. Students with poor working memory struggle to hold onto new information long enough to process it accurately. If the new information can't be processed quickly, it soon becomes lost.

An example of working memory in action is the simple task of memorizing a list of animals, in this instance: horse, dog, budgie, and rhinoceros. To remember the different species of the four animals requires us to use our mental storage capacity – not too difficult a task.

A more difficult task is to sort the animals ranging from the heaviest animal to the lightest. It's the manipulation of working out and sorting the heaviest animal (rhinoceros) down to the lightest animal (budgie) that is mentally taxing and difficult. It is this working or *manipulation* of recently learnt information that many students find difficult.

Classroom Strategies

This program, which has a classroom centred approach, is designed to lessen the working memory burden on school-age children who experience memory overload. This guide provides several memory aid and receptive language strategies to enable teachers to better assist their students to access classroom discourse and verbal and written information.



Working Memory Failure – The Warning Signs

The following are lists of warning signs to look for in your students that their working memory systems are being overloaded.

Difficulty understanding and following instructions

This may manifest as the student being unable to remember all the parts of a multistep instruction. So, for instance, if you were to say *“Get out the maths book turn to chapter 3 and start reading page 45,”* a child with working memory problems may have difficulty mentally organizing the amount of information and may process no further than, *‘Turn to chapter three.*

The student forgets some of the information

The student may not remember what the task was, even in the moment of completing the task. This may occur when a student is writing a long sentence - either attempting to write a verbal instruction or complete a sentence as part of a written recount of what they did on the weekend.

The student may fail to complete the sentence because he/she can't retain the words in memory long enough to work the information. The first few words of the sentence may be written down and completed; the rest of the sentence will be lost.

The student may lose track of what he/she is supposed to do. If a set task is relatively complex, a child with working memory difficulty can quickly lose their place and forget what they have already completed. This failure may extend to the student not being able to remember what steps are required to complete a task.

Students lose concentration or give up on a task

This is often the result of working memory failure, where students can't remember verbal instructions or can't organize the information in a coherent fashion. A student who can't remember the instruction may discontinue the task and sit passively waiting for teacher direction, or perhaps view their confusion as an opportunity to distract others.

Watch carefully for tell-tale signs of working memory difficulty

It's important to regularly monitor students with working memory problems. The signs of working memory overload may be subtle but can be recognized with a little added scrutiny of students. Look for signs of difficulty as discussed previously - students who abandon tasks, seem distracted, or have difficulty following instructions.

A useful and simple way of monitoring whether particular students have understood your instructions is to ask them what they need to do. You can use prompts to elicit a student's understanding with questions such as, *'Repeat back to me what you need to do?' 'What do you need to write about?'*, etc.

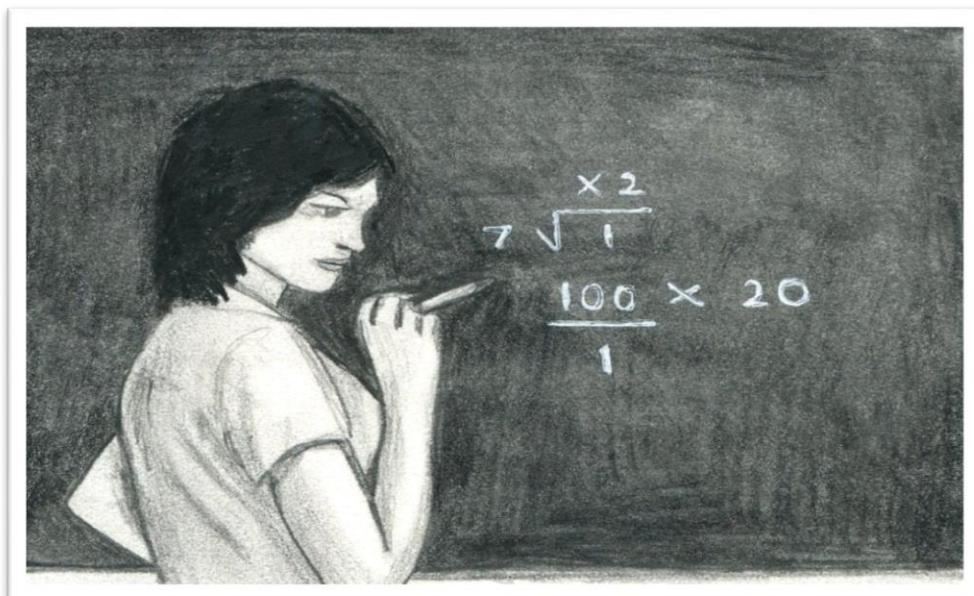
Be mindful of the working memory demands of particular classroom activities

