

For PGCE trainees

Cognition and learning

Working memory

Self-study task 8

Introduction to the self-study tasks

These self-study tasks are designed to help trainee teachers on PGCE courses learn more about teaching pupils with special educational needs (SEN) and/or disabilities. They can be used as stand-alone activities or to supplement and extend taught sessions on SEN and disability provided by the school or local authority.

There are 17 self-study tasks in all. Each task will take about two hours to complete, excluding practical activities.

Every Child Matters	
SST1	Inclusion and Every Child Matters
SST2	SEN and disability legislation
SST3	English as an additional language and SEN
SST4	Children's needs and development
SST5	ICT and SEN
Cognition and learning	
SST6	Moderate learning difficulties
SST7	Dyslexia and specific learning difficulties
SST8	Working memory
Behavioural, emotional and social needs	
SST9	Behavioural, emotional and social difficulties
Communication and interaction	
SST10	Speech, language and communication needs
SST11	Autistic spectrum disorders
Physical and sensory impairment	
SST12	Visual impairment
SST13	Hearing impairment
SST14	Handwriting
SST15	Developmental coordination disorder/dyspraxia
Working in partnership	
SST16	Working with colleagues in school
SST17	Working with parents/carers and other professionals

How to use the materials

This is an online resource. Some of the tasks are for you to do on your own; others are particularly suitable to do working with a partner.

Where some of the tasks ask you to record information you need to print out the relevant material first. Other tasks may involve using the internet, which gives you access to rich sources of information about SEN and disability and online forums for additional advice.

Each task includes the following elements:

- the professional standards addressed
- learning outcomes
- an opportunity to explore the concepts, definitions and research findings most relevant to the topic
- ideas for implementing the national curriculum inclusion statement in relation to the topic, including target setting, practical strategies, the role of additional adults and pupil grouping
- practical activities – including action research, child study and class observation
- resources – including books and websites
- an opportunity to evaluate your progress against the outcomes and plan your next steps.

A useful resource to support your studies is **Implementing the Disability Discrimination Act in Schools and Early Years Settings (DfES, 2006)**. It is available free to all schools and there should be a copy in your training institution or school. (If you haven't got a copy, you can order one using the link.)

It should be read in conjunction with **Promoting Disability Equality in Schools (DfES, 2006)** – which you can view, download or order by following the link.

Evidence and sources of information

As you work through these self-study tasks, try to keep a critical and evaluative attitude. Much of the understanding we have of what works, or doesn't work, in relation to meeting the needs of pupils with SEN and/or disabilities has not been fully researched.

Remember:

- many interventions suggested for one group of pupils with SEN and/or disabilities will often benefit other groups of pupils, including those without SEN and/or disabilities
- the quickest way to find out what to do is often to ask the pupil or their parent/carer what they think works.

Literature reviews of 'what works' in relation to literacy and mathematics for pupils with SEN and/or disabilities, which has been investigated in some depth, are available at: www.dcsf.gov.uk/research/data/uploadfiles/RR554.pdf

Other sources of information are listed at the end, under 'References'. You can use these to follow up and learn in greater depth about the material covered in this self-study task.

Self-study task 8

Working memory

Professional standards addressed

- Q1** Have high expectations of children and young people including a commitment to ensuring that they can achieve their full educational potential and to establishing fair, respectful, trusting, supportive and constructive relationships with them.
- Q10** Have a knowledge and understanding of a range of teaching, learning and behaviour management strategies and know how to use and adapt them, including how to personalise learning and provide opportunities for all learners to achieve their potential.
- Q19** Know how to make effective personalised provision for those they teach, including those whom English is an additional language or who have special educational needs or disabilities, and how to take practical account of diversity and promote equality and inclusion in their teaching.
- Q25** Teach lessons and sequences of lessons across the age and ability range for which they are trained in which they:
 - (a) use a range of teaching strategies and resources, including e-learning, taking practical account of diversity and promoting equality and inclusion
 - (b) build on prior knowledge, develop concepts and processes, enable learners to apply new knowledge, understanding and skills and meet learning objectives.

Learning outcome

You will understand how to remove barriers to participation and learning for pupils with a poor working memory.



