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A Systematic Review of Research Syntheses for Students with Mathematics Learning Disabilities and Difficulties

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Abstract

The purpose of this document is to provide readers with the coding protocol that authors used to code 36 research syntheses (including meta-analyses, evidence-based reviews, and quantitative systematic reviews) focused on mathematics interventions for students with learning disabilities (LD), mathematics learning disabilities (MLD), and mathematics difficulties (MD). The purpose of the systematic review of mathematics intervention syntheses was to identify patterns and gaps in content areas, instructional strategies, effect sizes, and definitions of LD, MLD, and MD. We searched the literature for research syntheses published between 2000 and 2020 and used rigorous inclusion criteria in our literature review process. We evaluated 36 syntheses that included 836 studies with 32,495 participants. We coded each synthesis for variables across seven categories including: publication codes (authors, year, journal), inclusion and exclusion criteria, content area focus, instructional strategy focus, sample size, methodological information, and results. The mean interrater reliability across all codes using this coding protocol was 90.3%. Although each synthesis stated a focus on LD, MLD, or MD, very few students with LD or MLD were included, and authors' operational definitions of disability and risk varied. Syntheses predominantly focused on word problem solving, fractions, computer-assisted learning, and schema-based instruction. Syntheses reported wide variation in effectiveness, content areas, and instructional strategies. Finally, our results indicate the majority of syntheses report achievement outcomes, but very few syntheses report on other outcomes (e.g., social validity, strategy use). We discuss how the results of this comprehensive review can guide researchers in expanding the knowledge base on mathematics interventions.

The systematic review that results from this coding process is accepted for publication and in press at *Learning Disabilities Research and Practice.*

Keywords: meta-analysis, mathematics, intervention, learning disability, coding protocol

Math Intervention Research Synthesis Coding Rubric

Please keep in mind that for coding purposes in this study, we use the following:
- MD (risk) = mathematics *difficulty;* low achievement in math; learning difficulty in math; risk in math
- MLD (disability) = mathematics learning disability; math disability; dyscalculia; LD with IEP goal in math

Some of the codes that required copy/paste were used for descriptive information or were recoded for qualitative themes.

This coding protocol includes variables in the following categories:
- Publication codes (p. 2)
- Inclusion and exclusion criteria (p. 2)
- Content area, stated focus of the synthesis (p. 5)
- Instructional strategies, stated focus of the synthesis (p. 8)
- Student participant demographics including Md and MLD identification (p. 11)
- Methodological information and results (p. 13)
- Instructional strategy, other results (p. 17)
- How effectiveness was measured and reported (p. 20)

Publication Codes

Cell	Variable	Code	Explanation
A	Authors	Name	List all authors' last names
B	Year	Number	Record year of publication
C	Journal	Name	Record journal; Use full name, do not use acronyms

PURPOSE AND FOCUS OF THE SYNTHESIS

Inclusion and Exclusion Criteria
Note: These codes are related to the **author's purpose of the synthesis and inclusion and exclusion criteria**, not on the specific results or description of included studies in the meta-analysis.

