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Proportional Reasoning Interventions in Special Education Synthesis Coding Protocol

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Proportional Reasoning Interventions in Special Education Synthesis Coding Protocol

This coding protocol was developed in correspondence with the publication Nelson et al. (2020).

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Study Information and Intervention Feature Codes

Variable	Code	Explanation
Year	Enter the year of publication	
Location	Selected <u>one</u> : 0 = US 1 = Other	Country where the data were collected
Design	Selected <u>one</u> : 0 = Pre-test and post-test	Codes defined as:

	1 = Pre/post-test and delayed post-test 2 = Post-test only 3 = Cross-over design 4 = Single case 5 = Other	<ul style="list-style-type: none"> • Pre-test and post-test = Researchers gave both a pre- and post-test to measure the effect of the treatment • Pre-/post-test and delayed post-tests = Researchers gave a pre-, post-, and delayed post-test to measure the effect of the intervention • Post-test only = Researchers gave only a post-test to measure the effect of the treatment • Cross-over = Researchers used a cross-over design; note: only the pre-test and mid-point (cross-over point) were used to measure the effect of the intervention. This was re-coded as pre-test and post-test (0) for analyses • Single case = single study, single case design, multiple baseline, etc. • Other = other design, make note of what design was used.
Independent Groups	Selected <u>one</u> : 0 = not independent groups 1 = independent groups	Codes defined as: <ul style="list-style-type: none"> • Not independent = more than one treatment group was compared to the <i>same</i> control group • Independent = One treatment group, and only one treatment group, was compared to one control group
Assignment to treatment	Selected <u>one</u> : 0 = Random, student level 1 = Random, teacher/classroom level 2 = Random, school level 3 = Random, level not specified 4 = Matching 5 = Not random, specified 6 = Not reported	How did researchers determine which students were in what condition?
Nature of treatment condition	Selected <u>one</u> : 0 = Supplants/replaces core 1 = Supplements/adds to core	Codes defined as:

	2 = Supplements and supplants 3 = Not reported	<ul style="list-style-type: none"> • Supplants = the intervention completely replaced the core curriculum (this may include remedial programs for students with disabilities) • Supplements = the intervention added to or supplemented the core curriculum and did not replace any part of the core • Supplements and supplants = the intervention replaced <i>part</i> of the core curriculum (e.g., intervention took place during the last 20 min of regular math instruction) • Not reported = no information provided regarding the nature of the treatment condition
Nature of control condition	Selected <u>one</u> : 0 = Business as usual (BAU) controlling time 1 = BAU not controlling for time 2 = Other math intervention, controlling for time 3 = Active control, controlling for time (non-math instruction or math intervention, but some other activity such as a reading intervention, free time) 4 = Not reported and not able to determine if regular control received regular math instruction, other intervention, etc.	Codes defined as: <ul style="list-style-type: none"> • BAU controlling for time = regular classroom mathematics instruction, intervention and control groups received approximately the same total amount of math instruction • Business as usual NOT controlling for time = regular mathematics instruction, intervention group did not receive the same amount of math instruction • Other math intervention = treatment and control groups both received math interventions • Active control = another activity such as a reading or games controlling for time; • Not reported = no information provided by study about control condition
Time of Math Instruction is Controlled	Selected <u>one</u> : 0 = No 1 = Yes 2 = Not able to determine	<ul style="list-style-type: none"> • No = the treatment and control did not receive the same total amount of math instruction time • Yes = the treatment and control received the same amount of total math instruction time

		<ul style="list-style-type: none"> Not able to determine = not able to determine if the treatment and control received the same amount of math instruction time
Instructional arrangement	Selected <u>as many</u> codes that apply: 0 = One-on-one instruction 1 = Small group 2 = Mixed, flexible grouping 3 = Whole Class 4 = Not reported	Codes defined as: <ul style="list-style-type: none"> One-on-one instruction = students received instruction individually, including computer-administered interventions Small group = students received instruction in a small group setting of ~2 to 5 students Mixed = students received instruction in flexible grouping (changed depending on lesson), including whole class, small groups, and individual Whole class = regular classroom instruction Not reported = study did not report instructional arrangement
Intervention agent	Selected <u>one</u> : 0 = Researcher 1 = Teacher 2 = Other school staff 3 = Mixed 4 = Computer-administered 5 = Not reported	Codes defined as: <ul style="list-style-type: none"> Researcher = a trained researcher or assistant for the specific purpose of conducting the study provided the intervention Teacher = Regular classroom teacher implemented the intervention Other school staff = Other school staff (not specified if intervention agent was the classroom teacher) implemented the intervention material; include staff hired by school to provide interventions such as retired school teachers; includes paraprofessionals Mix = mix of researchers, teachers, and school staff implemented the intervention Computer-administered = intervention content was delivered via computer or electronic device Not reported = not reported or not able to determine

