IDEAs that Work
Office of Special Education Programs
U.S. Department of Education

Readiness
Individual
Algebra:
Teaching of
Supporting

Improving Algebra Readiness for Middle School Students: A Literature Review

Stacy M. Hirt, Jennifer M. Gonzalez, Sarah R. Powell, & Leanne Ketterlin-Geller
(with Erica Mason & Erica Lembke)

What is the effect of mathematics interventions for middle-school students with learning difficulties or disabilities?

- Published 1992-2017
- Published in English
- Participants in grades 6, 7, or 8
- Participants with learning difficulties or mathematics difficulties
- Mathematics intervention

Identified 1,965 studies with 51 meeting all inclusion criteria

Characteristic	*n*
Publication year	
1990s	6
2000s	15
2010 - 2016	30
Math content	
Operations	13
Fractions	6
Problem solving	28
General skills	3
Algebra	4
Geometry	1
Instructional group size	
<8	19
8 or more	33
Sample size	
<25	24
25 to 50	10
51 to 100	4
>100	10
Total sessions	
<10	5
10 to 20	18
21 to 30	7
31 to 50	8
>50	5
Total hours	
<10	18
10 to 20	12
21 to 30	3
31 to 50	4
>50	5

Study	Design	*N*	Grade	*N* IEP	Math content	Interventionist	Description of conditions; Interventionist	Intervention: Sessions	Intervention: Hours
Barrett et al. (2011)	Group	15	6, 7, 8	15	Operations, problem solving	GEN Teacher	T1: dyad intervention T2/C: BAU	30	25
Bornfield (1992)	SCRD; group	9	7, 8	0	Operations, fractions, general skills	Researcher	T1: data-based instruction using CBA data; content derived from error analysis of student work T2/C: CBA-probes only	6	2
Bottge (1999)	Group	36	8	5	Operations, problem solving	GEN Teacher	T1: contextualized math instruction T2/C: word problem instruction	10	5
Bottge et al. (2001)	Group	75	8	25	Operations, problem solving	GEN Teacher, SPED Teacher	T1: enhanced anchored instruction, explicit instruction, procedural computation T2/C: BAU	10	15
Bottge et al. (2014)	Group	335	6, 7, 8	159	Operations, fractions, problem solving	GEN Teacher	T1: enhanced anchored instruction, explicit instruction, procedural computation T2/C: BAU	94	82.25
Bottge et al. (2015)	Group	471	6, 7, 8	134	Operations, fractions, problem solving	GEN Teacher	T1: explicit instruction T2/C: BAU	68.5	68.5
Bouck et al. (2009)	SCRD	3	6	3	Operations	GEN Teacher	T1: computer instruction T2/C: BAU	16	2.7
Butler et al. (2003)	Group	115	6, 7, 8	42	Operations, fractions, problem solving	SPED Teacher	T1: CRA T2/C: BAU	10	7.5
Butler (2014)	Group	47	7	26	Fractions	GEN Teacher	T1: enhanced anchored instruction, explicit instruction on procedural computation and problem solving	17	n/a
Cade (2002)	SCRD	3	6, 7, 8	3	Operations, general skills	GEN Teacher	T1: mnemonic instructional strategy T2/C: BAU	22	1.8
Choo (2017)	Group	57	7, 8	32	Operations, fractions, problem solving	GEN Teachers	T1: enhanced anchored instruction T2/C: BAU	38	38
Cleary et al. (2017)	Group	22	7		Operations	GEN Teacher	T1: self-monitoring T2/C: BAU	28	11.7
Cornelius (2013)	Group	45	7, 8		Operations	GEN Teacher	T1: direct instruction T2/C: BAU	48	36
Crawford et al. (2016)	Group	51	4, 5, 6	22	Operations	Computer	T1: computer-based instruction T2/C: BAU	18	12
Cuenca Carillo et al. (2015)	SCRD	6	6, 7, 8	6	Operations	SPED Teacher	T1: mnemonic T2/C: BAU	48	13.5
Daniel (2003)	Group	18	6, 7, 8	18	Operations	Researcher	T1: word problem solving T2/C: BAU	16	8
Elissa et al. (2013)	Group	31	6	31	Problem solving	GEN Teacher	T1: differentiated instruction scripted lessons T2/C: BAU	3	2.1
Fletcher et al. (2010)	SCRD	3	6, 7, 8	3	Operations	SPED Teacher	T1: explicit instruction on TouchMath T2/C: BAU	16	2.7
Flores et al. (2007)	Group	30	7		Operations, fractions	GEN Teacher	T1: direct instruction T2/C: BAU	14	7
Franklin (2016)	Group	189	8		Operations	GEN Teacher	T1: direct instruction with MathConnection T2: BAU with AIMSweb	45	41.25
Freeman-Green et al. (2015)	SCRD	6	8	6	Operations	Researcher	T1: explicit instruction with mnemonics SOLVE strategy	28	17.5
Harris (2009)	Multiple treatment	43	6, 7	43	Algebra	Researcher	T1: direct instruction, PALS, self-monitoring T2: direct instruction	10	15
Haynes (2011)	SCRD	4	7	4	General skills	Researcher	Phase 1: test-taking strategy instruction	n/a	0.5–1.5/session
Hunt (2014)	SCRD	3	6, 7, 8		Fractions	Researcher	T1: abstract ration equivalency instruction T2/C: BAU	45	18.8
Jitendra et al. (2002)	Group	6	8	6	Problem solving	SPED Teacher	T1: schema-based strategy instruction T2/C: BAU	8	5
