**Building Word-Problem Solving and Working Memory Capacity:**

**A Randomized Controlled Trial Comparing Three Intervention Approaches**

**Supplemental File**

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This Supplemental File includes the following: (1) a table with descriptions of the Cogmed activities that involve numbers or letters; (2) a table with descriptions of games in the two WPS conditions; (3) a table with an outline of the instructional content in the two WPS conditions; (4) a table providing intra-class correlations; and (5) examples of second-grade WPS intervention work.

Supplemental File Table 1

*Cogmed Activities Involving Numbers or Letters*

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Add-Up (included on six Cogmed Progress Indicator (CPI) Lessons, which index performance and improvement on WM tasks not practiced during training Lessons): Students solve single-digit addition problems in 1 min in multiple-choice format, using up/down/side arrows to answer.

Sorter: Students see boxes open to reveal numbers out of order and then click on the boxes in correct order.

Input Module with Lid: Students see a covered panel; hear a series of numbers presented aloud while the numbers are covered with a lid; and then see the panel of numbers labeled 1 - 9 and click on number in reverse order in which they were presented.

Input Module: Students see a panel of numbers labeled 1 – 9; hear a series of number of numbers presented aloud, which light up sequentially as they are read; then click on the numbers in reverse order.

Decoder: Students hear letters read sequentially as a lamp lights up for each; then reproduce the sequence by selecting 1 letter from 3 choices below each lamp.

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Supplemental File Table 2

*Content Addressed in the Two WPS Conditions*

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| Lesson(s) | Lesson Content | Focus of Lesson(s) |
| 1-11 (Unit 1: Intro) | Intervention behavior expectations; =, +, - signs; Counting strategies for addition/subtraction; Meet or Beat Your Score and strategies; Checking if answers make sense; “Find What’s Missing!” strategy; Bar graphs/pictographs; Double-digit addition/subtraction; Labels; Parts of sentences | Equal sign as a relational symbol; Addition and subtraction concepts, inverse relation between adding/subtracting, meaning of subtraction as take away and as equalize, missing addends; Commutative property of addition/addend order; Solving for missing number (\_\_\_) in addition and subtraction number sentences |
| 12-20(Unit 2: Total) | Intro to Total problems; Intro to RUN!; Solving Total problems; Irrelevant information; Double-digit problems; Money problems; Problems with graphs; Missing information in varied positions; 3-part problems | Addition concepts; Understanding the central mathematical event in Total problems; Setting up problem-model number sentences to correspond to the structure of Total word problems; Solving for the missing number (\_\_) in the problem-model number sentence; Evaluating the reasonableness of solutions |
| 21-29(Unit 3: Difference) | Intro to Difference problems; Graphs; Compare/Contrasting Total and Difference problems; “Compare” words; “Greater Gator” and “Cover” strategies; Irrelevant information; Double-digit problems; Money problems; Problems with graphs; Missing information in varied positions; Review of Total/ Difference problems | Subtraction concepts; Understanding the central mathematical event in Difference problems; Setting up problem-model number sentences to correspond to the structure of Difference word problems; Solving for the missing number (\_\_) in the problem-model number sentence; Evaluating the reasonableness of solutions  |
| 30-38 (Unit 4: Change) | Intro to Change-Bigger problems; Intro to Change-Smaller problems; Compare/Contrast Total, Difference, Change problems; Irrelevant information; Double-digit problems; Money problems; Problems with graphs; Missing information in varied positions; 2-Change problems; Review all three problem types | Change concepts; Understanding the central mathematical event in Change problems; Setting up problem-model number sentences to correspond to the structure of Change word problems; Solving for the missing number (\_\_) in the problem-model number sentence; Evaluating the reasonableness of solutions  |
| 39-45 (Unit 5: Review)  | Mixed review of and practice with all problem types | Total/Difference/Change concepts; Understanding of the central mathematics events in Total/Difference/Change problems; Set up problem-model number sentence to correspond to the structure of word problems; Solve for the missing number (\_\_), as expressed in problem-model number sentences; Evaluating the reasonableness of solutions  |

Supplemental File Table 3

*Games in the Two WPS Conditions (and Lessons Played)*

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Condition: WPS (without WM Training)

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Biggest Number Game: Student identifies the operation and the location of the Biggest number in an addition or subtraction equation. Student explains why the Biggest number is first/last. (Lessons 1-5)