Variable	Code	Explanation

Grade/Age	Copy/Paste Information or NA	Copy and paste inclusion and exclusion criteria related to the age or grade of participants. If authors did not state inclusion or exclusion criteria related to age or grade, write N/A.
Outcome Measure	Copy/Paste Information or NA	Copy and paste inclusion and exclusion criteria related outcome measure requirements. If authors did not state inclusion or exclusion criteria related to outcome measures, write N/A.
Participant Disability or Risk as Specified in Method	Copy and Paste Information	Copy and paste the specific requirement that authors state related to including studies. Copy and paste information such as "studies were required to include at least one student with LD" or "Studies were required to include participants who performed below the 25th percentile on a standardized measure of achievement." Or
Participant **LD/MLD** Criteria	Select **all that apply** related to disability requirement: 0 = Not Applicable 1 = percentile cutoff 2 = IDEA, school, district, or state criteria 3 = documented 4 = IEP goal 5 = Services in special education setting 6 = Other 7 = Not described Separate responses using a semi-colon (e.g., "1; 3; 4")	These codes specifically refer to how authors identified or described their definition of learning disabilities or mathematics learning disabilities. Codes defined as: • Not applicable = The authors did not include participants with LD/MLD (disability) in their synthesis, they only included Math Difficulty. • Percentile = authors used a percentile to state students had LD/MLD, such as performing below the 10th percentile on a measure of math achievement. • IDEA, School, district, or state criteria = Authors stated that participants had LD/MLD according to a set of criteria • Documented = Authors stated that the participants had a documented LD/MLD (e.g., "students with documented MLD were included.") • IEP = Authors stated that the participants that had IEPs goals in math • Special education = Authors stated that students received special education services in mathematics • Other = Authors used other criteria and specified what criteria were (e.g., a statement that they used the criteria identified in the original study, "The study included a subset of participants as have a learning disability." Not described = Authors stated

		that students with LD/MLD were a focus of their study, but the authors did not provide the criteria they used (authors of the synthesis may also state something like, "students were identified with MLD with methods as described by the author" although, the specific criteria are still not described).
Participant **LD/MLD** Criteria: PERCENTILE	Number or N/A	If the synthesis identified participants with MLD using a percentile cutoff (code of 1 above), provide the percentile (use pc. and < or <=) Examples: • <35 pc • <=25 pc • 11 to 25 pc
Participant **LD/MLD** Criteria: OTHER	NA or Anecdotal (fill out anecdotal only if you marked code of "6" above)	If the synthesis identified participants with MLD using a "other" criteria, copy and paste the criteria here.
Participant Math **Difficulty (MD)** or Risk Criteria	Select **all that apply**: 0 = Not applicable 1 = percentile cut off on a screening test or measure 2 = teacher or parent referral or identification 3 = state test scores/ benchmark 4 = Receiving Intervention 5 = Other 6 = Not Described Separate responses using a semi-colon (e.g., "1; 3; 4")	These codes specifically refer to how authors identified or described their definition of DIFFICULTY or RISK. Codes defined as: • Not applicable = The authors did not include participants with MD (risk) in their synthesis, they only included disability. • Percentile = authors used a percentile to state students had MD, such as performing below the 25th percentile on a measure of achievement. • Referral = parents or teachers referred students for MD • State test = Authors stated that participants had MD according to a score on a state test • Receiving Intervention = Authors stated that students were included as MD due to receiving targeted services, intervention, Tier 2, 3, etc. • Other = Authors used other criteria and specified what criteria were (e.g., a statement that the authors used the criteria identified in the original study such as "We included any study where authors specified that students had MD.") • Not described = Authors stated that students with MD were a focus of their study, but the authors did not provide difficulty

		criteria they used (authors of the synthesis may also state that students were identified with MD with methods 'as described by the author' although, the specific criteria are still not described).
Participant Math **Difficulty** Criteria: PERCENTILE	Number or NA	Code defined: If the synthesis identified participants with MD using a percentile cutoff (code of 1 above), provide the percentile (use pc. and < or <=) Examples: <35 pc <=25 pc 11 to 25 pc
Participant Math **Difficulty** Criteria: OTHER	NA or Anecdotal (fill out only if you marked code of "5")	If the synthesis identified participants with MD using an "other" criteria, copy and paste the criteria here.

Content Area Focus: As the Stated Purpose of the Synthesis
Note: These codes are related to the **author's purpose of the synthesis and inclusion and exclusion criteria**, not on the specific results or description of included studies in the meta-analysis.

