Working memory

Memory Magic is an intervention designed to help children with working memory difficulties cope better in class. Participants in an action research project to evaluate its effectiveness talk to **Alison Thomas** about the outcomes

'The first "magic trick" is called Focus,' explains Sue Burns, inclusion manager of St Catherine's Catholic Primary School in Littlehampton.

'The children might be given two almost identical pictures and asked to spot the tiny differences between them. Or they might play a pairs game, where pictures are laid out face down on the table, and to match them up they have to remember where each one is. Another activity involves passing actions round – so if the first child claps their hands, say, the second child copies that, adds a new action of their own, and passes it on.

'That one went down really well with my group. They found it great fun and were surprised by how many actions they managed to hold in their heads without losing the thread. They reached six or seven by the end, which is quite challenging.

'Yet at the start, they might look at an activity and say: "That's too hard. I will never be able to do that." So one of the benefits of the intervention was the impact on their confidence.'

Memory Magic

The intervention she is describing is Memory Magic by Janie Booth, which comprises a wide variety of games and activities to teach children seven 'magic tricks' or strategies that could help them overcome some of the challenges they face in class due to a poor working memory.

After Focus, they move on to Rehearse, where they are supported to remember

Using the Rehearse strategy, children from St Catherine's Catholic Primary School try to remember items on a shopping list to put in the trolley. The children watching are also trying hard to hold the list in their heads to check if the child playing is right

items through repeating them in their heads using inner speech. Next comes Group, which includes chunking a series of numbers and grouping objects by category in order to remember them better, followed by Picture it, where children are encouraged to paint mental pictures of things or find their own engaging ways of linking unconnected images to make them more memorable.

The fifth trick is Map which, as its name suggests, is akin to mind mapping, and the sixth one is Link, which includes strategies such as acronyms, acrostics and chaining.

The series concludes with Your spell, where the children are encouraged to evaluate all the strategies they have learned and identify what works best for them.

For the pupils in Mrs Burns' group, the process of evaluation was ongoing. 'At the end of each session, I encouraged them to take what we had been practising back to the classroom, then tell me next time what they had done and how it had helped,' she says. 'As time went by, they began to get a feel for their preferred strategy. One little girl liked Picture it. "I try to picture what I am going to do and remember it before I do it," she told me, while another child said: "I like Rehearse, so I practise it in my head first."'

> ***Visuals make a massive difference to children with working memory difficulties***

Kimberley Viney, inclusion leader of Summerlea Community Primary School, also in Littlehampton, found the icons and the key fob very useful in this respect. 'A card with the icon for the trick the children are practising is laid in front of them when they are playing a game to remind them which strategy they are using,' she explains. 'These reappear on a key fob with all seven tricks on it, which they can keep in their pocket so they can access it easily in class. It's about reflection and identifying your strengths, which the older ones are able to do, but it takes the little ones a bit longer. Having the visual support helps and eventually they are able to do it too.'

Visual support is a core feature of the resource, which comes with a CD containing over 600 pictures. On a practical note, Mrs Burns warns that, first time round, you have to set aside time for printing these out and laminating them, although 'once it is done, it is done.' 'Visuals make such a massive difference to children with working memory difficulties,' she observes. 'These ones are very good – bright, colourful and very clear – and I found myself using them in other contexts too.'

Action research project

St Catherine's and Summerlea were two of four schools from the Littlehampton Locality SENCO group that participated in an action research project to evaluate the effectiveness of the resource. Conducted by education psychologist Dr Jerricah Holder and her assistant Jillen Fatania of West Sussex Council, the project involved 24 children altogether, ranging in age from seven to 11.

Teachers and SENCOs selected the participants based on who they felt would benefit most, irrespective of whether or not they were on the SEN register. In the case of Summerlea, of the six children from years 2 to 5 who took part, four had identified SEND while the other two were exhibiting behaviours in class that indicated they might benefit. Likewise, three out of Mrs Burns' four pupils were on SEN support, but the fourth was having difficulties stemming from memory issues.

On the advice of the researchers, group size was kept to a maximum of six. Otherwise, schools were free to implement the intervention as they saw fit, with the recommendation that they should use at least three activities to practise each trick and that all tricks should be covered.

How the project came about

It was the absence of any objective evaluation of the effectiveness of the intervention that prompted the launch of the project. Dr Holder and Ms Fatania had been keen to address this gap for some time, and the enthusiasm of the Littlehampton Locality SENCO group allowed them to bring this about.