Activities

		Timings
Activity 1	The different types of memory	15 minutes
Activity 2	Some characteristics of working memory	20 minutes
Activity 3	Working memory in the classroom	25 minutes
Activity 4	Removing barriers to participation and learning for pupils with a poor working memory	35 minutes
Activity 5	Points for action	15 minutes
References		
Appendix	Suggested answers and solutions	

Activity 1

The different types of memory



Approximate timing: 15 minutes

There are usually considered to be five types of memory:

- procedural memory – for learnt skills
- semantic memory – for facts, concepts, knowledge
- autobiographical memory – long-lasting memory system that stores facts and events from throughout your life
- episodic memory – particular memories in the relatively recent past: minutes, hours and days ago, and
- working memory – used to hold new information in the mind before it is discarded or transferred into a long-term type of memory.

Quiz: types of memory



Read table 1 and fill in the gaps – think of an example of each type of memory and how long it lasts.

Table 1: Types of memory quiz

Type of memory	Involves	Example	How long does it last?
Procedural	Learnt skills	Writing, riding a bike	Lifetime, once the skill is established
Semantic	Facts, knowledge		
Autobiographical	Stored facts and events from all your life		
Episodic	Details of particular recent experiences		
Working	Storing information for current activities		

Now compare your answers with those in **the appendix**.

Activity 2

Some characteristics of working memory



Approximate timing: 20 minutes

'Working memory' is widely used to refer to a memory system that provides a kind of mental jotting pad, briefly storing information needed for everyday activities such as remembering telephone numbers, following directions and instructions and keeping track of shopping list items while in the supermarket.

Working memory has two properties that are extremely important for a pupil trying to learn in school:

- It has a limited capacity – there is only so much information that can be held in working memory, and the information is rapidly lost when we are distracted – eg by something happening, or an unrelated thought springing to mind. There is substantial variation in different people's working memory capacity, with some people able to store much more information than others.
- If you overload your working memory or if you are distracted, this leads to a complete loss of information from your working memory. Therefore, although this mental workspace is useful and flexible, it is also very fragile. People with poor working memory capacities often struggle to meet the heavy working memory loads of many situations, particularly lessons.

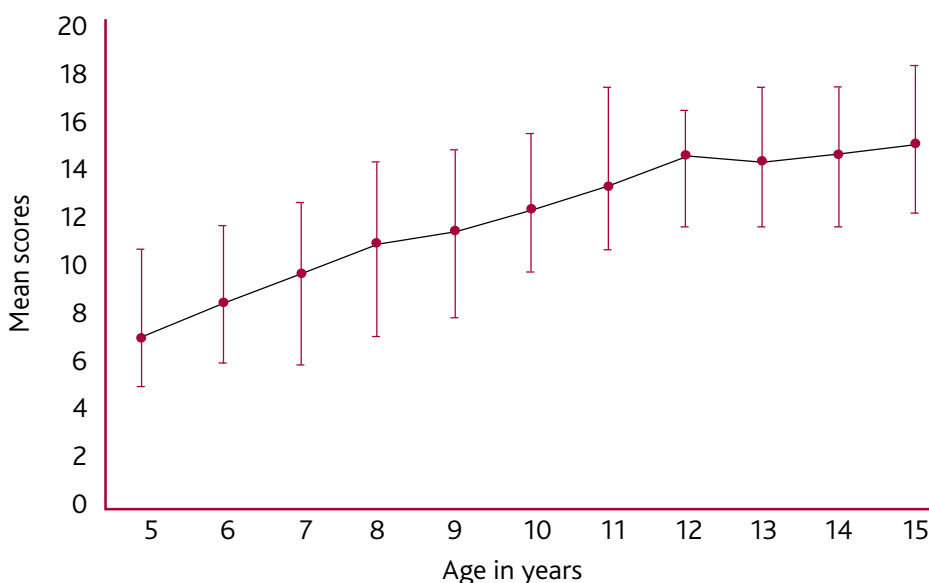
Assessing working memory

Working memory increases steadily with age between four and 14 years.

There are huge differences in working memory ability between pupils of the same age. This is illustrated in the graph below – figure 1 – which shows the wide range in scores for children in a particular age group, between those in the lowest 10 per cent of memory ability (the 10th centile) and those in the highest 10 per cent (the 90th centile).

The Working Memory Test Battery for Children (WMTB-C) can be used to assess working memory in five to 15-year-olds. The graph shows the ability of children of different ages to recall what they have heard. It gives the mean scores and the range around the mean at each age.