Variable	Code	Explanation
Content Area as Specified in Purpose	Copy and Paste Information	Copy and paste information from the purpose or inclusion and exclusion criteria about the focus of the synthesis (perhaps this would be in the title as well). This will help you determine which content areas to select "yes" for below.
Broad Math	Two Codes, See Below	Some meta-analysis or reviews might simply state that they focused on "math interventions" without any follow up information, this is an example of when this code would be "yes" Or, some studies might say that they focused on Number and Operations skills (which encompass many different mathematics skills), this would also be a code a "yes"
Early Numeracy	Two Codes, See Below	This includes number sense, place value, counting, number identification, subitizing, decomposing and composing, early math, etc.
Basic Facts, Computation	Two Codes, See Below	This includes interventions focused on operations: basic facts, computation, number combinations (including addition, subtraction,

		multiplication, division) and may include a focus on complex computation (algorithms) or basic fact retrieval.
Fractions	Two Codes, See Below	This includes interventions that focus on conceptual and procedural fraction knowledge and includes topics like part-whole fractions, measurement interpretation of fractions (fractions and number lines), equivalent fractions, operations with fractions, etc.
Decimals	Two Codes, See Below	This includes interventions that focus on conceptual and procedural decimal knowledge. Topics can include place value, magnitude comparison, and computation.
Percents	Two Codes, See Below	This includes interventions that focus on conceptual and procedural percent knowledge.
Word Problem Solving	Two Codes, See Below	This involves instruction that focuses on problems with a few sentences describing a "real-life" situation which are translated into a mathematical calculation. Interventions focused on word problems for computation or proportions would be coded only as word problem solving. Word problems could include computation with whole numbers, fractions, decimals, ratios, etc.
Problem Solving	Two Codes, See Below	Problem solving involves using logic or reasoning to solve a task or a set of related tasks for which there is no immediately apparent solution. Interventions that focus on computations or word problem solving are not included in problem solving.
Geometry & Measurement	Two Codes, See Below	Geometry: These interventions may focus on spatial reasoning, shapes, and transformations. At higher grade levels, this may also incorporate argumentation and proof. Measurement: these interventions focus on things like linear measurement, area, perimeter, angle measures, and trigonometry.
Algebra	Two Codes, See Below	This will include topics such as variables, integers, equations and inequalities, functions, and graphing on a Cartesian plane (x, y coordinates).
Rate, Ratio, Proportional Reasoning	Two Codes, See Below	These interventions focus on topics that involve composite units, multiplicative comparisons, and covariation. Topics may include unit rates, scale factors, and missing value proportions.

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Data Analysis/Probability	Two Codes, See Below	These interventions would focus on the collection and presentation of data (e.g., graphing), central tendency (e.g., mean, median, mode) and variability (e.g., MAD, SD, range), and likelihood of outcomes.

For each content area, you will code the following two codes:

Variable	Code	Explanation
Content area is identified or listed in title, Introduction, or Method as a focus of the synthesis.	Select **one**: 0 = No, not identified 1 = yes, identified Note, if you mark a 0 in this column, it's automatically an NA in the next column, for the next code.	Note: do not consider the abstract for this code as often the abstract reports results, and this code is about the *intent* of the study. • No = The content area (e.g., early numeracy) was not identified by authors in the title, Introduction, or Method section as a focus of the synthesis, however, the results presented may have included information about the effects of the content area. In other words, authors may not have been clear about the content area focus of the intervention, or they presented results in different content areas ad hoc, or as an afterthought. • Yes = the synthesis focused on a content area and the authors were clear about the focus somewhere in the title, Introduction, or Methods section. For example, "The interventions in this meta-analysis were required to focus on ratio and unit rate concepts." Or the title of the synthesis clearly states "Synthesis of problem solving interventions" or it is clearly detailed in the literature review, research questions or purpose, inclusion criteria, etc.
Content area is defined.	Select **one**: NA = not applicable (select this option if you selected "0" for the previous code) 0 = No, not defined 1 = yes, defined	This code refers to whether or not the author or article provided how the research team envisioned or defined the content area in relation to their own synthesis. The article does not have to read, "we **define** ratio/problem solving/early numeracy/etc. as…" but there does need to be text provided for the reader to understand how the research team defined the content area. • Not applicable = the synthesis did not address this content area. (select this option if you selected "0" for the previous code for "identification")

		• No = The author/article did not provide how their synthesis defined the content area. • Yes = The author/article provided how their synthesis defined the content area. This can happen at any point in the synthesis but will likely happen in the Introduction or Method.