Duration	Days, weeks, or months of the intervention; recoded as number of weeks .	Coded as total duration of the intervention as the time from the first session to the last session (unless specified in the study that total intervention time was specifically a different amount of time). <i>Leave blank if not directly reported by the study.</i>
Intensity	Number of sessions per day, week, month, recorded as anecdotally given in the text of the article	Coded as the frequency of the intervention (e.g., 2 sessions per week, 10 sessions per month). <i>Leave blank if not directly reported by the study.</i>
Number of sessions	Total number	Coded as the total number of sessions that the intervention lasted; for analyses, this variable was calculated if the total number of sessions was not provided (i.e., total number of weeks \times number of sessions per week). <i>Leave blank if not directly reported by the study.</i>
Length of session	Record as Minutes	Coded as the average number of min each intervention session lasted, sometimes a range is given. <i>Leave blank if not directly reported by the study.</i>
Total instructional time	Record as Minutes	Coded as the total number minutes of instruction, sometimes a range is given. <i>Leave blank if not directly reported by the study.</i>
Short Description of the Intervention	Copy and paste, or your summary	In 2-3 sentences, briefly describe the intervention. This can be a copy and paste from the article.
Progress monitoring in treatment and/or control	Selected one : a) 1 = Yes b) 0 = No, or not reported	Coded yes or no if authors monitored progress on the effect of the intervention (i.e., CBM) during the intervention period. This included administering assessments during the intervention period that were not the pre-test, post-test, or delayed post-test administrations.
Scripted Lessons	Selected one : 0 = No, or not reported 1 = yes	Study states the intervention used scripted lesson plans.
Teacher Modeling	Selected one : 0 = No, or not reported 1 = yes	Study states the intervention used teacher modeling, modeling, demonstrating of concepts/steps.
Guided Practice	Selected one :	Study states the intervention used guided practice.

	0 = No, or not reported 1 = yes	
Independent Practice	Selected <u>one</u> : 0 = No, or not reported 1 = yes	Study states the intervention allowed for independent student practice/work time.
Scaffolded Instruction	Selected <u>one</u> : 0 = No, or not reported 1 = yes	Study states that the intervention scaffolded instruction (e.g., breaking down steps into manageable steps).
Corrective Feedback	Selected <u>one</u> : 0 = No, or not reported 1 = yes	Study states the intervention scripts provided teachers with options for corrective feedback, or the study states errors were corrected.
Positive Reinforcement	Selected <u>one</u> : 0 = No, or not reported 1 = yes	Study states the teacher used a positive behavior tactic such as verbal praise, giving stickers or points, etc.
Explicit and Systematic Instruction	Selected <u>one</u> : 0 = No, or not reported 1 = yes	Study states features of explicit and systematic instruction were used (note: we are coding for some of those features, but sometimes authors simply state “explicit and systematic instruction.”
Pictorial and Schema Representations	Selected <u>one</u> : 0 = No, or not reported 1 = yes	Study states the intervention used pictorial representations such as double number lines, diagrams. Was it the use of the schematic or concept map? Was it a double number line?
Pictorial and Schema Representations (Justification)	Anecdotal	Add justification sentence or description about why you selected yes for “pictorial and schema representations.”
Concrete representations	Selected <u>one</u> : 0 = No, or not reported 1 = yes	Study states the intervention used concrete manipulatives such as different colored counting cubes.
Concrete-representational-abstract or concrete-semi concrete-abstract (CRA)	Selected <u>one</u> : 0 = No, or not reported 1 = yes	Study states the intervention specifically used the CRA method to teach concepts, teaching concepts in a framework/sequence.
Developmental progressions	Selected <u>one</u> : 0 = No, or not reported	Study states the intervention focused on student’s developmental progressions/trajectories.

