

Classroom support for children with working memory problems

As yet, no certain ways of directly improving working memory in children have been developed. However, there is plenty that can be done to enhance learning in children with working memory problems. The approach that we recommend involves teachers managing children's working memory loads in the classroom, with the aim of alleviating the disruptive consequences on learning of excessive working memory loads. The following recommendations should be used to guide both the development of lesson plans for children with working memory impairments and the monitoring of children's performance in class. In each case, the aim is to minimise the chances that the child will fail to complete the intended learning activity successfully due to working memory failures.

1. Recognise working memory failures

Working memory failures typically manifest themselves in frequent errors of the following kinds:

- incomplete recall, such as forgetting some or all of the words in a sentence, or of a sequence of words
- failing to follow instructions, including remembering only part of a sequence of instructions, or forgetting the content of an instruction (for example, the child correctly remembers to go to Mrs Smith's classroom as instructed by the teacher, but once there cannot remember the content of the message to be given)
- place-keeping errors – for example, repeating and/or skipping letters and words during sentence writing, missing out large chunks of a task
- task abandonment – the child gives up a task completely.

If these types of activity failure are observed, it is recommended that the working memory demands of the task are considered (see point 2) and if believed to be excessive, the activity should be repeated with reduced working memory loads (see point 3).

2. Monitor the child

It is important to monitor the child's working memory regularly in the course of demanding activities. This will include:

- looking for warning signs of memory overload (see point 1);
- ask the child directly – for example, ask for details of what s/he is doing and intends to do next.

In cases when the child has forgotten crucial information:

- repeat information as required
- break down tasks and instructions into smaller components to minimise memory load
- encourage the child to request information when required.

3. Evaluate the working demands of learning activities

Activities that impose heavy storage demands typically involve the retention of significant amounts of verbal material with a relatively arbitrary content. Some examples of activities with working memory demands that are likely to exceed the capacities of a child with working memory deficits include:

- remembering sequences of three or more numbers or unrelated words (e.g. 5, 9, 2, 6 or cat, lion, kangaroo)
- remembering and successfully following lengthy instructions (e.g. Put your sheets on the green table, arrow cards in the packet, put your pencil away, and come and sit on the carpet)

- remembering lengthy sentences containing some arbitrary content to be written down (e.g. To blow up parliament, Guy Fawkes had 36 barrels of gunpowder)
- keeping track of the place reached in the course of multi-level tasks (e.g. writing a sentence down either from memory or from the white board)

4. Reduce working memory loads if necessary

In order to avoid working-memory-related failures (see point 1), working memory loads in structured activities should be decreased. This can be achieved in a number of ways, including:

- reducing the overall amount of material to be stored (e.g. shortening sentences to be written or number of items to be remembered)
- increasing the meaningfulness and degree of familiarity of the material to be remembered
- simplifying the linguistic structures of verbal material (e.g. using simple active constructions rather than passive forms with embedded clauses in activities involving remembering sentences, and in instructions)
- reducing processing demands (see point 5)
- re-structuring multi-step tasks into separate independent steps, supported by memory aids if possible
- making available and encouraging the use of external devices that act as memory aids for the child; these include 'useful spellings' on white boards and cards, providing number lines, printed notes, and dictaphones to store information that needs to be remembered.

5. Be aware that processing demands increase working memory loads

Although children may be capable of storing a particular amount of information in one situation, a demanding concurrent processing task will increase working memory demands and so may lead to memory failure, as illustrated in the two examples below of children with working memory deficits.

Example 1

The children in Horatio's class were asked to identify the rhyming words in a text read aloud by the teacher. They had to wait until all four lines had been read before telling the teacher the two words that rhymed: tie and fly. This task involves matching the sound structures of a pair of words, and storing them. Horatio was unable to do this, although he was able to remember two words under conditions where no concurrent processing was required.

Example 2

An activity in Delilah's class involved the teacher writing number sequences on the white board with some numbers missing. She counted the numbers aloud as she wrote them, and asked the class what numbers she had missed out. In each case, there was more than one number missing (e.g. 0, 1, 2, 4, 5, 7, 8). In this activity, the child has to use his/her number knowledge to identify each missing number, and store them. On all occasions, Delilah was unable to identify the missing numbers. In such cases, steps should be taken to modify the learning activity in order to reduce working memory loads (see point 3).

6. Frequently repeat important information

It is good practice when working with children with working memory deficits to regularly repeat information that is crucial to ongoing activities. This will include:

- general classroom management instructions
- task-specific instructions (what the whole activity consists of, broken down into simple steps)
- detailed content intrinsic to an activity (e.g. the particular sentence to be written).

Children should also be encouraged to request repetition of important information in cases of forgetting.

7. Encourage the use of memory aids

A variety of tools that support memory are in common use in classrooms – these include number lines, Unifix blocks and other counting devices, cards, dictaphones, personalised dictionaries with useful spellings, teacher notes on the class white board, and wall charts. These tools can help in several different ways to reduce working memory loads – they may reduce the processing demands of the activity (e.g. useful spellings and Unifix blocks), and they may also reduce the storage load of the task and so help the child keep their place (e.g. number lines).

However, many children with working memory problems often struggle to use such tools, possibly because of the initial cost of mastering the new skill. It is therefore recommended that children are given practice in the use of memory aids in situations with minimal working memory demands in order to establish mastery of the basic skill, before their use in more complex activities with higher working memory loads.

8. Develop the child's use of memory-relieving strategies

Children with working memory deficits are typically aware of when they have forgotten crucial information, but often do not know what to do in such situations. An important role for the teacher is to encourage the child to develop strategies for overcoming memory problems. These will include:

- use of rehearsal to maintain important information
- use of memory aids (see point 7)
- organisational strategies – breaking tasks down into component parts where possible
- asking for help when important information has been forgotten.

These suggestions were provided by Professor Susan Gathercole and Doctor Tracy Alloway who were both members of the Centre for Working Memory and Learning at the Universities of York and Durham at the time of writing. The material is reprinted with permission and may be photocopied for educational purposes.