Instructional Area Focus: As Stated Purpose of the Synthesis

Note: These codes are related to the **author's purpose of the synthesis and inclusion and exclusion criteria**, not on the specific results or description of included studies in the meta-analysis.

Variable	Code	Explanation
Components of Explicit and Systematic Instruction	Two Codes, See Below	Note: Study may state "explicit instruction" or "explicit and systematic instruction" but they may also state common components such as: modeling, stating lesson objectives, breaking down steps, guided practice and independent practice, logically sequencing skills. Although monitoring students and providing feedback is a component of explicit and systematic instruction, it is often separated for synthesis purposes; so this is a different instructional strategy (below).
Direct Instruction	Two Codes, See Below	Specifically identified as Direct Instruction as opposed to explicit and systematic instruction.
Feedback (corrective, specific, academic, affirmative)	Two Codes, See Below	This refers to interventions that are focused on considering the effectiveness of forms of feedback to students.
Cognitive Strategy Instruction	Two Codes, See Below	This may include: cognitive strategy instruction, self-monitoring, self-regulation, self-questioning, meta-cognition. Definition from Montague's work: "the intervention presents a routine for mathematical problem solving that incorporates both cognitive processes and metacognitive strategies for solving problems and utilizes explicit instructional

		procedures with an emphasis on process modeling and verbalization of the routine during the acquisition stage."
Concrete Representations	Two Codes, See Below	This refers to interventions that focus on using hands-on/physical manipulatives to teach mathematical concepts or procedures.
Visual/Pictorial Representations	Two Codes, See Below	This refers to interventions that focus on using drawings or visual models to teach mathematical concepts or procedures. These visuals can range from informal (realistic drawings) to formal (abstract representations).
CRA Framework	Two Codes, See Below	Note. This may be referred to as a graduated sequence of instruction.
SBI or SI Framework	Two Codes, See Below	Note, this is a specific framework and may be called "schema-instruction" "schema-based instruction" or "schema broadening instruction." (though it includes components such as using representations). For the purpose of this review, SI/SBI may also be referred to as "priming the underlying problem structure." From Powell (general description from a 2013 article, so Asha's work might look more like the broadening definition used here as well): *Schema-based instruction*, teaches students to use schematic diagrams to solve word problems. The student reads a word problem, selects a schema diagram into which the word problem fits, and uses the structure of the diagram to solve the problem. Schema-broadening instruction is similar to schema-based instruction in that students read the word problem and select a schema (from the taught schema) to solve word problems. Schema-broadening instruction differs from schema-based instruction because students are taught to transfer their knowledge of problem types to recognize problems with novel features (e.g., different format, additional question, irrelevant information, unfamiliar vocabulary, or information presented in charts, graphs, or pictures) as belonging to a problem type for which they know a solution."
Peer-Assisted Learning	Two Codes, See Below	This may also be referred to as peer-mediated instruction, peer-tutoring, or class wide peer-tutoring.
Computer-assisted learning; technology	Two Codes, See Below	This refers to instructional modes that represent digital learning or computer assisted learning/instruction.
Other	Anecdotal	Please provide the description.