Figure 1: Mean scores on listening recall tests from WMTB-C, by age, showing the 10th and 90th centiles



WMTB – C, Susan Pickering and Susan Gathercole, 2001, Pearson.

As you can see from the graph, the highest 10 per cent (90th centile) of the children assessed for listening recall are typically up to four years in advance of average performance for their age, whereas lower attaining children are often behind by four years. Typically, the difference in score at a given age between the highest and lowest attainers on working memory assessments is equivalent to eight years.

Why is working memory important?

Working memory ability is important because:

- it is closely associated with the ability to learn and academic attainment
- it does not appear to be affected by factors such as prior education, socio-economic status or ethnic group, and
- it is fragile – people with a poor working memory are likely to find storing information for everyday tasks even harder if they are anxious, or distracted in other ways.

Activity 3

Working memory in the classroom

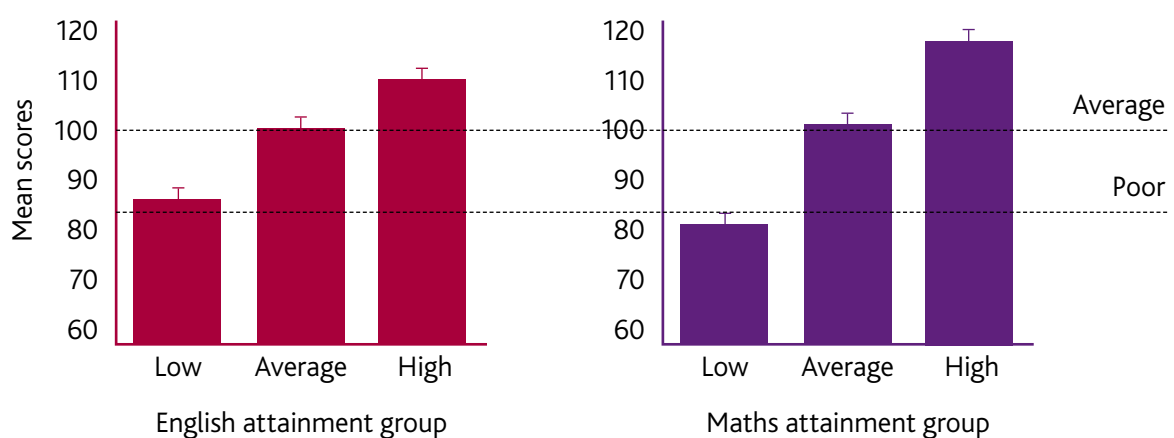


Approximate timing: 25 minutes

Evidence (Gathercole et al, 2004) suggests that pupils with a poor working memory make poor academic progress – as shown in figure 2.

Working memory and attainment at key stage 2

Figure 2: Mean working memory scores for 11-year-olds (key stage 2) in different attainment groups in English and maths



This data suggests that at key stage 2, 80 per cent of pupils with poor working memory fail to achieve the expected levels of attainment in both English and mathematics.

It has been suggested that pupils with a poor working memory experience barriers to learning when:

- the learning involves a step-by-step process, with each step based on remembering the one before
- working memory loads in the classroom are excessive, and
- pupils forget what they are doing and become inattentive.

Remember that a pupil with a poor working memory is more likely than others to suffer a total failure of memory when asked to recall facts under pressure.

Now read table 2, which gives some examples of pupils' behaviour that could be a result of poor working memory.