'The group was interested in finding out more about how they could support children with working memory difficulties and had invited me to deliver some training on this topic,' explains Dr Holder. 'As part of the training, we looked at Memory Magic, and as we explored the rationale behind it and the different strategies involved, they could see how it might be very useful for some of their pupils. Meanwhile, in the absence of any known research, it was also identified as a great opportunity to conduct some action research of our own.'

Two pupils from Summerlea Community Primary School practise Rehearse by playing a game where they work in pairs to order food from a restaurant menu

Research to date

The crucial importance of working memory for learning is highlighted by research findings showing that working memory skills at the start of formal education are a more powerful predictor of subsequent academic success than IQ (Alloway & Alloway, 2010). There is less clarity about how to support children with working memory difficulties, however, and two main approaches have emerged.

- **The environmental approach** (e.g. Alloway and Gathercole, 2008) involves adapting the classroom environment and curriculum delivery so as not to overload the learner's working memory capacity. Strategies include giving instructions one at a time, chunking tasks and providing visual memory aids.
- **The within-child approach** focuses on developing the pupil's skills, either by training their working memory capacity with a view to increasing it (e.g. St. Clair-Thompson, Stevens, Hunt and Bolder, 2010), or by giving them strategies to help them cope better with the demands of the classroom (e.g. Booth, 2009).

Which of these strategies is likely to be most effective remains the subject of much debate. Some research supports the premise put forward in Baddeley and Hitch's original model (1974) that children's working memory capacity cannot easily be changed, and therefore favours strategies that will help them to cope; other studies suggest that working memory capacity develops until the teenage years, meaning that childhood training could be useful (Gathercole, Pickering, Ambridge and Wearing, 2004).

> ***Working memory is a more powerful predictor of academic success than IQ***

Meanwhile, claims by memory training programs like Cogmed and Jungle Memory that they improve working memory have been called into question by a number of meta-analyses, which found that improvements in recall were only observed during tasks similar to those on the program, and were therefore unlikely to impact on academic outcomes (Redick et al., 2015). Apter's (2012) review also concluded that any gains achieved through these programs are more probably the result of children discovering and learning memory strategies rather than an increase in working memory capacity.

Why Memory Magic?

- Memory Magic makes no claims to increase working memory capacity and focuses instead on providing strategies that will help children access learning.
- At the same time, it encourages educators to adopt an environmental approach and differentiate classroom practice so that the child is also working within their optimal working memory range as much as possible.
- Although the intervention itself does not have a published evidence base, the tricks do have a sound theoretical and empirical base and have been found to be effective in improving the memory recall of some children (Apter, 2012; Tayler, 2015).

Looking at Memory Magic in the context of the abundant research and conflicting views, it was clear to the researchers that it merited further investigation.

Methodology

The project set out to test the following four hypotheses.

1. Working memory capacity will not change.
2. Knowledge and awareness of memory strategies will increase.
3. Use of memory strategies will increase.
4. Impact of working memory in the classroom should decrease.

To evaluate impact, the researchers conducted the following assessments pre- and post-intervention.

- Working Memory Rating Scale – a teacher-rated assessment to assess behaviours in the classroom that are characteristic of children with working memory deficits (Alloway, Gathercole & Kirkwood, 2008).
- Digit Span Test – an assessment of auditory short-term and working memory (WISC-IV; Wechsler, 2003).
- Princess Captive Test – a story task to assess knowledge about memory strategies using a narrative format (Vianello, Cornoldi, & Moniga, 1991).
- Memory recall using pictorials – visual aids from The Children's Inferential Thinking Modifiability Test used to assess knowledge and use of memory strategies (Tzuriel, 1992).

Outcomes

The outcomes of the project suggest the intervention can be effective in supporting children with working memory difficulties.

The post-tests results showed an increase in the participants' awareness

and use of memory strategies, particularly those of a self-internal nature, such as verbal rehearsal. Furthermore, while collecting the post-intervention data, the researchers noted that several of the children were naming the specific tricks, identifying them as useful strategies and utilising them during the tasks.

Meanwhile, the teachers' responses to the teacher-rated Working Memory Rating Scale indicated a decrease of observable behaviours characteristic of children with working memory difficulties in the classroom. This suggested that the impact of working memory difficulties on children's learning was reduced.

The Digit Span Test, on the other hand, revealed no change in the children's working memory capacity, in line with hypothesis one and Badeley's original model.

Taken as a whole, the results indicate that teaching children memory strategies and giving them opportunities to explore and practise ways of processing and storing information more effectively could be instrumental in supporting them to negate some of their working memory difficulties. This is supported by the evidence base regarding the positive impact of each of the tricks on children's memory recall in Tayler's (2015) review of the Memory Magic strategies, as well as Apter's (2012) review of working memory training programmes more generally.