RESULTS

Student Participant Demographics Including MD and MLD Identification: Descriptive Results

Variable	Code	Explanation
Students Total *N*	Number or "Not Reported"	● List the total number of student participants across studies; only provide the number as it is presented in text or tables. Do not perform your own calculations.
Students with LD or MLD *N*	Number or NA/NR	● List the total number of student participants across studies who authors identified as having a **Learning Disability (LD) or Mathematics Learning Disability (MLD).** For the purposes of this study, this may also include "mathematics disability" or "dyscalculia."; only provide the number as it is presented in text or tables. Do not perform your own calculations. This option is presented because not all studies will differentiate between LD (any type) and MLD specifically.
Students with MLD specifically *N*	Number or NA/NR	● List the total number of student participants across studies who authors specifically identified as having a **Mathematics Learning Disability (MLD).** For the purposes of this study, this may also include "mathematics disability" or "dyscalculia."; only provide the number as it is presented in text or tables. Do not perform your own calculations. This option is presented for studies that report, specifically, the number of students that had a math learning disability, dyscalculia, or a math disability (not just LD generally).
Students with MD *N*	Number or NA/NR	● List the total number of student participants across studies who authors identified as having a **Mathematics Difficulty (MD);** For the purposes of this study, this may also include "low achievement in mathematics" or "struggling in mathematics." Only provide the number as it is presented in text or tables. Do not perform your own calculations.

		This option is presented for studies that report, specifically, the number of students that had risk in math, math difficulty, or were low achieving in math.
Students with LD/MLD or MD *N* and Authors don't provide separate data	Number or NA/NR	• Only use this code if authors included students with or at-risk of learning disabilities AND mathematics difficulty and authors did not report the separate sample sizes for LD versus LD. • List the total number of students with LD or MD. Sometimes, studies include students with learning disabilities and math difficulty in the same sample, but the authors do not provide different sample sizes for LD/MLD compared to Math Difficulty. This option is presented for studies that report, the number of students with LD/MLD and MD without providing disaggregated data.
Students with Disabilities other than LD/MLD *N*	Number or NA/NR	• List the total number of student participants across studies who authors identified as having other types of disabilities other than LD or MD. **This may include ADHD, developmental disability, OHI, ASD, etc.** Only provide the number as it is presented in text or tables. Do not perform your own calculations. Some studies might also include a small number of students with other types of disabilities. This column is specifically for disabilities other than LD and MLD.
Students who are Typically Achieving *N*	Number or NA/NR	• List the total number of student participants across studies who authors identified as typically achieving. Only provide the number as it is presented in text or tables. Do not perform your own calculations. Some studies might also include typically achieving students. This column is to report the number of typically achieving students in the sample.
Notes about Sample Size	Anecdotal	• Provide any detail related to the sample size, such as if information was not provided in a straightforward manner and you need to explain the number

Mean Age or Range	Number (years)	• List the mean age of participants (years, months; 8, 11 for 8 years, 11 months) if it is provided; this refers to the descriptive results of included studies.
Specific Grades Included There will be a cell for each grade level PreK – 12.	Select **one for each grade level**: 0 = no, grade not represented 1 = yes, grade represented	• Mark 1 in the cell if this grade level is represented in the synthesis; this should be specific information about the grade levels such as provided in a table or sample sizes per grade level in the text • If the synthesis only provides a range, then you put a mark in each grade represented by the range. For example, K-2 would receive a 1 in K, 1, and 2.
Notes about Grades	Anecdotal	• Provide any detail related to the grade levels included in the synthesis, such as noting that "elementary" or "middle grades" were included without specifying which grade levels this refers to.

Methodological Information and Results

Variable	Code	Explanation
Type of Synthesis	Select **one**: 0 = meta-analysis 1 = best-evidence synthesis 2 = systematic review or synthesis	Codes defined: • 0 = authors conducted a meta-analysis (a summary effect is reported) • 1 = authors conducted a "best evidence synthesis" or "review of the evidence" which typically includes a review of the quality of the studies, and may also include reporting a summary effect. • 2 = authors completed a systematic review in which they outline their search procedures and may or may not report individual summary effects for studies or possibly a range of effect sizes across studies; this may also be referred to as a "review of the literature"
Designs Included	Select **one**: 0 = Not reported; not clear 1 = SCD only 2 = group design only 3 = SCD and group design	Codes defined as: • 0 = It is not reported and it is not able to be determined what designs were included in the study • 1 = Single-case design (SCD) studies only were included • 2 = group design only were included (experimental and/or quasi-experimental)