Table 2: Some examples of issues with working memory in lessons

The issue	The observation
Being reserved in groups	Ross, aged 6, is a reserved and quiet pupil who tends not to volunteer responses and rarely answers direct questions, particularly in the whole-class situation. He sometimes talks more when working in small groups, although he isn't necessarily discussing the task in hand. He worries about remembering the question he has been asked and the anxiety sometimes makes him forget the answer he has prepared.
Activities involving processing and storage	Ruby's year 7 class was revising prime numbers. The teacher wrote sequences of numbers on the whiteboard, read them aloud and asked the class which were the prime numbers. Ruby was unable to remember or calculate which were the prime numbers quickly enough to respond.
Following instructions	<p>"Put your sheets on the green table, arrow cards in the packet, put your pencil away and come and sit on the carpet."</p> <p>John (aged 6) moved his sheets as requested, but failed to do anything else. When he realised that the rest of the class was sitting on the carpet, he went and joined them, leaving his arrow cards and pencil on the table.</p>
Place-keeping	A year 8 class is learning history. Nathan knows that when he takes notes he should put the date at the top. He reads Monday 11 November from the board and begins to copy it laboriously. Meanwhile, the teacher is writing lines of text to be copied on the whiteboard. Nathan realises that he is getting behind and knows that the teacher is soon going to move on to another activity. He tries to speed up his copying, keeps losing his place and ends up with an incomplete page of notes with two lines missed out altogether and several key words left out. When he rereads the notes for his homework, he does not understand them.
Short attention span and easily distracted	<p>Adult comments:</p> <p>"He's in a world of his own"</p> <p>"He doesn't listen to a word I say"</p> <p>"She's always daydreaming"</p> <p>"With him, it's in one ear and out of the other"</p>
Short attention span and distractibility	Adam, aged 5, struggles to maintain his attention, particularly during whole-class teaching when all the pupils sit together on the carpet. As a result, he sits directly in front of the teacher and is frequently prompted to sit correctly and pay attention, as he regularly fidgets, looks around the classroom and distracts other pupils near him.

Poor working memory can affect pupils' ability to take part and learn in school for a number of reasons:

- Many structured learning activities place high demands on memory – pupils with a poor working memory face learning difficulties because they cannot meet the memory demands (Gathercole et al, 2008). As a consequence, their working memory becomes overloaded and they lose the crucial information they need to guide what they are doing – such as the sentence they are attempting to write or the sequence of instructions they need to follow.
- Because of the consequences of losing material from working memory – information is permanently lost through overload or distraction – the pupil cannot continue with the activity and finish it successfully unless they have access to the critical task information again. The pupil is therefore forced either to guess at this point (which is likely to lead to errors) or to abandon the task without completing it. It can be particularly damaging, for example, when a teacher sets a significant independent learning task, such as a piece of homework, in a way that makes high demands on working memory – eg by simply reading out the task to the class or writing it up on a whiteboard just before the end of a lesson. These failures on activities represent missed learning opportunities for the pupil, and the more frequent they are, the more their learning will be delayed.
- Teachers often do not spot working memory problems – Gathercole et al (2006) note that pupils with a poor working memory were rarely described by their teachers as having memory problems. Instead, they typically report the pupils as having attention problems, using descriptions such as "it's in one ear and out of the other", and "just doesn't listen to a word I say".
- Pupils 'zone out' – recent evidence indicates that pupils with low working memory spans were much more likely than others to let their minds wander when performing demanding cognitive activities (Kane et al, 2007). This phenomenon has been termed 'zoning out', and appears to be a hallmark of situations in which working memory is so overloaded that the pupil can no longer keep in mind the information needed to guide the mental activity. It seems likely that pupils with poor working memory become inattentive because they lose the crucial information needed for the activity and so shift their attention away from the task in hand. In this way, memory loss may masquerade as failure of attention.

Activity 4

Removing barriers to participation and learning for pupils with a poor working memory



Approximate timing: 35 minutes

35 mins

Read table 3, which suggests strategies for recognising and including pupils with poor working memories.

Table 3: How to recognise and include pupils with poor working memories

The classroom-based approach to poor working memory	
Principles	Watch out for
Recognise working memory failures	Warning signs include incomplete recall, failure to follow instructions, place-keeping errors, abandoning tasks or guessing at answers
Monitor pupils	Look out for the warning signs and ask pupils to let you or a buddy know if something is going too fast for them
Evaluate working memory loads	Think about the loads on working memory caused by lengthy sequences, unfamiliar and meaningless content and demanding mental processing activities
Reduce working memory loads	Reduce the amount of material to be remembered, use shorter sentences, make the material more meaningful and familiar, simplify the mental processing required and restructure your explanation of complex tasks Structure activities so that the pupil can use available resources, such as word banks Check that any new learning fits into the framework of what the pupil already knows
Repeat important information	Repetition can be supplied by teachers, teaching assistants or fellow pupils nominated as 'memory guides'
Encourage the pupil to use memory aids	These can include wallcharts and posters, useful spellings, personalised dictionaries, cubes, counters, abacus, Unifix blocks, number lines, multiplication grids, calculators, memory cards, audio recorders and computer software
Support memory through motivating approaches	Use visual or concrete ('real') materials, or activities involving movement, to reinforce learning through a range of sensory channels Plan so that the new knowledge can be tried out in a range of enjoyable applications, for example by using computer software or simulations
Develop the pupil's own strategies	Strategies can include setting up an agreed approach for the pupil to ask for help, rehearsal, note-taking, use of long-term memory, and strategies for place-keeping and organisation

A case study: Norad in personal, social and health education (PSHE)

In any class of 30 pupils there may be four or five with a poor working memory. So it is important that teachers are able to consider, in their planning, ways to remove barriers to participation and learning for these pupils.