	1 = yes	
Emphasized student actions or verbalizations	Selected one : 0 = No, or not reported 1 = yes	Study states the intervention emphasized student actions or verbalizations in instruction.
Gave think time	Selected one : 0 = No, or not reported 1 = yes	Study states that the intervention allowed for student think time.
Opportunities for student discourse/discussion	Selected one : 0 = No, or not reported 1 = yes	Study states that the students were given opportunities to engage in discussion/discourse.
Metacognition	Selected one : 0 = No, or not reported 1 = yes	Study states that the teacher modeled a metacognitive strategy such as using a “think aloud” process, or a process for monitoring their work/understanding, or reflecting on their process.
Underlying problem structure	Selected one : 0 = No, or not reported 1 = yes	Study states that the intervention focused on teaching students the underlying structure of problems.
Procedural flexibility/solving problems in many different ways	Selected one : 0 = No 1 = yes, unspecified 2 = yes, specified routine expertise 3 = yes, specified adaptive expertise	Study states that the intervention helped develop procedural flexibility so that students understood how to solve math problems in many different ways using appropriate methods. Routine expertise = student is able to fluently and efficiently solve problems using a variety of appropriate methods. Adaptive expertise = student is able to determine if a specific procedure applies to that problem type using conceptual understanding.
Other Features	Record Specific Information	Are there any other instructional features in the article that were not captured in the coding?

Dependent Measures Codes

Variable	Code	Explanation
Measure Name (NOTE: each measure gets its own line in the Excel file)	Name of the test	E.g., Test of Mathematics Ability – 3 rd Edition

Measure Citation	APA brief in-text citation	You do not need the full APA citation, just what is provided in text, such as (Clarke & Shinn, 2004)
Description	Skills measured	Described the measure and what skills were assessed.
Alignment of measures to the intervention (also same code as “type of primary measure”)	<p>Selected one for all measures:</p> <p>0 = Proximal, comprehensive 1 = Distal, comprehensive 2 = Proximal, narrow 3 = Distal, narrow</p>	<p>Codes defined as:</p> <ul style="list-style-type: none"> • Proximal = aligned to the intervention (e.g., researcher developed measure, measure of proportional reasoning skills specific to the intervention) • Distal = not closely aligned to the intervention (e.g., achievement test such as the WJ-III, calculation fluency) • Comprehensive = measures more than one narrow skill, a broad test • Narrow = measures one specific skills (e.g., numeral identification only, subtraction only)
Type	<p>Select one:</p> <p>0 = norm-referenced 1 = researcher developed 2 = Not reported, unsure</p>	<p>Codes defined as:</p> <ul style="list-style-type: none"> • Norm-referenced = the primary measure is norm-referenced and this was determined by author report, or correspondence with the test publisher or author of the measure (e.g., Woodcock Johnson, SAT-10, SESAT. • Researcher Developed = the measure is not norm-referenced (e.g., research developed for the purpose of the intervention). This includes measures that are widely available through publishers, but are not norm-referenced. • 2 = If you are unsure or it is not reported.
Reliability	<p>Reliability estimates separated by “;”</p> <p>Coded as: SH: split half reliability TR: test-retest reliability IC: internal consistency CA: Cronbach’s AF: alternate form IR: Inter-rater scoring</p>	<p>Coded estimates of reliability for all measures; this included: test-retest, split-half, alternate form, and Cronbach’s alpha.</p> <p>Examples (always re-code % as decimals): TR: .87; SH: .82 R: good, meets standards</p> <p>Always list all estimates given.</p>

	Omega: Omega reliability O: other R: reliability	
Validity Estimates and Sources	Validity estimates with other measures, copy/paste	<i>Not always provided for every measure.</i> Coded estimates of validity of the primary measure with other mathematics measures (i.e., correlations). E.g., “authors reported .87 predictive validity of their researcher measure with the SAT-10.”
Delayed post-test	Selected one : 0 = No 1 = Yes	Code yes or no. Sometimes this is referred to as a maintenance test.
Delayed post-test time	Weeks, months recode to weeks .	Recorded the length of time (as weeks) between the end of the intervention and the delayed post-test.