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		• 3 = SCD and group design were both included
Total Number of Studies	Number	Total number of studies that the authors decided to include in the synthesis; you may need to count the number from a table if it is not provided in text (also, check the abstract, it is often there)
Type of Effect Size	Select **all** that apply: 0 = Not Reported 1 = Cohen's d ES 2 = Hedges g ES 3 = Eta-squared ES 4 = Tau U 5 = PND (percent of non-overlapping data) 6 = PAND (percentage of all non-overlapping data) 7 = SMD (standard mean difference) 8 = IRD (Improvement Rate Difference) 9 = LLR = log response ratio 10 = Phi 11 = PEM (percentage of data points exceeding the median) 12 = Other Separate responses using a semi-colon (e.g., "1; 3; 4")	What type of effect size(s) did researchers report for the studies (this is after any conversion or transformation of data). Note: codes 1-3 are common for group design studies; codes 4-11 are common for SCD. Note this refers specifically to how authors reported aggregated effect sizes; if effectiveness is measured in some other capacity (e.g., social validity) that information will be captured elsewhere.
Effect Size Aggregation	Anecdotal and Copy and Paste	If studies reported effect sizes, how were effect sizes within the same study aggregated. In other words, did the authors calculate a composite effect sizes (they took all outcome measures and reported 1 effect sizes for each study as a representative effect size), they selected 1 measure/effect size as the primary measure (if so, was it a proximal measure, norm-referenced, or a specific content area?), or they accounted for dependency of effect sizes.

		An example of a composite effect sizes: "In the case where a study used multiple outcome measures, we calculated the mean effect size across measures." An example of the primary measure: "When researchers used more than one math measure, we identified a primary outcome measure that was the best representation of the construct of early numeracy, as the purpose of this meta-analysis was to determine the effect of early numeracy interventions on math performance." An example of accounting for dependency of effect sizes: "All eligible, independent effect sizes were included from each study, resulting in some studies contributing multiple effect sizes when several math outcomes were reported. Therefore, to account for the statistical dependencies of correlated effects, random effects robust standard estimation was used."
<mark>Long-term Effectiveness of the Intervention</mark>	Select **all that apply (1 and 2 could both be selected if appropriate)**: 0 = no 1 = yes, ***summary*** effect for delayed post-test, maintenance 2 = yes, ***individual study*** effect for delayed post-test, maintenance 3 = reported other information about long-term effectiveness	This code refers to whether or not authors evaluated summary effects beyond typical post-test, such as with a delayed post-test analysis. **This is only a code for summary or individual effects.** • No = no long-term effects, maintenance, or delayed-post-test results were reported as results • Yes, summary effects = an aggregate effect for long-term effectiveness was reported across studies • Yes, individual effects = individual long-term effects were reported • 3 = Authors reported other information about long-term measures when present in included studies (presence of maintenance tests, visual inspection, etc.)
<mark>Outcome Measures Presented</mark>	Select all that apply: 0 = not reported 1 = achievement outcomes (effect sizes) 2 = strategy use	Codes defined: This code refers to how authors defined effectiveness of the intervention. This code indicates what outcome measures were reported in any format. In other words, what outcome data were authors of the synthesis reporting (often it's just achievement data). This can be summary effects, individual

