Working memory and neurodivergence

Working memory is the conscious part of our memory, where we hold information in order to do something with it. Working memory plays a crucial role in learning because the way we engage with information in our working memory influences how well this memory will be stored in long-term memory, and therefore how effectively it can be retrieved and used. However, working memory is limited, and its limitations can often present challenges for students. For neurodivergent students, the limitations of working memory may be even greater than for their neurotypical peers. This means that, while accommodating the constraints of working memory is important for all students, it is particularly pertinent when teaching neurodivergent students.

The role of working memory in learning

Working memory is the place where thinking takes place. It is where information is manipulated and prior knowledge is drawn upon to add to new knowledge. Like a short-term parking place for information, the working memory is needed to 'park' information, both new and existing, in order to work with it. What is more, it is essential that new knowledge is processed in working memory in order for it to be transferred to long-term memory. This means that the role of working memory in learning new material is vital. You can read more about working memory here.

The limitations of working memory mean it only has a certain amount of capacity to hold new information (although its capacity to hold and work with existing knowledge drawn from long-term memory is not limited in the same way). When the working memory is overloaded, this leads to information loss – either incoming information will not be processed, or an item 'in process' will be dropped to make space for the new information. Cognitive load theory explains the way that new knowledge is built in working memory. In order to facilitate learning and the effective transfer of knowledge to long-term memory, it is important to reduce cognitive load in appropriate ways.

How working memory constraints can affect neurodivergent students

As described above, a student's working memory capacity is a crucial part of their ability to effectively learn new information and use previously learned information. Working memory has a limited capacity, and for neurodivergent students, this already limited capacity is likely to be even further reduced, and learning challenges exacerbated. An example might be learning spelling patterns. If a student's capacity to 'hold' new patterns in their working memory is limited, they may only learn two or three, while peers may hold five or six, thus allowing them to make greater progress in their understanding of spelling. If this example is then extended to writing, it may be that the student with a reduced working memory cannot apply the spelling pattern to writing a new word because they have already 'lost' the pattern.

Here are some of the factors that may place additional limits on a neurodivergent student's working memory:

- Sensory overload: this is often experienced by neurodivergent students, particularly those who are autistic and/or have ADHD.

- Slower processing speed: students may need more time than their peers to process verbal and/or written information.

- Increased cognitive load: other things may be taking up space in the student's brain, such as uncertainty about what is coming up next (this can be particularly challenging for autistic students, and is related to cognitive flexibility), tension with a peer in the class, or a change in the usual routine, such as the presence of a relief teacher in place of the regular classroom teacher.

- Emotional dysregulation: a student's ability to regulate their emotions may be limited (for example, students with ADHD may struggle more than their peers to regulate their emotions). They may also experience increased anxiety when learning or trying to learn.

Working memory sits under the umbrella term of executive functioning, alongside cognitive flexibility and inhibitory control. Many neurodivergent students experience challenges with their executive functioning skills, which are critical for effective learning as they include planning, focusing, moving from one task to another, and controlling impulses and emotional regulation. Neurodivergent students may experience additional challenges related to executive functioning. For example, autistic students can find flexibility in the classroom challenging - this includes things like shifting from one task to another, or working with others. Students with ADHD may struggle to inhibit their behaviour, and may shout out answers, move around the room, and interact inappropriately with peers (and it is important to note that many students with ADHD do not have control over this behaviour). They may also find maintaining focus and attention difficult, and struggle to stay on task (in some cases their attention span may only be a couple of minutes). Abstract thought can be challenging for autistic and ADHD students – they may find understanding the 'why' of the learning difficult, and starting a task without knowing the purpose of the task may lead to a refusal to engage in it.

What teachers might notice

There are many classroom behaviours that may initially appear to be due to laziness or lack of effort, but are actually the result of working memory limitations. These include:

- Difficulty remembering and following a set of instructions

- Difficulty prioritising one task over another

- Distractedness or difficulty staying on task

- Apparent inattentiveness

- Difficulty with tasks such as mental mathematics.