Jitendra (2009)	Group	149	7	15	Problem solving	GEN Teacher	T1: schema-based instruction T2/C: BAU	10	6.7
Jitendra (2016)	Group	148	7	15	Operations, fractions, problem solving	GEN Teacher	T1: schema-based instruction with self-monitoring T2/C: BAU	10	6.7
Jitendra (2017)	Group	399	7		Operations, fractions, problem solving	GEN Teacher	T1: schema-based instruction T2/C: BAU	30	23.8
Joseph (2001)	SCRD	3	8	3	Fractions, problem solving	SPED Teacher	T1: Self-monitoring cue cards T2/C: BAU	27	9
Krawec (2013)	Group	77	7, 8		Problem solving	GEN Teacher	T1: Solve It! T2/C: BAU	31	16.8
Maccini (2000)	SCRD	3	8		Operations, problem solving	Researcher	T1: CSA instruction, problem solving strategies with self-monitoring strategies T2/C: BAU	31	16.8
Mills (2012)	Group	25	8	25	Operations, fractions, problem solving	GEN Teacher	T1: problem solving instruction T2/C: BAU	180	165
Montague (1992)	SCRD	6	6, 7, 8	6	Problem solving	Researcher	T1: cognitive strategy instruction T2: metacognitive strategy instruction	3	2.75
Montague (1993)	Group	72	7, 9	24	Operations, problem solving	Researcher	T1: direct instruction on problem solving T2: explicit instruction on problem solving T3: combined T1 and T2	12	10
Montague (2011)	Group	319	8	32	Problem solving	GEN Teacher	T1: Solve It! T2/C: BAU	140	128.33
Montague (2014)	Group	644	7, 8		Problem solving	GEN Teacher	T1: Solve It! T2/C: BAU	160	146.67
Monye (2016)	Group	106	7		Operations, problem solving	GEN Teacher	T1: direct instruction T2/C: BAU	18	13.5
Moore (2014)	Group	146	6, 7, 8		Operations	GEN Teacher	T1: direct instruction T2/C: BAU	36	47.9
Murthy (2016)	Group	69	6		Operations, Problem solving	GEN Teacher	T1: self-monitoring T2/C: additional instruction	30	23
Na (2009)	SCRD	4	6, 7	4	Problem solving	n/a	Phase 1: problem schemata instruction Phase 2: problem solution instruction	4	2.67
Naglieri & Johnson (2000)	SCRD	19	6, 7, 8	19	Operations, fractions	School psychologist/teacher	Phase 1: facilitating students' planning	n/a	0.5/session
O'Melia & Rosenberg (1994)	Multiple treatment	171	6, 7, 8	68	n/a	Teachers	T1: cooperative homework teams T2/C: no cooperative homework teams, all other conditions being similar	n/a	n/a
Root (2016)	SCRD	3	6, 7	3	Problem Solving	Researcher	Phase 1: modified schema-based instruction	n/a	n/a
Sheriff & Boon (2014)	SCRD	3	6, 7, 8	3	Problem Solving	SPED Teacher	Phase 1: computer-based word problem solving	n/a	0.33/session
Shin & Bryant (2017)	SCRD	3	6, 7, 8	3	Problem Solving	Researcher	Phase 1: computer-assisted instruction (modeling, guided practice, cognitive, and metacognitive strategies)	n/a	0.5/session
Shumate et al. (2012)	SCRD	5	8	5	Algebra; geometry	Teacher	Phase 1: culturally responsive instruction Phase 2: modified culturally responsive instruction (e.g., manipulatives, puzzles, increased number of culturally relevant examples)	n/a	0.5–0.58/session
Talbot (2016)	Multiple treatment	27	8	25	Algebra	Teacher	T1: online algebra intervention with virtual manipulatives T2/C: online algebra intervention	15	7.5
van Garderen (2007)	SCRD	3	8	3	General skills; Problem solving	Researcher	Phase 1: explicit instruction about how to generate diagrams Phase 2: strategy instruction (one-step word problems) Phase 3: strategy instruction (two-step word problems)	n/a	0.58/session
Watt & Therien (2016)	Treatment comparison	NR	6	NR	Fractions	Interventionist	T1: pre-teaching and CRA T2/C: supplemental reading group	10	5
Witzel (2005)	Treatment comparison	182	6, 7	49	Algebra	Gen Ed Teacher	T1: CRA T2: direct instruction using abstract equations	19	15.83

Combination of interventions researched with group and single case design

Majority of interventions used explicit instruction, CRA, self-monitoring, or schema instruction (Gersten et al., 2009)

Majority of interventions focused on **operations** or **problem solving**

Need more interventions focused on fractions given importance of fraction knowledge for algebra

Majority of interventions included fewer than 20 sessions and less than 20 hours of additional support

Need more time spent in intervention as middle school students exhibit large gaps in mathematics knowledge

Majority of implementers were general education teachers

Need to ensure that all educators are adequately prepared to teach students with learning difficulties

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