	3 = attitude, anxiety 4 = engagement 5 = student social validity 6 = teacher social validity 7= social validity (not specified)	effects, frequencies, or any other form of reporting on the presence of these measures. • 0 = it is not clear from the study how authors were reporting effectiveness • 1 = any math achievement data, such as problems correct, score on a standardized measure, pre to posttest gains, CBMs, etc. • 2 = any data about students' growth or difference in use of strategies as a result of the intervention • 3 = any data about students' math attitude or anxiety as a result of the intervention • 4 = any data about students' engagement in math as a result of the intervention • 5 = any data about students' perceptions of the intervention, such as usefulness of the lessons, likeness of the lessons, etc. • 6 = any data about teachers' perceptions of the intervention, such as usefulness of the lessons, likeness of the lessons, this might also be feasibility or cost effectiveness data • 7 = social validity data were captured but it's not clear or specified from who
Proximal and Distal Outcomes	Select all that apply: NA = not applicable 0 = not able to determine 1 = proximal measures 2 = distal measures 3 = CBMs 4 = Norm-referenced 5 = researcher developed	What types of measures did authors use to calculate effect sizes? Note that some of the options are not mutually exclusive. Two codes may apply if the measure or measures are explicitly identified as such (e.g., a proximal CBM is coded as both but a CBM with no other information would just be coded as CBM). (This is ONLY about which effect sizes are reported, either summary effects OR individual effects. This is NOT based on inclusion criteria—this is only what effect sizes are reported in the results.) • NA = authors did not calculate any effect sizes (this would only be a handful of studies) • Proximal = authors stated that they calculated effect sizes using proximal measures (measures closely aligned to the intervention) • Distal = authors stated that they calculated effect sizes using distal measures (measures not aligned to the intervention)

		• CBMs = authors used data from curriculum based measures to calculate effect sizes • Norm-referenced = authors used standardized norm-referenced tests such as TEMA, WJ, SAT-10, SESAT, etc. to calculate effect sizes • Researcher-developed = authors considered researcher created measures to calculate effect sizes, also called experimenter developed. If the measure is only identified as "standardized" with no other information, code this as 0-not able to determine.
Outcome Measure Results Information	Anecdotal	• Use this column to report any specific information. For example, maybe social validity data were only presented for SCD studies, or strategy use was only reported for a handful of studies.
Effect Sizes and Results	Number	Record all effect sizes reported by authors; this includes effect sizes that are summary effects, and for subgroup analyses such as for different content areas, instructional strategies, and groups of students (e.g., LD, MLD, MD).

Instructional Strategies

For each instructional area that is mentioned in the Results or Discussion, you will select if any results were presented. This coding should happen regardless of what the authors specified was the focus of their synthesis. This can be effect sizes, frequency counts of the number of studies that address a strategy, etc.

Variable	Code	Explanation
Components of Explicit and Systematic Instruction	Select **all that apply**: 0 = no results reported 1 = summary effect sizes 2 = individual study effect sizes 3 = frequency counts 4 = other results (e.g., qualitative)	Note: Study may state "explicit instruction" or "explicit and systematic instruction" but they may also state common components such as: modeling, breaking down steps, guided practice and independent practice, logically sequencing skills. • 0 = No results (summary effects, individual study effects, qualitative information, or frequency counts) were reported for this instructional strategy. • 1 = Yes, there is a summary effect size for this instructional strategy.

		• 2 = yes, there are individual study effect sizes linked with this instructional strategy (could be in text or in a table). • 3 = frequency counts were reported, such as the number of studies in the synthesis that focused on this instructional strategy • 4 = other results including qualitative synthesis of the instructional strategy or individual summaries of studies that used this instructional strategy.
Direct Instruction	Select **all that apply**: 0 = no results reported 1 = summary effect sizes 2 = individual study effect sizes 3 = frequency counts 4 = other results (e.g., qualitative)	Specifically identified as Direct Instruction as opposed to Explicit and Systematic Instruction.
Feedback (corrective, specific, academic, affirmative)	Select **all that apply**: 0 = no results reported 1 = summary effect sizes 2 = individual study effect sizes 3 = frequency counts 4 = other results (e.g., qualitative)	This refers to interventions that are focused on considering the effectiveness of forms of feedback to students.
Cognitive Strategy Instruction	Select **all that apply**: 0 = no results reported 1 = summary effect sizes 2 = individual study effect sizes 3 = frequency counts 4 = other results (e.g., qualitative)	This may include: cognitive strategy instruction, self-monitoring, self-regulation, self-questioning, meta-cognition. Definition from Montague's work: "the intervention presents a routine for mathematical problem solving that incorporates both cognitive processes and metacognitive strategies for solving problems and utilizes explicit instructional procedures with an emphasis on process modeling and verbalization of the routine during the acquisition stage."
Concrete Representations	Select **all that apply**: 0 = no results reported 1 = summary effect sizes 2 = individual study effect sizes 3 = frequency counts	This refers to interventions that focus on using hands-on manipulatives to teach mathematical concepts or procedures.