Working memory is also essential for social cognition, or the ability to notice and interpret the social behaviours of others, so limited working memory capacity may also impact neurodivergent students' ability to interact with other students. For example, the process of labelling the emotions communicated through facial expressions can place high demands on working memory resources, so students may find working in groups or other activities that rely on social interactions challenging. Students may also be reluctant to ask for help, both from their peers and from a teacher or teacher aide.

Strategies to support working memory for neurodivergent students

It is important that teaching and learning take into account the limited working memory capacity of all students. Approaches that help to reduce cognitive load include structured, explicit approaches to teaching new content that include reviewing previously learned content, explicitly teaching new content, asking lots of questions to check students' understanding, having students practise new content until they reach high levels of mastery, and regularly reviewing content that has been learned using evidence-based practices such as retrieval and spacing.

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As neurodivergent students are likely to have even less working memory capacity than their neurotypical peers, below are some additional strategies that teachers can use to provide necessary support.

Planning: when planning a unit of work, consider adopting an inclusive design approach (such as Universal Design for Learning). It is also helpful to:

- Ask students what they think will help them, as they can be an invaluable source of insight into what will support them to learn. For example, the student may already have developed some effective strategies, such as breaking tasks down into even smaller units, or using a mini-whiteboard on their desk to note down the teacher's instructions for completing a task.

- Try and make the learning relevant to the individual student, perhaps by using their special interests as the foundation for new learning. For example, giving the student opportunities to draw on existing knowledge that is well-established in long-term memory to support new learning may help to reduce cognitive load.

- Consider ways to draw on the student's strengths. For example, if they enjoy drawing, allow them to provide a visual representation of the information they are learning, which may help to reduce the additional cognitive load that can be caused by handwriting.

More information on creating an inclusive classroom can be found here.

Teaching and learning: it is important to support students to process new information deeply in order to ensure transfer to long-term memory. Remember that learning is a *process* and each stage of the process (knowing, understanding, using, and mastering) has to be achieved in order for successful learning to happen. Useful strategies include:

- Offering multi-modal opportunities by presenting the information in a variety of ways, such as adding a visual representation to accompany the written information. Visual cues can often effectively increase a student's ability to understand something and ensure it sticks.

- Providing additional time where needed to allow students to process new learning.

- Providing a range of opportunities for students to use and practise the knowledge, such as having them create a quiz for their peers, or giving them multiple practice problems of gradually increasing difficulty.

- Ensuring students are given multiple opportunities to retrieve and re-visit information frequently and in different ways, such as written tests, informal question and answer sessions with the whole class, and short homework tasks.

- Considering whether peer support might enable a student to understand information in a way that makes sense to them.

- Utilising the home-school partnership by letting families and whānau know what you are currently learning, and suggesting ways that the learning can be reviewed or consolidated at home. This can be particularly important if the student is reluctant to ask for help at school.

Reducing cognitive load: There are simple steps that can be taken to reduce a student's cognitive load which may free up additional working memory space, such as:

- Not asking students to do two things at once, like listening to the teacher talking while copying things down from the whiteboard.

- Ensuring that new knowledge is presented in a way that takes into account students' prior knowledge.

- Summarising written information for the student, rather than expecting them to be able to do this.

- Avoiding the inclusion of unnecessary information alongside key information, such as adding a funny cartoon that does not contribute directly to students' understanding of the concept or content.

- Using post-it notes to quickly and simply re-direct a student's attention, or explain or suggest something to them.

- Using a mini-whiteboard for following up with individual students by, for example, revisiting key concepts and providing additional concrete examples.

- Having meaningful check-ins with the students using open questions, for example: Can you explain what you are focusing on? Can you repeat for me what you have been asked to do? This will ensure that the student understands what is required.

- Implementing a clear communication system so that students can ask for help discreetly and effectively, and teachers can discreetly check in with students.

- Reducing sensory overload: some students may benefit from sitting in a quieter part of the classroom, using noise-cancelling headphones, or having information printed out on different coloured paper.

References

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PREPARED FOR THE EDUCATION HUB BY

Cath Dyson

Cath Dyson is an RTLB (Resource Teacher of Learning and Behaviour) in Whakatū (Nelson). She is also an Autistic Advisor for Altogether Autism and has a special interest in neurodiversity, trauma-informed practice, and inclusive education.

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