Participant Demographics Codes

Variable	Code	Explanation
Pre Total N	Number	This is the sample size of the entire sample (treatment and control) at the beginning of the study.
Post Total N	Number	This is the sample size of the entire sample (treatment and control) at the end of the study.
Pre TRT N	Number	This is the sample size of the treatment (TRT) at the beginning of the study.
Post TRT N	Number	This is the sample size of the treatment (TRT) at the end of the study.
Pre CTRL N	Number	This is the sample size of the control/comparison (CTRL) at the beginning of the study.
Post CTRL N	Number	This is the sample size of the control/comparison (CTRL) at the end of the study.
Age	Mean age of participants coded years.	Coded as years; converted “months” to years and “years, months” to years. For example, 3 years, 6 months would be

		recoded as 3.5 years. Or 6 years 3 months would be recoded as 6.25 years.
Grade	Grade	Codes as grade level of participants. If there are multiple grade levels in the same sample, separate all by a “,” for example 6, 7, 9, NOT 6-9.
Demographic Reporting Level (use appropriate columns in Excel file)	Select one : 0 = Study level only 1 = Group level	<ul style="list-style-type: none"> • Study Level = the study gave demographics such as gender, race, etc. for the study level only and did not disaggregate by group. • Group level = the study may have given study level demographics, but demographics were also disaggregated by group (treatment, control) too.
Males, Females (TRT and CTRL separately)	Number of participants identified as: a) Female b) Male	Total number of participants identified in each category.
Race/ethnicity (TRT and CTRL separately)	Number of participants identified as: a) White b) Black/African American c) Asian American d) Hispanic/Latino e) Other	Total number of participants identified in each category.
English Learners (EL; ELL) and Limited English Proficient (LEP) (TRT and CTRL separately)	Number, always convert to a number if (%) is given	Total number of participants identified as English Learners or having Limited English Proficiency (US studies only).
Free/reduced lunch (TRT and CTRL separately)	Number, always convert to a number if (%) is given	Total number of participants identified as receiving free or reduced-price lunch (US studies only). For foreign studies, SES information recorded anecdotally.
Disability (TRT and CTRL separately)	Number, always convert to a number if (%) is given	Total number of participants identified as having a documented disability or as receiving special education services.

Learning Disability (LD) and Mathematics Difficulty (MD) Definitions

Variable	Code	Explanation
Learning Disability (LD)	Select one : 0 = No, not reported 1 = yes	Study states that the sample specifically included students with learning disabilities (this does not refer to special education generally). <i>Sometimes referred to as math disability or math learning disability.</i>
LD <i>N</i>	Number	How many total students in the sample had LD?
LD Criteria	Note all that apply: 0 = percentile cutoff 1 = state or district criteria 2 = documented 3 = IEP math goal 4 = Other	<ul style="list-style-type: none"> • Percentile = authors used a percentile to state students had LD, such as performing below the 10th percentile on a measure of math achievement • State or district criteria = Authors stated that participants had LD according to state or district criteria • Documented = Authors stated that the participants had <i>documented</i> LD • IEP = Authors stated that the participants that had IEPs with math goals
Math Difficulty (MD)	Select one : 0 = No, not reported 1 = yes	Study states that the sample specifically included students with math difficulty (this does not refer to special education generally). This may also be referred to as low achievement in math.
MD <i>N</i>	Number	How many total students in the sample had LD?
MD Criteria	Note all that apply: 0 = percentile cut off on a test (if so, also include a note about test name and specific percentile) 1 = teacher referral 2 = state test scores/benchmark (if so, include the benchmark used	<ul style="list-style-type: none"> • E.g., for “0” (0, TEMA-3RD ED., < 25th percentile) • Teacher referral and then screening test (1; 0, TEMA-3RD ED., < 25th percentile)

	and the state test name if given) 3 = Other	
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Instructional Content Codes

There are three sets of codes for instruction content. The skills/concepts we code for are defined below. Then see the following page for variable codes.

Proportions

Variable	Explanation
Ratio	Ratio is defined as an expression of a mathematical relationship that involved multiplication (e.g., \$2.00 for 3 balloons, or $\frac{2}{3}$ of a dollar for one balloon).
Unit Rate	Unit rate is defined as changing a ratio through division to find an equivalent relation to one (e.g., the cost of a single balloon).
Covariance	Covariation is defined as features of a proportional situation that can change together.
Invariance	Invariance is defined as features of a proportional situation that do not change. This is the multiplicative relation that exists within the proportion. Related to unit rate.
Composite Units	Composite units are defined as units of units, or recognizing that a unit is made up of other units. For example, the rate \$2 for 3 balloons is a composite unit.
Proportional Reasoning	Proportional reasoning refers to understanding the underlying relationships in a proportional situation and working with these relationships.