As a classroom teacher, it's important to be aware of the length and complexity of verbal instructions you give to a child with poor working memory. Working memory has a limited capacity so if the length of the instruction is too long or contains complex details then the information will not be processed well. Any complex instructions will not be processed quickly enough and will be essentially lost by students with working memory difficulties.

Be alert to memory problems when introducing unfamiliar or decontextualized information

Words and sentences that are low in meaning to students or are unfamiliar, place a heavy demand on students when they attempt to learn new information. Working memory failure quickly occurs if the student doesn't already have solid background information about a subject that is introduced as a classroom discussion. In this instance, a student would be obligated to rely on their working memory to rapidly store and manipulate any new information, which of course would be a heavy burden for a child with limited memory capacity.

For instance, a child may be required to process unfamiliar information, such as, *'Before the Navy could rule the Caribbean Sea, they had to first capture Port Royal from the buccaneers.'* A child with working memory difficulty may be overwhelmed by the complexity of the sentence and also the language such as, buccaneer, Port Royal, etc.



Strategies: Cut back the amount of information to be learned at any one time

There are a number of steps you can use and maximise if you suspect one or several of your students have working memory problems and are having difficulty following classroom discourse or instructions.

Reduce the working memory load on students by shortening the amount of information they have to process. For instance use shorter sentences, and pause often to allow a student time to process any new information.

Increase the *meaningfulness* of any new information by providing a context for it. A key way to provide this is to **pre-teach**. This is particularly effective when introducing important and/or complex concepts. If a child has a familiar context within which to learn new information, this can act as a foundation so that students don't rely solely on their often overburdened working memory capacity.

For instance, when introducing a new concept such as complex sentences pre-teach or review the structure of simple sentences to provide some background for students to link the new information to. The review of simple sentence structure will provide a solid background for students to compare and contrast the difference and similarities between simple and complex sentences.

Break down or simplify new information to ease processing demands. The length of sentences and student awareness of sentence structure can

impact students' ability to understand any new information that uses complex forms. This is a result of students attempting to process unfamiliar complex sentence forms.

If students have difficulty coping with instructions delivered in complex forms, then much of their memory capacity will be devoted to processing the actual sentence, not the information contained within the sentence. In this situation, students need to rely on the stored form of the sentence in working memory to make sense of the verbal instructions. This can quickly lead to the information being lost and not retained.

An example of this communication breakdown would be a teacher giving instructions using complex sentence forms such as, *'After you find the passage about koalas that is on page 40, make sure you write down the key features of a koala which is listed there.'* This is a complex sentence and contains a main clause and three subordinate clauses. It is a huge amount of complex information to store in working memory and process – too complex for students with poor working memory, in most situations.