'Viewed alongside existing research and theory, the results are very promising,' says Dr Holder. 'However, given the small sample size and the lack of a control group for statistical comparison, they must be interpreted with caution. It's a start, but further research and statistical analysis is required.'

For this reason, Ms Fatania, who has now started her educational psychology training, will be following up the research as part of her doctorate at the Institute of Education. 'We are about to get some more robust data soon,' says Dr Holder. 'We eagerly await the results.'

FIND OUT MORE

- **Memory Magic** by Janie Booth, Stass Publications. The CD contains pre- and post-assessments, worksheets and pictures. The accompanying manual includes a discussion of memory, advice for practitioners and instructions for all the activities. www.stass.co.uk/publications/memory-magic

Insights from the schools

The intervention is entirely games based and the children at St Catherine's absolutely loved it. 'The games are differentiated, so you can add in a bit of extra challenge, which was great,' says Sue Burns. 'There's an element of drama to it too, like the stepping stone game, where the children have to remember which stone to step on. They could work together as well and give each other instructions, so it was good for participation.'

The children at Summerlea also engaged well, although the mixture of ages created a few problems. 'There's a big difference in maturity between a seven-year-old and a 10-year-old,' observes Kimberley Viney. 'That said, the children were very supportive of each other.'

Both teachers found the resource very straightforward to implement, with clear instructions for all the tasks. 'I ran it myself this time because it was new to us and I wanted to see how it would work,' says Mrs Burns, 'but it could certainly be rolled out by a TA.'

Her only minor criticism would be the lack of guidance on how often to run sessions, how many activities to include and how long the intervention might last. 'With hindsight, I think I spent too long on the earlier tricks,' she says. 'Second time around, I would streamline it more. Obviously, each child is different, so you can't be too prescriptive, but a little guidance would have been helpful.'

Ms Viney agrees that it would take far too long to do every activity. 'We were very mindful of the fact that different children will have different preferred strategies, and different preferred strategies within each trick, so we tried to cover as many as possible,' she says, 'But we tended to dip in and out, and, of course, I was led by the children. Every session, we started off by reviewing what had happened the last time for consolidation.'

Making the links explicit

With regard to optimum group size, the teachers' experiences differed slightly, and while Mrs Burns, who had opted to have four children in her group, might increase that to six in future, Ms Viney would reduce her group from six to four.

'I would also choose children of similar ages,' she says, 'and probably no younger than Year 3. I think Year 2 might struggle with concentration, although the games are fun and they know some of them already. Picture lotto, for example, is something we use regularly in Reception and Year 1.'

Indeed, many of the activities are variations on good classroom practice, but while children might play a game in class without understanding what lay behind it, the intervention makes the intention explicit.

'As adults, when we are having trouble remembering something, we instinctively look for ways of linking it to something we can't forget,' observes Mrs Burns. 'It's encouraging children to find those links as well. They are used to using things like mnemonics we have created for them, but this focuses them and encourages them to think of different ways of remembering things for themselves.

'It's about giving them tools, so that instead of panicking they can look at a task and think: "If I do this, it will help." One of the pupils in my group has dyscalculia and struggles really badly to retain numbers, and there was a noticeable impact on his confidence. There is a huge link between anxiety and maths difficulties. Anything that can reduce anxiety is going to help.'

> ***"Different children will have different preferred strategies"***

Where now?

Both teachers thoroughly recommend the resource and intend to use it again themselves, adapting the groups, times and content in line with what they have learned from the pilot. One improvement Ms Viney would envisage would be to run a preliminary session for parents.

'I called all the parents up beforehand to explain why were doing the intervention, and the children were taking the games home each time, so hopefully this was prompting parents to ask them all about it,' she says. 'But if we were able to show them the tricks at the start, so they were systematically reinforcing them at home, the impact would be massive.'

Meanwhile Mrs Burns can see potential for introducing some of the strategies into the classroom. 'It has been suggested it could be rolled out as a whole-class initiative, and the manual gives you some good classroom support suggestions,' she says. 'Unfortunately, the timetable is so pressured, that is probably impractical. But from time to time, it would be good as a quick starter activity before children embark on a task, just to say: "Let's practise this. What skill are we using? How might it help you?"'

While agreeing that the pressures of the curriculum make things difficult, Ms Viney would like to make it a priority for whole-school learning. 'If I could have a magic wand to say what I would like to come out of this, it would be to have a whole-school approach on it,' she says. 'That would obviously take time and require everyone to be on board. But working memory is so important, if we had another tool in the toolbox for everybody, I'm sure we would reap rewards.'