Read through the following sketch of a PSHE lesson and the description of the pupil, Norad, and note down in table 4 anything in the plan of the lesson that you think could present barriers for Norad.

The PSHE lesson

This work is part of a series of primary-secondary transfer sessions which aim to:

- encourage pupils to see how advocacy and lobbying support community change, and
- teach them how they can help younger pupils take part in discussions about choices of action.

This lesson is to give pupils the opportunity to practise facilitating discussion in small groups.

The teacher plans to the lesson as follows:

- Explain what facilitation is and how facilitators try to keep dialogue going, without dominating it.
- Engage the class in discussion of the filmed example of a facilitator working with a group that they watched the week before.
- Put pupils in groups of four to take turns in practising facilitating discussion in which participants hold different views on contentious issues. Two of each group of four have postcards with opposing views of a fairly straightforward situation. One person is the timekeeper; one is the facilitator. The opponents have one minute each to argue for their position. Once they have spoken, the facilitator encourages a discussion lasting three minutes. The facilitator feeds back briefly on the discussion. Pupils then take new cards and swap roles until everyone has had a chance to be the facilitator. Make clear that the timekeeper can support the facilitation if necessary.
- All pupils come into a plenary discussion to consider what they have learnt.

Norad

Norad is 12. He works in low-ability groups in English and mathematics, and many activities in lessons present barriers for him. He can be very quiet in whole-class sessions and sometimes in group discussions.

He often fails to follow complex instructions – he completes the first part of the instruction but then can go no further. He also makes errors in activities that involve remembering small amounts of information at the same time as processing other material. Often he loses his place in complex tasks, making errors such as skipping important steps or repeating them.

His family has many pets and Norad is fond of his terrapin called Ron Weazley. He likes art and design and uses simple mind maps to help him remember things. He often goes around with Chaz, a pupil of his age, who sometimes acts as a buddy to him in lessons.

Table 4: Possible barriers for Norad

The lesson sequence	Possible barriers for Norad
Presentation of intended learning outcomes	
Whole-class reminder: last lesson's film and discussion	
Small groups to practise facilitation in groups of four	
Whole-class discussion of results	
Evaluation against learning outcomes	
Scope for including ideas relating to pupil's strengths and interests	
Learning environment	

Now look at the suggested barriers in **the appendix**.

Now use the information from table 3 and your thoughts from this activity to help Norad succeed in the PSHE lesson described in page 12. Record your answers in table 5.

When you have finished, compare your answers with those in **the appendix**.

Table 5: Helping Norad to succeed		
The lesson sequence	Approaches to consider	Your ideas for approaches to overcome the barriers
Presentation of intended learning outcomes	How, if at all, would you differentiate the presentation of the lesson's intended learning outcomes for Norad?	
Whole-class reminder: last lesson's film and discussion	How would you make sure Norad can contribute to the discussion?	
Small groups to practise facilitation in groups of four	How would you group the pupils for this activity? Any strategies you might use to support Norad?	
Whole-class discussion of results	How would you support Norad in joining in and remembering key points from the lesson?	
Evaluation against learning outcomes	How would you ensure that Norad could evaluate his success in the lesson effectively?	
Scope for including ideas relating to pupil's strengths and interests	What might you include that relates to Norad's strengths and interests?	
Learning environment	How might you use the learning environment to support Norad in this lesson?	

Memory training

Recent research suggests that some forms of computerised memory training might be helpful for pupils with a poor working memory. The extracts below from a study of a Swedish programme (Holmes et al, 2009) describe a promising approach which, although at an early stage of development, may prove valuable.



Read the extracts and then answer the questions on the next page and compare your answers to the answers shown in **the appendix**.