Find What’s Missing! Game: Student identifies the operation and the location of the Biggest number in an addition or subtraction equation. Student explains why the Biggest number is first/last. Then, student uses Find What’s Missing! steps to solve for the missing number. (Lessons 7-11, 15, 18, 26, 32, 40, 44)

Total Game: Student creates a Total word problem to match a given number sentence. (Lessons 14, 16, 17, 19, 20, 35)

Greater Gator Game: Student circles the two things being compared in a compare sentence. Next, student uses Greater Gator cards to decide < or > sign. Student labels the Bigger and smaller amounts. (Lessons 22-24, 28, 33, 37)

Sorting Game: Tutor reads a word problem out loud. Student identifies the problem type (Total, Difference, Change). (Lessons 25, 27, 29, 31, 34, 38, 39, 42, 43, 45)

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Condition: WPS+MWM (with WM Training)

Biggest Number Memory Game: Student identifies the operation and the location of the Biggest number in an addition or subtraction equation. Student explains why the Biggest number is first/last. *Student recalls the Biggest number.* (Lessons 2, 4)

Find What’s Missing! Memory Game: Student identifies the operation and the location of the Biggest number in a number sentence. Student explains why the Biggest number is first/last. Then, student uses Find What’s Missing! steps to solve for the missing number. *Student recalls the missing number.* (Lessons 8, 10, 15, 18, 33, 37)

Greater Gator Memory Game: Student identifies the two things being compared in a compare sentence. Next, student uses Greater Gator to decide < or > sign. Student labels the Bigger and smaller amounts. *Student recalls the < or > sign.* (Lessons 22, 25, 28)

Sorting Memory Game: Student matches 3 word problems to corresponding problem type (Total, Difference, Change). (Lessons 42, 45)

Adding Memory Game: Tutor reads addition problems out loud. Student solves each problem verbally, then recalls the answers to each problem in the correct order. Trials increase in Span following 4 consecutive correct trials or decrease in Span following 4 consecutive incorrect trials. (Lessons 1, 3, 5, 7, 9, 11)

Total Memory Game: Tutor reads Total word problems out loud. After each word problem, student states the label and the number sentence with the answer. Student recalls the answers to each word problem in the correct order. Trials increase in Span following 4 consecutive correct trials or decrease in Span following 4 consecutive incorrect trials. (Lessons 14, 16, 17, 19, 20)

Difference Memory Game: Tutor reads Difference word problems out loud. After each word problem, student states the label and the number sentence with the answer. Student recalls the answers to each word problem in the correct order. Trials increase in Span following 4 consecutive correct trials or decrease in Span following 4 consecutive incorrect trials. (Lessons 23, 24, 26, 27, 29)

Change Memory Game: Tutor reads Change word problems out loud. After each word problem, student states the label and the number sentence with the answer. Student recalls the answers to each word problem in the correct order. Trials increase in Span following 4 consecutive correct trials or decrease in Span following 4 consecutive incorrect trials. (Lessons 31, 32, 34, 35, 38)

Problem Type Memory Game: Tutor reads Total, Difference, and Change word problems out loud. After each word problem, student identifies the problem type. Next, student states the label and the number sentence with the answer. Student recalls the answers to each word problem in the correct order. Trials increase in Span following 4 consecutive correct trials or decrease in Span following 4 consecutive incorrect trials. (Lessons 39, 40, 43, 44)

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Supplemental File Table 4

*Intra-Class Correlation (ICC) Coefficients Indexing Dependency of Outcomes at the Classroom-level (Level 2) and School-Level (Level-3)*

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| --- | --- | --- |
|  | Classroom-level ICC | School-levelICC |
| Post visuospatial WM [VSWM] | .048 | .005 |
| Post verbal-numerals WM [NWM] | .027 | .007 |
| Post verbal-sentences WM [SWM] | .073 | .058 |
| Post verbal WM word problems [WPWM] | .032 | .045 |
| Post Arithmetic | .067 | .156 |
| Delay Arithmetic | .070 | .127 |
| Post WPS | .006 | .001 |
| Delay WPS | .024 | .003 |

 *Notes.* Post is posttest; Delay is delayed posttest. WPS is word-problem solving.

**SFF1: Examples of Second-Grade WPS Intervention Work**

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