Situations

Variable	Explanation
Missing Value	Missing value problems ask students to find a fourth or missing value across two proportions given three of the other values (e.g., If 3 balloons cost \$2.00, then how much do 24 balloons cost?)
Numerical Comparisons	Numerical comparison problems ask students to determine which of two given ratios represents more or less (e.g., Which is more or less- 3 balloons for \$2.00 or 24 balloons for \$12.00?)
Qualitative Comparisons	Qualitative comparison problems ask students to evaluate the effects on a ratio of a qualitative change in one or both of the quantities involved (e.g., What happens to the price of a balloon if you get more balloons for the same amount of money?)

Instructional Content Codes: Options

Variable	Code	Explanation
Skill or concept is identified or listed	Select one : 0 = No, not reported (the concept or skills was not listed or identified as being addressed in the intervention) 1 = yes, the concept or skill was listed or identified as being addressed in the intervention	The first set of instruction content codes refers to whether or not the author/study simply identified or mentioned the skill. For example, the article might state, “The intervention focused on ratio and unit rate concepts.”
Authors provided their definition of the skill or concept in relation to their intervention content (<i>you only fill these codes out if a concept or skill received a 1 for skill listed or identified</i>)	Select one : 0 = No, not reported (the author/article did not provide how their intervention defined the concept or skill) 1 = yes, the author/article provided how their intervention defined the concept or skill	This refers to whether or not the author or article provide how the research team envisioned the concept or skill in relation to their own intervention. The article does not have to read, “we define ratio as...” but there does need to be text provided for the reader to understand how the research team defined the concept.
Authors illustrated/described in depth how the concept was taught in the intervention (<i>you only fill these codes out if a concept or skill received a 1 for skill listed or identified</i>)	Select one : 0 = No, not reported (the author/article did not provide an in-depth description of how the concept or skill was taught) 1 = yes, the author/article provided an in-depth description of how the concept or skill was taught	This refers to how/if the authors illustrated and described the content. So, beyond the definition, how did the intervention actually teach and address the skill and content? This may be provided with an excerpt from a lesson plan, an in-depth description of the skill or concept, or with a picture of the lesson plan content.

Study Results

Note: These codes are less explicit. The purpose of this coding is to look for significant or important information in the findings as it relates to our research questions.

Study Result	Information
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Which students directly benefited from the intervention?	Include summarized information and page numbers: <ul style="list-style-type: none"> Did the authors specify that the intervention benefited all students generally? Did the authors make any statements, or did the tables show that certain subgroups benefited more or less compared to the total average? Or were disaggregated data provided for certain groups?
Was an effect size reported for the intervention? For different subgroups?	Include a Cohen's d, Hedges' g or other effect size statistic for relevant groups and the whole group.
How do studies define improvement of understanding in ratios and proportional reasoning?	In other words, summarize how the authors know students improved in their understanding (so other than the quantitative information) how did authors report students improved? Did authors provide any work samples, clinical interviews, descriptive or qualitative information, or student excerpts?
Other Significant Findings	List as many other significant findings from the studies that you find interesting or relevant. In other words, researchers might have looked at other research questions that we aren't considering in this study.

Quality Indicators for Group Design

(Note, these indicators are adapted from Gersten et al., 2005 and any use of this coding rubric should give credit to Gersten et al., 2005)

- High Quality = All but one of the Essential Indicators AND at least FOUR of the Desirable Indicators
- Acceptable = All but one of the Essential Indicators AND at least ONE of the Desirable Indicators

Indicator	0	1	2
Conceptual Underpinnings			
Is a compelling case for the importance of the research made? Is the conceptualization based on well-	Neither: Importance of the proportional reasoning content is stated OR evidence of previous	Importance of the proportional reasoning content is stated OR evidence of previous	Importance of the proportional reasoning content is stated AND evidence of previous