An adaptive working memory training programme: an approach with encouraging possibilities

There has been some success in boosting performance on working memory tests through strategy training, but since gains often do not extend beyond trained tasks, they are unlikely to yield substantial benefits for the multiplicity of learning situations in which children depend on working memory during learning. What is desperately needed is a training programme that delivers generalised and sustained enhancement of working memory, which can then be flexibly used to meet the demands on this system in classroom activities.

A new programme that delivers great promise in this respect is an adaptive computerised training program in which individuals engage intensively on multiple activities that tax working memory across a relatively short period (www.cogmed.com/cogmed).

Remarkable gains have been reported both on the trained tasks and on other tests of short-term memory (STM) in children with ADHD (Klingberg et al 2005) and in adult neuropsychological patients following strokes (Forssberg and Klingberg 2007). Training leads to increased activation in frontal and parietal areas of the brain and may reflect long-term cortical plasticity (Olesen et al 2004). While this training programme looks promising, its educational significance is as yet largely untested.

The team tested the programme with school-age children. These are some of their conclusions:

- there will be four or five pupils in a typical class of 30 who have working memory abilities as low as the participants in this study, and they will be progressing poorly in all areas of academic learning. This study provides the first demonstration that these commonplace deficits and associated learning difficulties can be ameliorated, and possibly even overcome, by intensive adaptive training over a relatively short period: just six weeks, typically
- the majority of the children who completed the adaptive programme, which involved intensive training of 35 minutes a day in school for at least 20 days, improved their working memory scores substantially over this period and for a further 6 months after training had been completed. The gains generalised to independent and validated working memory assessments that were not trained, and were greatest for the tests involving either the storage of visuo-spatial material, or the simultaneous storage and manipulation of either visuo-spatial or verbal material
- adaptive training had little discernible impact on measures of the children's academic progress immediately following completion of training. This is unsurprising, as any improved cognitive support for learning caused by training would be expected to take some time to work its way through to significant advances in performance on standardised ability tests. Importantly, a significant improvement in mathematics performance was found six months following adaptive training was completed. Interestingly, IQ scores did not show a comparable boost with training, indicating that although working memory and IQ are related, their contribution to learning can be distinguished in struggling learners.

This adaptive working memory training programme clearly meets the criteria for educational significance: its benefits extend to the many children whose low working memory abilities are accompanied by poor academic learning but who often fall below the radar of recognition of special needs, the gains generalise to a wide range of non-trained working memory assessments, and the training leads to detectable gains in academic performance. The nature of the precise cognitive and neural changes that underpin the dramatic gains in working memory with this adaptive training program are yet to be fully understood and will require further investigation. The experience of taxing working memory to its limits intensively over a sustained period of time may induce long-term plasticity through either improving the efficiency of neuronal responses or extending the cortical map serving working memory.

Another explanation supported by self-report data from the present is that the training programme provides the opportunity to develop their own idiosyncratic strategies to support a variety of working memory demands. By doing so, the program may promote self-awareness and the development of compensatory strategies that capitalises on personal cognitive strengths to overcome areas of weakness. It may turn out to be this self-discovery feature of the training program that yields the promising signs of generalised and long-term benefits for learning.

1 The study assessed the programme for use in what sort of settings?

2 For how long did the working memory scores of children who successfully completed the programme continue to improve?

3 What explanations do the researchers suggest for the success of the programme?

This study represents the beginning of what seems likely to be an increasingly effective response to the barriers faced in the classroom and in life by children and young people with poor working memories. As parents, teachers and their colleagues realise the significance of working memory for many impairments and SEN, the wide implementation of the conclusions of studies like this activity to be given priority.

Activity 5

Points for action



Approximate timing: 15 minutes

Spend a few minutes reflecting on this self-study task and record key points for action below.

What do I want to do next to develop my practice?

How will I do this?

What is my timescale for this to happen?

How will I know if I have been successful?

Do I need to involve anyone else in enabling this to happen?