	4 = other results (e.g., qualitative)	
Visual/Pictorial Representations	Select **all that apply**: 0 = no results reported 1 = summary effect sizes 2 = individual study effect sizes 3 = frequency counts 4 = other results (e.g., qualitative)	This refers to interventions that focus on using drawings or visual models to teach mathematical concepts or procedures. These visuals can range from informal (realistic drawings) to formal (abstract representations).
CRA Framework	Select **all that apply**: 0 = no results reported 1 = summary effect sizes 2 = individual study effect sizes 3 = frequency counts 4 = other results (e.g., qualitative)	Note. This may be referred to as a graduated sequence of instruction.
SBI or SI Framework	Select **all that apply**: 0 = no results reported 1 = summary effect sizes 2 = individual study effect sizes 3 = frequency counts 4 = other results (e.g., qualitative)	Note, this is a specific framework and may be called "schema-instruction" "schema-based instruction" or "schema broadening instruction." (though it includes components such as using representations). For the purpose of this review, SI/SBI may also be referred to as "priming the underlying problem structure." From Powell (general description from a 2013 article, so Asha's work might look more like the broadening definition used here as well): *Schema-based instruction*, teaches students to use schematic diagrams to solve word problems. The student reads a word problem, selects a schema diagram into which the word problem fits, and uses the structure of the diagram to solve the problem. Schema-broadening instruction is similar to schema-based instruction in that students read the word problem and select a schema (from the taught schema) to solve word problems. Schema-broadening instruction differs from schema-based instruction because students are taught to transfer their knowledge of problem types to recognize problems with novel features (e.g., different format, additional question, irrelevant information, unfamiliar vocabulary, or information

		presented in charts, graphs, or pictures) as belonging to a problem type for which they know a solution."
Peer-Assisted Learning	Select **all that apply**: 0 = no results reported 1 = summary effect sizes 2 = individual study effect sizes 3 = frequency counts 4 = other results (e.g., qualitative)	This may also be referred to as peer-mediated instruction, peer-tutoring, or class wide peer-tutoring.
Computer-Assisted Learning; Technology; Digital	Select **all that apply**: 0 = no results reported 1 = summary effect sizes 2 = individual study effect sizes 3 = frequency counts 4 = other results (e.g., qualitative)	This refers to instructional modes that represent digital learning or computer assisted learning/instruction.
Other	Anecdotal	Please provide the description.

How Effectiveness was Measured and Reported
- There are a few other codes throughout related to effectiveness in different sections. They are highlighted in blue.

Variable	Code	Explanation
EBPs Focus?	Select one: 0 = no 1 = yes	This code refers to if the synthesis **attempted** to identify a practice as an evidence-based practice. No = the purpose of the study was not to identify a practice as EBP (this is many of the meta-analyses) Yes = yes, the purpose of the article (usually a quality review) was to identify a practice as EBP
Was the practice identified as EBP?	Select one: NA 0 = no 1 = yes	If you coded a 1 above, was the practice actually identified as EBP at the conclusion of the study? NA = not applicable because you selected a code of) above

		No = the authors determined that the practice was not EBP or there wasn't enough evidence
		Yes = according to the results of the study, the practice is EBP
Evidence Indicators	Anecdotal	Copy and paste information about what measure, scale, quality indicators the authors used to determine if the practice was EBP. Some studies will include quality indicators without actually identifying a practice as evidence-based. Only quality indicators used to identify an EBP should be reported here.