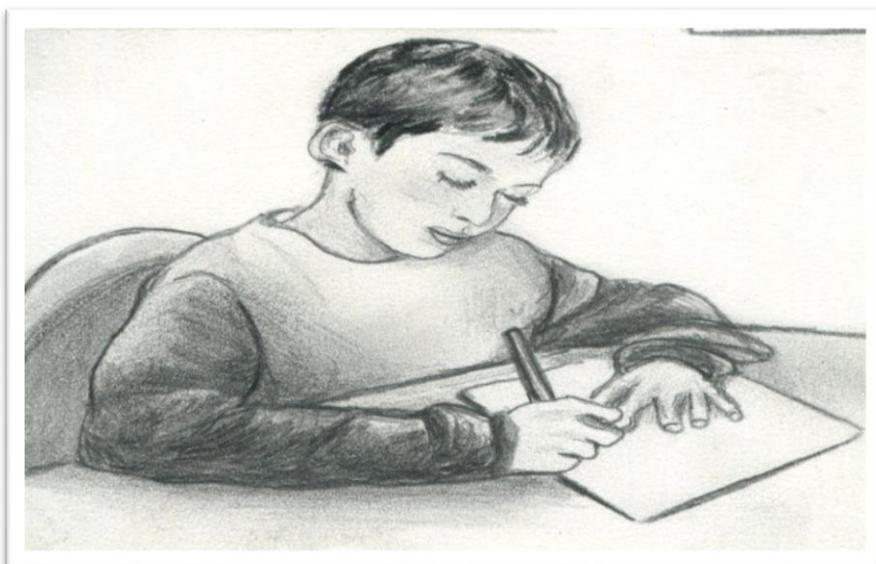
A simpler structure to comprehend would be, *'Turn to page 40 in your book. (Pause) You will find the key features of a koala listed there. (Pause) Write those key features down.'* This is much the same information, but is delivered in easier to comprehend simple and short sentences with several pauses in between, which gives space and time for students to retain and manipulate complex information.

Students with poor working memory will have more opportunity to complete a task and not be so overloaded with complex information.

It's important to reorganize complicated instructions by breaking down complex tasks into distinct separate parts. Students are required to complete the separate parts in order before continuing to the next step of the task.

For instance, if students are to learn about story grammar and concepts such as setting, *initiating event*, *problem*, *plan* and *conclusion*, it would be best to spend time on one concept, such as setting in some detail, first, before introducing other story grammar concepts.

By focusing on separate steps of a larger construction, the amount of information to process at once is lessened, the load on working memory is reduced, and students will be better placed to learn complex material.



Strategies: Repeat complex instructions and encourage students to use memory aids

Repeating complex instructions sounds like simple advice but can be often overlooked, so it is important to mention it. Students with working memory difficulty may need instructions to be repeated several times during a class activity. If students feel that they struggle with complex instructions or information, they should be encouraged to ask the teacher for clarification. Teachers, of course, need to provide an environment where students feel comfortable to ask the teacher for clarification if they have missed the gist of verbal or written instructions.

Memory aids are recommended for students to review instructions or information, or to guide the completion of a specific activity. For instance, if we return to the story grammar example, when learning the sequence of story grammar elements, students can be provided with a sequence of graphic organizers to assist in story construction and a list of topic words to help provide mood and emotion to a story.

Student Directed Strategies

Support students with working memory difficulties to take ownership of their learning by increasing their independence as active learners.

Students should be encouraged to ask for help when they are unsure about a task or need instructions to be repeated.

Language intervention strategies to assist students' working memory capacity

The following strategies are speech-language pathology methods of supporting children with receptive language impairment. School-age students with language impairment have difficulty with working memory tasks that rely on storage and processing newly learnt information or instructions. Therefore it makes good practical sense to support children with working memory problems by using techniques that are the speech-language pathologist's traditional domain.

Language Support Strategies

Preparatory Set: Preparatory sets assist students to learn new information by building background knowledge about a particular topic or concept. Preparatory sets can be particularly useful for students with poor working memory because they focus students' attention on particular themes or words. With preparatory sets, students have an expectation of what to look for or listen to in any new material they are required to learn.