References

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Appendix

Suggested answers and solutions

Table 1: Types of memory quiz – possible answers

Type of memory	Involves	Example	How long does it last?
Procedural	Learnt skills	Writing, riding a bike	Lifetime, once the skill is established
Semantic	Facts, knowledge	Knowing that Paris is the capital of France	A lifetime, if used often enough
Autobiographical	Stored facts and events from all your life	First day at school, a memorable birthday	A lifetime
Episodic	Details of particular recent experiences	What you had for breakfast this morning, or where you parked your car	Up to several days
Working	Storing information for current activities	Following instructions such as "when you pass the church on the left, turn immediately right and take the second left"	Seconds only

Back to activity 1, page 5

Table 4: Possible barriers for Norad – some thoughts

The lesson sequence	Possible barriers for Norad
Presentation of intended learning outcomes	Norad might have difficulty remembering the intended outcomes without some sort of support
Whole-class reminder: last lesson's film and discussion	Questions directed to Norad might contain more information than he could cope with, particularly if he can't remember the last lesson very well
Small groups to practise facilitation in groups of four	Norad might find himself in a group that offered little support to his memory and might find it hard to ask for help
Whole-class discussion of results	Norad might be very anxious about reporting on slightly contentious group work to the whole class, and might find remembering details even more difficult than usual because of this
Evaluation against learning outcomes	At the end of the lesson Norad might find he has no notes on and little recall of the stages of the lesson
Scope for including ideas relating to pupil's strengths and interests	The topic chosen for group discussion could be irrelevant to Norad or be unfamiliar to him
Learning environment	The learning environment could offer little that would support Norad's memory

Back to activity 4, page 13

Table 5: Helping Norad to succeed – what happened in the lesson?

The lesson sequence	Approaches to consider	What the teacher did
Presentation of intended learning outcomes	How, if at all, would you differentiate the presentation of the lesson's intended learning outcomes for Norad?	The teacher simplified the presentation of the outcomes to include all pupils. Each pupil had a small card with the outcomes written on it. The teacher explained each element in turn so that everyone understood at each stage and Norad did not feel hurried or anxious.
Whole-class reminder: last lesson's film and discussion	How would you make sure Norad can contribute to the discussion?	<p>Norad had created a mind map to record the messages from the film. This helped him contribute his memories of the lesson.</p> <p>The teacher framed her questions to Norad carefully and used words appropriate to his understanding. Her questions were not overloaded with content, while challenging him a little. She had noted the questions to use on her planning sheet.</p>
Small groups to practise facilitation in groups of four	<p>How would you group the pupils for this activity?</p> <p>Any strategies you might use to support Norad?</p>	<p>The pupils were in mixed-ability groups, with Norad's buddy sitting working with him and able to prompt his memory from time to time.</p> <p>Norad had a record card with symbols and text on it, taking him through the stages of the task. His buddy Chaz was scheduled to be timekeeper when Norad was facilitating, to give him support if necessary.</p> <p>Norad carries a symbols and text card on the ways he can ask for help or repetition of questions.</p>
Whole-class discussion of results	How would you support Norad in joining in and remembering key points from the lesson?	The teacher encouraged Norad to use his record card to prepare one or two key points for the plenary discussion.
Evaluation against learning outcomes	How would you ensure that Norad could evaluate his success in the lesson effectively?	<p>The record card is designed to allow Norad to evaluate his learning one stage at a time.</p> <p>The teacher checked his recall of the lesson, using his record card, and confirmed that things had gone successfully.</p>

Table 5: Helping Norad to succeed – what happened in the lesson? continued

The lesson sequence	Approaches to consider	What the teacher did
Scope for including ideas relating to pupil's strengths and interests	What might you include that relates to Norad's strengths and interests?	The teacher gave Norad a familiar situation, with limited new memory demands, to discuss in the group: Terrapins are living in a local pond and some people think they are eating ducklings. One local group is arguing that the terrapins should be killed or removed; another wants to allow them to stay until there is good evidence that they are eating ducklings.
Learning environment	How might you use the learning environment to support Norad in this lesson?	On the wall near Norad is a large poster explaining in words and cartoons exactly what a facilitator does and the key rules for debating something in a group.

Back to activity 4, page 14

Answers

1 The study assessed the programme for use in what sort of settings?	Educational settings
2 For how long did the working memory scores of children who successfully completed the programme continue to improve?	Six months
3 What explanations do the researchers suggest for the success of the programme?	'Taxing' working memory intensively may improve 'plasticity' (the ability of the brain to reorganise itself to incorporate new experiences into responses to events) or 'extend the cortical map' (develop the patterns of neurones in the brain that support memory) The programme may encourage children and young people to develop their own efficient strategies for improving their working memory

Back to activity 4, page 16