Working memory and learning

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Working memory: key features

- Capacity to hold material in mind and manipulate as necessary for brief period
- Mental workspace
- Limited in capacity
- Catastrophic loss

Development of working memory

- Working memory ability increases steadily with age between 4 and 14 years
- Huge differences in working memory ability between children of the same age

Mean scores on listening recall test from WMTB-C as a function of age, with 10th & 90th centiles

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Working memory and learning

WM ability is important because:

- it is closely associated with the ability to learn, and academic attainment
- it does not appear to be affected by experience such as prior education, socio economic status or ethnic group membership.

Links between working memory and learning:
Some evidence

- Baseline assessments
- Key stages 1, 2 and 3
- Learning difficulties

Baseline assessments:
Gathercole et al. (2003)

- Assessed within 6 weeks of school entry
- Working memory skills were strongly associated with baseline assessments of
  - reading
  - writing
  - mathematics
- Excellent predictors of KS1 maths and English levels, in Yr 2
Key Stage 2:
Gathercole et al. (2004):
Mean working memory scores as a function of English and maths attainment groups, data from 11-year olds

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<th>Low</th>
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Characteristics of children with poor working memory
- Poor academic progress
- Reserved in groups
- Difficulties in following instructions

Ross (6 years) is a reserved and quiet child who tends not to volunteer responses and rarely answers direct questions, particularly in the whole-class situation. He is sometimes becomes more vocal when working in small groups although he isn’t necessarily discussing the task in hand.

“Put your sheets on the green table, arrow cards in the packet, put your pencil away and come and sit on the carpet.”

John (6 years) moved his sheets as requested, but failed to do anything else. When he realized that the rest of the class was seated on the carpet, he went and joined them, leaving his arrow cards and pencil on the table.
### Characteristics of children with poor working memory

- Poor academic progress, particularly in reading and maths
- Reserved in groups
- Difficulties in following instructions
- Problems when activities involve processing and storage

Ruby’s teacher wrote sequences of numbers on the white board that had some numbers missing. She read aloud the numbers, and asked the class what numbers had been missed out. In each case, there was more than one number missing. In each case, Ruby was unable to name the missing numbers.

### Characteristics of children with poor working memory

- Poor academic progress, particularly in reading and maths
- Reserved in groups
- Difficulties in following instructions
- Problems combining processing with storage
- Place-keeping difficulties

When the teacher wrote on the board Monday 11th November and, underneath, The Market, which was the title of the piece of work, Nathan lost his place in the laboured attempt to copy the words down letter by letter, writing moNemarket.

### Characteristics of children with poor working memory

- Poor academic progress, particularly in reading and maths
- Normal social integration
- Reserved in groups
- Difficulties in following instructions
- Problems combining processing with storage
- Place-keeping difficulties
- Short attention span and distractibility

**“he’s in a world of his own”**

**“he doesn’t listen to a word I say”**

**“she’s always day-dreaming”**

**“with him, it’s in one ear and out of the other”**

Adam (5 years) struggles to maintain attention, particularly during whole-class teaching when the pupils join together on the carpet. Hence, he sits directly in front of the teacher and is frequently prompted to sit correctly and to pay attention as he regularly fidgets, looks around the classroom and distracts other children near him.
Why do these children struggle to learn?

- Learning is a step-by-step process, based on successes in individual learning activities.
- Children with working memory impairments often fail in the classroom because the working memory loads are excessive for them.
- Working memory failure leads to inattentive behaviour, simply because the child forgets what s/he is doing.

Identifying children with working memory problems

- Behavioural profile
- Working Memory Rating Scale (Alloway et al.)
- WISC IV Working Memory Index
- Working Memory Test Battery for Children (Pickering & Gathercole)
- Automated Working Memory Assessment (Alloway)

Supporting children with poor working memory

Two approaches

- Classroom-based support
- Working memory training
Classroom-based support

Children with poor working memory struggle to learn because of memory overload in activities designed to promote learning.

The main purpose of the intervention is to:
- minimise learning difficulties by preventing working memory overload.

Principles of the intervention outlined in the booklet:
- Understanding Working Memory: A Classroom Guide

Developed in collaboration with Professor Julian Elliott (Durham) and Dr Tracy Alloway (Stirling)

Classroom support: The principles

- Be aware of the warning signs of working memory failure
- Monitor
- Reduce amount of information to be stored
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<td>- Encourage the use of memory aids</td>
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<td>- Help the child to use strategies</td>
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Working memory training

- Training programme developed by CogMed
  - Game-style environment designed to train working memory using high-quality graphics game-style environment
  - Training on working memory tasks for 25 days over a 6-week period
  - Adaptive: individual works at span level

Training children with ADHD

- Holmes, Gathercole, Place, & Elliott (under revision)
  - 25 children with ADHD aged 8-11 years, psychostimulant medication
  - Tested on working memory (AWMA) and IQ (WASI) before and after training.