Paraphrasing: Paraphrasing is a highly useful and simple tool that assists children with working memory difficulties to comprehend new material. Paraphrasing works by reducing the complexity of verbal instructions. An example of paraphrasing is to reduce complex sentence forms to simple sentences when delivering instructions. So even though the complexity is reduced the essential message is still delivered with the same accuracy.

Students can recount or review newly learned information by repeating the information either mentally or out loud. This type of strategy is only useful when there is a small amount of information to be learned.

Increase students' automatic use of skills to help them to learn new information better. This can be achieved by repeated practice, or over-rehearsing and over-learning key academic skills. For instance, provide templates of key grammar or syntactical structures or the elements of story structure, which students with poor working memory skills can access when needed.

If students with working memory problems can monitor their difficulty (*metacognitive awareness*) then they will have better insight into what strategies work best for them. To do this successfully, students need to be able to recognise when new and complex information has the potential to tax their working memory ability. Students can be taught to compensate or make adjustments to ensure that new information is processed and comprehended.

Question Students' Understanding: Teachers can use a variety of question types to allow students with working memory problems to understand verbal instructions. For instance, learning about the varieties of crocodile, a teacher may use **fact based questions** – For instance, *'What did I just ask you to do? What are the three steps you need to include?'* etc. **Interpretation based questions** – *'What should you do, when listing the different types of crocodiles, when you can't remember where to find the information?'* **Inference based questions** – *'What are the best ways to list the habits of salt-water crocodiles?'*

Cloze Procedures: Cloze procedures may be used to obtain an insight into students' understanding of subject matter or assist them to organize the material in their own mind. Students fill in the gaps when provided with a context. For instance, *'We've just discussed the three parts of the world where salt water crocodiles are found, Australia, South East Asia and In...'(India).* Students are required to fill in the missing information themselves, using their long term memory or word/world knowledge.

Summarization: Summarization is an important tool when delivering instructions for a new concept. The teacher essentially summarizes all the information they have just delivered. The technique would be even more useful if the summary of the information is written onto a whiteboard or as clear written instructions for students to have access to on their desks. The goal of summaries is for students to attend to the most important points of any instructions or concepts to ensure they have an overall gist of what is required of them.

Working Memory Intervention Example

The following passage is an example of a teacher introducing the structure of a story writing to her grade 5 students. Story grammar concepts can be difficult material for students to learn, particularly if they have little experience at thinking about the mechanics of story writing. Students with working memory problems would be at a distinct disadvantage if the teacher's instructions were too complex. Particularly if there was little thought given to appropriately scaffolding the material presented. In this example, the teacher presented the instructions verbally and expected her students to write the instructions down.

The class teacher's instructions to students

The instructions the teacher delivers here are entirely verbal, with no written material to support the information. **Class Teacher:** *'Today we are going to learn about story writing. To be a good story writer requires that you construct a story following several principles. You need to have a clear beginning, middle and end. You also need to devote attention to the setting, character motivation, and a problem a main character has to overcome.'*

'I want you to write a story about a happy event in your own life that you remember vividly. Before you begin to think about a happy story though, I

want you to quickly write down these main headings, because we are going to spend a bit of time on each. The main headings are: setting, beginning, middle and end, character and story sequence.'

As you can see, there is a significant amount of information for the grade 5 students to process in this example. The children with good working memories and strong receptive language skills may have a little difficulty coping with the amount of information and keep up with the teacher's thoughts. They may even be actively writing down the key headings as instructed by the class teacher.

However the children with poor working memory will quickly flounder with the amount of information they have to process. Much of the teacher's instructions would be lost to them. If we analyse what the teacher was doing it may provide some insight into how to better scaffold the information for students with working memory difficulties.

First, there is too much information to process at once. Students with working memory difficulties will not be able to keep up with the teacher.

Second, the sentences are too complex. Many of the sentences contain relative clauses which may be too difficult to process for students with poor working memory.

Third, the instructions are poorly organized and the teacher hasn't really provided enough scaffolding before launching into getting students to write stories based on their own life experiences. The teacher also expects the students to write down the main headings without providing support such as written instructions on a whiteboard or printed material for students to follow.