designed studies and does it reflect the scope of extant knowledge? If an innovative approach is proposed, it is based on a sound conceptualization formed from research?	research in this area related to intervention is provided.	research in this area related to intervention is provided.	research in this area related to intervention is provided.
Are the research questions appropriate and stated clearly for the purpose of the study? Are valid arguments supporting the nature of the intervention in the comparison group presented?	Neither: The research questions are appropriate and stated clearly for the purpose of the study OR there is a valid argument supporting the nature of the intervention in the comparison group.	The research questions are appropriate and stated clearly for the purpose of the study OR there is a valid argument supporting the nature of the intervention in the comparison group.	The research questions are appropriate and stated clearly for the purpose of the study AND there is a valid argument supporting the nature of the intervention in the comparison group.
Participants			
Sufficient information provided to determine/confirm whether the participants demonstrated the disabilities or difficulties presented.	For MD (0-1) <ul style="list-style-type: none"> a) Authors identify students as LD but do not provide evidence; authors identify students as MD but use criteria that is less restrictive than performance at or below the 25th percentile b) Authors document that each participant met the criteria 	For MD (all 3): <ul style="list-style-type: none"> c) Authors identify students as LD but do not provide evidence; authors identify students as MD but use criteria that is less restrictive than performance at or below the 25th percentile d) Authors document that each participant met the criteria 	For LD and MD (all 3): <ul style="list-style-type: none"> a) Authors document that all students met district-criteria, state criteria, had an IEP related to math goals, or had performance below the 10th percentile (LD) or below the 25th pc. for (MD) b) Authors define the math difficulty or LD c) Authors document that each participant met the criteria

<p>Were appropriate procedures used to increase the likelihood that relevant characteristics of participants in the sample were comparable across conditions?</p> <ul style="list-style-type: none"> • Comorbid disabilities • Age • Race • Gender • FRL • ELL status • Achievement data 	<p>Study provides fewer than 3 in the list provided.</p>	<p>Study provides at least 4 demographics of those provided BUT does not describe random assignment OR pre-test differences.</p>	<p>Study provides at least 4 demographics of those listed AND presents data on pre-test differences or comparability on at least one measure OR used random assignment.</p>
<p>Was sufficient information given characterizing the interventionists or teachers provided? Did it indicate whether interventionists were comparable across conditions?</p> <ul style="list-style-type: none"> • Age • Race • Gender • Educational background • Relevant Experience 	<p>Study provides fewer than 3 of the demographics provided</p>	<p>Study provides at least 3 of the demographics provided by does not describe assignment procedures for interventionists.</p>	<p>Study provides at least 3 demographics of those listed AND describes assignment procedures for interventionists.</p>
Intervention Implementation			
<p>Was the intervention clearly described and specified?</p> <ul style="list-style-type: none"> • Detailed instructional procedures • Teacher actions (e.g., modeling, corrective feedback) and language • Use of instructional materials • Student behavior (what they did and said) 	<p>Either any number of components in the absence of the conceptual underpinnings or conceptual underpinnings and only 1 component.</p>	<p>Conceptual underpinnings and at least 2 of the instructional components.</p>	<p>Conceptual underpinnings and at least 3 of the instructional components.</p>

Was the fidelity of implementation described and assessed?	Study does not specify how fidelity data were collected.	Study presents data that fidelity was collected, how it was collected but fidelity was not above 80%.	Study presents data that fidelity was collected, how it was collected and that fidelity was above 80%.
Was the nature of services provided in comparison conditions described? <ul style="list-style-type: none"> Name of curriculum Amount/time of instruction Instructional features that allow for replication 	One or zero components described.	Only two components described OR 3 components described but not to a level of replication.	All three components described to a level of replication.
Outcome Measures			
Were multiple measures used to provide an appropriate balance between measures closely aligned with the intervention and measures of generalized performance (to measure the effect of the intervention; this does not include screening measures or social validity)?	Study includes only a proximal measure of math performance.	Study includes only a distal measure of math performance.	Study includes at least one proximal measure to the intervention content and at least one measure of generalized performance that is standardized and norm-referenced (or adapted from norm-referenced).
Were outcome measures administered at appropriate times?	No pre-test given OR No mention of post-test timeline OR evidence of greater than 2 weeks post-test following intervention.	Pre-test administered and evidence that post-tests were administered between 1-2 weeks following the end of the intervention.	Pre-test administered and evidence that post-tests were administered <i>immediately</i> following the end of the intervention (less than or equal to one week).
Data Analysis			
Were the data analysis techniques appropriately linked to key research questions and hypotheses? Were they appropriately linked to the unit of analysis?	Neither data analysis techniques appropriately linked to key research questions OR appropriately linked to the unit of analysis.	Data analysis techniques were appropriately linked to key research questions OR they appropriately linked to the unit of analysis. (research questions may not be present or description/rationale for	Data analysis techniques were appropriately linked to key research questions AND they appropriately linked to the unit of analysis. (research questions must be present, along with a