Children with ADHD

- No gains in IQ
Training children with poor working memory

Holmes, Gathercole, Dunning, & Elliott (in press). Developmental Science

- 23 children aged 8-10 years with poor verbal WM scores (<15th centile)

Pre- and post-training assessments
- Working memory (AWMA), IQ (WASI), maths, reading
- Instruction span: Touch the blue pencil then pick up the yellow ruler and put it in the red box

Children with low working memory

Gains with adaptive vs non-adaptive training in low memory children

Adaptive training: IQ, reading and maths scores

<table>
<thead>
<tr>
<th>Time of testing</th>
<th>Pre-training M</th>
<th>Post-training M</th>
<th>6th month follow-up M</th>
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<td>Measure</td>
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<td>90.86 11.52</td>
<td>92.78 9.10</td>
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<td>Reading</td>
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<tr>
<td>Mathematics</td>
<td>84.27 12.28</td>
<td>85.68 12.70</td>
<td>89.94* 9.88</td>
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Conclusions

- Working memory problems are relatively common, and are associated with:
  - low academic attainments
  - inattentive behaviour

- Encouraging signs that the problems can be alleviated by behavioural training and classroom-based support.

To find out more ....


www.york.ac.uk/res/wml
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fil.came@learning-works.org.uk
Described as 'a practical manual for assessing individual needs' Baroness Mary Warnock goes further in her foreword and suggests that 'CAP It All' is a tool kit 'that all teachers can use'. It is certainly all of these things and much more besides!

The introduction recognises that busy teachers need to identify problems before they begin to interfere with a student's learning. Not all teachers have specialist training in SEN, but they are required to cater for all students in their classes. This book will enable ANY teacher to work through a process of assessment efficiently and professionally.

Those who are familiar with Gavin Reid's work will recognise the sound research on which it is based, and those who have worked with Fil Came will rejoice to see so much that is practical and instantly usable!

Clearly organised into 10 separate areas, any teacher can go straight to the section they require by consulting the detailed table of contents.

Specialist teachers will find much within these pages to interest them and support them in their quest to develop excellent specialist practice. There is a superb glossary of assessment terms which is a helpful reminder to us all and a really useful tool when delivering INSET to colleagues. The, resources section also holds a wealth of information particularly for those involved in outreach to parents and carers. The pupil self-assessment section is interesting – exploring ways of encouraging students to take responsibility for their own learning.

CAP It All is excellent. Clear, accessible and so useful. It may perhaps appeal more to those in the primary sector where initial concerns and accurate assessments as early as possible are so vital. However, it will also prove invaluable to those of us who work with older students, enabling us all to keep clear, concise records of student development and progress.

Edwina Cole
SENCo and Head of ALC Stanbridge
Earls School
Romsey.
CAP It All!
Fil Came & Gavin Reid

Fil Came is leading consultant for Learning Works®, having previously been a teacher, Research Fellow at Bristol University and later an SEN adviser. Dr. Gavin Reid is an experienced teacher, author and international speaker. This book aims to be a practical manual for assessing individual needs and can be used as a resource bank for busy teachers, learning support staff and SEN co-ordinators who work with pupils who have learning difficulties. Its purpose is to assist the process of identification and assessment of pupils who are beginning to cause concern, due to their lack of progress in learning so that remediatory strategies can be applied to help reduce the problems.

Ten sections in the book explore the following:
- **Initial Concern**, outlines initial assessment and where to find information and evidence. Useful proforma are included.
- **Formal Assessment** examines standardised tests and advises which ones to use.
- **Informal Assessment** helps to gather information about/from the pupil. Helpful tick sheets and checklists are included.
- **Assessing Literacy Skills** advises on checks to make such as, pre-reading skill, phonological awareness, vocabulary, reading strategies used, spelling and writing.
- **Assessing Maths Skills** helps to identify concepts where difficulties are common, such as the counting system, vocabulary, syntax and the four rules.
- **Monitoring Behaviour** has checklists and assessment sheets to help record behaviour patterns over time.
- **Pupil Self-assessment sheets** help pupils to realise what type of learner they are and how they feel about their own learning.
- **Planning to make a Difference** advises on targets and Individual Educational Plans.
- The book concludes with useful websites, lists of resources and support groups.

All resource material is written in accessible language, ensuring qualifications in SEN are not required to fully access this solution-focused manual. Those working with pupils with SEN in all phases will find this a brilliant resource.

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