Working memory tips the teacher could use to assist students

The teacher does not need to give all the instructions in one long and unwieldy package, but can instead break the instructions into several manageable steps.

The teacher could have planned the introduction of the story grammar elements by first analysing the structure of a popular, well known story such as a fairy tale like Hansel and Gretel or a popular children's book.

If students demonstrate some confusion about a given task, the teacher can provide guidance by asking students to recount what their task *is*, what they propose to write and how they intend to structure their writing.

Also, students can be provided with a written outline of the different aspects of story grammar and can use graphic organizers to help them to remember the structure of stories.

Appendix

Answer Section

Smallest to Largest

a. mouse – dog – horse b. cat – pig – cow c. rat – chicken
sheep

d. flea – fly – butterfly e. ladybug – caterpillar – goliath beetle f. midge –
fly - grasshopper

g. sparrow – seagull - eagle h. hummingbird – duck - condor i. starling –
swan – albatross j. meerkat – lion – elephant k. hyena – leopard – giraffe
l. monkey – warthog - buffalo

Smallest to Largest

a. grape – apple - grapefruit b. cherry – orange - watermelon c. plum –
banana - rockmelon d. pea – carrot - pumpkin e. bean – tomato - cabbage
f. brussel sprout – potato - eggplant g. peanut – macadamia nut – brazil
nut h. sesame seed – almond - chestnut i. pumpkin seed – peanut - walnut

Longest to Shortest

a. dining table – drinking straw - finger b. ship – truck - car c. fishing pole
– spanner – paper clip d. tree – branch - twig e. river – lake – pond f. whale
– shark – sardine g. tree – bush tree

Shortest to Tallest

Chihuahua – Labrador – Great Dane b. Marmoset – Baboon – Gorilla c.
Warthog – Antelope – Giraffe d. mound – hill – mountain e. dollhouse –
house – skyscraper f. flower – bush - tree

Heaviest to Lightest

a. tennis racquet – tennis – tissue paper b. cannon ball – basketball –
orange c. broom – hairbrush - toothbrush d. cargo ship – tugboat – sailboat
e. motorbike – bicycle – skateboard f. jet aircraft – glider – model plane g.
sparrow – wasp – fly h. rhinoceros - wombat – guinea pig i. eagle – pigeon
– wren j. flat screen TV – computer – mobile phone k. hardcover book –
newspaper – brochure l. fridge – saucepan - cup

Thickest to Thinnest

a. crayon – matchstick - pin b. dictionary – picturebook - postcard c. rope
– string – human hair d. watermelon – carrot - spaghetti e. leg – arm -
finger f. tree trunk – branch - twig g. hippopotamus – horse – cheetah h.
car tire – steering wheel – vinyl record i. fridge – lunchbox – CD cover j.
rocket – harpoon – dart k. hammer – key – pin l. barrel – cake - DVD

Coldest to Warmest

a. Artic – England – Sahara Desert b. Siberia – beach in Fiji – erupting volcano
c. Winter – Spring Summer d. hot soup – apple – icy pole e. chilli – tomato - ice
cube f. hot donut – jam – ice-cream g. ice-rink – concert hall – sauna h. mountain
top – rainforest – desert i. hot tea – tap water – cold milk j. frozen lake – backyard
pool – heated swimming pool k. snow skiing – water skiing – desert trek l. sea in
Winter – lagoon – hot springs

Temporal Sequence Exercises

- a. after
- b. after
- c. hit the ball
- d. put the DVD in the player
- e. put toothpaste on toothbrush
- f. open the car door
- g. start the computer
- h. ice-cream out of freezer

i. write a greeting j. put your socks on

k. have breakfast l. put the plug in

m. after

n. take toast out of toaster

o. arrange lettuce leaves

p. pay the far

q. the entrée

r. plug in power cord

s. open word program

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