		the analyses may not be present)	description/rationale for the analyses)
Did the research report include not only inferential statistics but also effect size calculations ?		No effect sizes reported regarding the effectiveness of the intervention.	Yes, effect sizes reported for at least one measure.
Desirable Indicators			
Were data available on attrition rates among intervention samples? Was severe overall attrition documented? If so, is attrition comparable across samples? Is overall attrition less than 30%? Yes = Attrition documented, comparable across conditions, and less than 30%.			Yes No
Did the study provide not only internal consistency reliability but also test-re-test reliability and interrater reliability (when appropriate) for ALL outcome measures? Were data collectors and/or scorers blind to study conditions and equally unfamiliar to examinees across study conditions? Yes = Provides at internal consistency AND least 1 of the following: test-retest OR interrater reliability AND specify data collectors/scorers were blind to study conditions.			Yes No
Were outcomes for capturing the intervention's effect measured beyond an immediate post-test? Delayed.			Yes No
Was evidence of the criterion-related validity AND construct validity of the measures provided? Yes = concurrent or predictive validity for alike measures AND construct/expert validity (e.g., items were pulled from TIMMS/NAEP); it can't simply be a correlation between the measures within the study if those measures aren't alike (see below) in order to be identified as high quality. From Gersten et al. (2005): "Yet, to be highly acceptable, the researcher should independently conduct some type of concurrent validity. Concurrent validity becomes even more critical when using measures for groups other than those for which the test was designed (e.g., using a measure translated into Spanish for use with Spanish- speaking bilingual students). For studies to rank in the highly acceptable category, empirical data on predictive validity of measures used and any information on construct validity should be reported."			Yes No
Did the research team assess not only surface features of fidelity implementation, but also examine quality of implementation/instruction?			Yes No
Was any documentation of the nature of instruction provided in comparison/control conditions? YES = fidelity of the comparison, goes beyond just a description of the condition as in above indicators.			Yes No
Did the research report include actual audio or videotape excerpts that capture the nature of the intervention?			Yes No
Were the results presented in a clear, coherent fashion?			Yes No

Quality Indicators Single Case Design

(Note, these indicators are adapted from Horner et al., 2005 and any use of this coding rubric should give credit to Horner et al., 2005)

Indicator	0	1	2
Description of Participants and Setting			
<p>Participants are described with sufficient detail to allow others to select individuals with similar characteristics and the process for selecting participants is described with replicable precision.</p> <ul style="list-style-type: none"> • Comorbid disabilities • Age • Race • Gender • FRL • ELL status • Achievement data 	<p>Authors identify disability or difficulty but do not describe method of identification OR b) only 2 or fewer of the demographics (left) were provided.</p>	<p>Authors identify a) disability or difficulty present but the method for identification for difficulty was above the 25th percentile for MD); OR b) only 3 of the demographics listed (left) were provided.</p>	<p>Authors identify a) disability or difficulty present AND the method for identification (difficulty must be equivalent to at or below the 25th percentile for MD); AND b) at least 4 of the demographics listed (left).</p>
<p>Critical features of the physical setting are described with sufficient precision to allow for replication.</p> <ul style="list-style-type: none"> • Location (school, community, etc.) • Geographical location • When instruction occurred • What room looked like (desks, tables, computer equipment) • Other important information about 	<p>No information on setting.</p>	<p>Setting described but not to the extent of replication.</p>	<p>Setting is described with replication including location and when instruction occurred.</p>

interventionists in the setting			
Dependent Variable			
Dependent variables are described with operational precision.	Dependent measure is not identified or defined OR not a valid tool for the behavior being measured.	Dependent variable is not operationally defined and therefore does not allow for objective measurement (e.g., frequency counts of behavior without a description of the problem behavior) OR defined but does not generate a quantifiable index.	Dependent variable is operationally defined and allows for direct measurement (e.g., ORF, frequency counts of behavior) AND with a method that generates a quantifiable index (e.g., PND).
Dependent variables are measured repeatedly over time (each phase should have 3 data points).	NA	Dependent variables are measured repeatedly over time but they do not allow for establishing the overall pattern of performance under that condition (e.g., level, trend, variability).	Within an experimental phase or condition, sufficient assessment occasions are provided to establish the overall pattern of performance under that condition (e.g., level, trend, variability). Measurement of the behavior of the same individual across phases or conditions allows comparison of performance patterns under different environmental conditions.
Data are collected on reliability or interobserver agreement associated with each dependent variable and IOA levels meet minimum standards (IOA = 80%; Kappa = 60%).	No measure of interobserver agreement reported.	Interobserver agreement for fewer than all participants, or certain conditions (e.g., baseline only) OR does meet for participant, condition, and variable but does not meet the minimum standards (must still be reported).	Interobserver agreement for each participant AND variable in EACH condition of the student AND minimum levels.
Independent Variable			

Independent variable is systematically manipulated and under the control of the experimenter and Independent variable is described with replicable precision. <ul style="list-style-type: none"> • Interventionist identified • Procedures (sessions, days per week, overall length) • Teacher actions • Student actions • Materials 	Does not include a description of the interventionist OR no detailed information OR only includes information on 1 of the other components. Does not include active manipulation of the independent variable.	Description of the intervention allows for replicability AND includes detailed information about the interventionist AND at least 2 of the other components (left). Includes active manipulation of the independent variable.	a) Description of the intervention allows for replicability; AND b) includes detailed information about the interventionist AND c) at least 3 of the other components (left). Includes active manipulation of the independent variable.
Overt measurement of the fidelity of implementation for the independent variable is highly desirable.	Study does not specify how fidelity data were collected.	Study presents data that fidelity was collected, how it was collected but fidelity was not above 80%.	Study presents data that fidelity was collected, how it was collected and that fidelity was above 80%.
Baseline			
Baseline conditions are described with replicable precision.	Baseline data documents a trend in the direction predicted by the intervention (upward) or variable performance; fewer than 3 data points in the baseline.	Description of the baseline condition, possible inconsistent/variable performance in the baseline AND at least 3 data points.	Detailed description of the baseline condition AND consistent/stable performance in the baseline (no upward trend) AND at least 3 data points.
Experimental control/Internal Validity			
The design provides at least three demonstrations of experimental effect at three different time points. An experimental effect is demonstrated when predicted	Only 1 or no documentation of experimental control across time points or participants OR serious threats to internal validity.	Experimental control is demonstrated when the design documents three demonstrations of the experimental effect at two different points in time with a single participant (within-	Experimental control is demonstrated when the design documents three demonstrations of the experimental effect at three different points in time with a single participant (within-subject replication), or across

change in the dependent variable covaries with manipulation of the independent variable (e.g., the level, and/or variability of the dataset in a phase decreases when a behavior-reduction intervention is implemented, or the level and/or variability of the dataset in a phase increases when the behavior-reduction intervention is withdrawn).		subject replication), or across different participants (inter-subject replication) AND controls for common threats to internal validity for most participants (rival hypotheses). OR each phase of instruction did not have 3 data points to establish a trend.	different participants (inter-subject replication) AND controls for common threats to internal validity (rival hypotheses). This could also be across different problem types. There must be 3 data points in each phase for a 2.
External Validity			
Experimental effects are replicated across participants, settings, or materials to establish external validity.	Not replicated across participants, settings, or materials and does not provide detail to for whom and under what conditions does the intervention work.	Replication of the effects across different participants, different conditions, and/or different measures of the dependent variable. Might be: <ul style="list-style-type: none"> - 2 environments - 2 participants - 2 different measures/problem types 	Replication of the effects across different participants, different conditions, and/or different measures of the dependent variable. Might be: <ul style="list-style-type: none"> - 3 environments - 3 participants - 3 different measures/problem types
Social Validity			
Evidence (author specifies or makes a statement): <ul style="list-style-type: none"> - The dependent variable is socially important. 	Meets 1 or fewer criteria.	Meets 2-3 criteria.	Meets 4-5 criteria.

<ul style="list-style-type: none">- The magnitude of change (effectiveness) in the dependent variable resulting from the intervention is socially important.- Implementation of the independent variable is practical OR cost effective.- Social validity is enhanced by implementation of the independent variable by typical intervention agents (part of the normal school context) and in typical physical and social context.- Measures of social validity (measure students' perception of the importance of the intervention, confidence, external student factor, teacher perception).			
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References

- Gersten, R., Fuchs, L. S., Compton, D., Coyne, M., Greenwood, C., & Innocenti, M. S. (2005). Quality indicators for group experimental and quasi-experimental research in special education. *Exceptional Children*, 71(2), 149-164.
- Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children*, 71(2), 165-179.
- Nelson, G., Hunt, J. H., Martin, K., Patterson, B., & Khounmeuang, A. (2020). Current knowledge and future directions: proportional reasoning interventions for students with learning disabilities and mathematics difficulties. *Learning Disability Quarterly*. Advanced online publication. <https://doi.org/10.1177/0731948720932850>