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OPERATIONALIZING ALGEBRA READINESS

A Replicable Implementation Framework for the Algebra Readiness Intervention and Teacher-Development Framework (ARITF), Grades 7-9

Companion Implementation Paper

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Companion to From Foundational Mathematics Gaps to Algebra Readiness: A Replicable Mathematics Intervention and Teacher-Development Framework for U.S. Secondary Schools

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Implementation Framework at a Glance

Implementation Domain	Operational Standard
Purpose	Convert the ARITF white paper into a bounded, school-authorized implementation system that can be piloted, measured, revised, and responsibly replicated.
Target population	Grades 7-9 students who show specific algebra-readiness needs based on multiple indicators; flexible participation rather than permanent ability grouping.
Core instructional cycle	Diagnose -> prioritize -> teach -> check -> analyze -> adapt -> consolidate/transfer.
Teacher-development cycle	Learn -> plan -> implement -> collect low-inference evidence -> study student work -> revise practice.
Pilot duration	12 weeks, including readiness/baseline, two or three instructional cycles, post-assessment, and implementation review.
Primary evidence	Student construct growth, response patterns, implementation fidelity, teacher practice/learning, feasibility, and intervention exposure.
Replication gate	No expansion based on narrative enthusiasm alone; replication follows documented feasibility, a stable core, usable tools, and evidence that a second site can implement with defined support.

Abstract

The Algebra Readiness Intervention and Teacher-Development Framework (ARITF) was proposed as a Grades 7-9 improvement model linking diagnostic assessment, targeted small-group instruction, contextualized tasks, formative progress monitoring, and job-embedded teacher learning. This companion paper converts that conceptual model into an implementation architecture that a school or district can authorize, operate, study, and refine. The need for such disciplined implementation is reinforced by 2024 National Assessment of Educational Progress

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results showing that eighth-grade mathematics performance remained below 2019 and that lower-performing students experienced particularly concerning patterns of performance.[1]

The framework is deliberately designed as a pilot-and-learn system, not as a proprietary curriculum or a claim of already proven effectiveness. Its operational premise is that a school should know, before scaling, exactly what the intervention requires, which components must remain stable, which may be adapted, how teachers are prepared, how student response is monitored, how fidelity is measured, and what evidence justifies the next decision. This paper therefore specifies governance, readiness criteria, diagnostic procedures, instructional routines, teacher-development structures, decision rules, fidelity indicators, evaluation measures, equity safeguards, and replication gates. The resulting model is intended to make the proposed endeavor teachable, observable, measurable, and transferable while preserving local control over curriculum, scheduling, staffing, and student-support obligations.

1. Purpose and Relationship to the White Paper

The foundational white paper defines the educational problem and the design logic of ARITF. It argues that algebra readiness is a developmental capacity involving rational-number reasoning, proportionality, equivalence, expressions, variables, representations, functional relationships, mathematical language, and strategic problem solving. It further proposes five coordinated components: diagnostic mapping, targeted instructional cycles, contextualized algebra-readiness tasks, formative progress monitoring with decision rules, and teacher development through collaborative review. This companion paper begins where that design paper ends: with the practical question of how an authorized school can implement those components coherently enough to learn whether the model is feasible and educationally promising.

The implementation framework adopts three evidence-based algebra practices identified by the What Works Clearinghouse: analyzing solved problems, teaching students to use the structure of algebraic representations, and helping students intentionally choose among alternative strategies. These recommendations are not treated as a complete curriculum. They are embedded as recurring instructional routines within the school's existing mathematics program, consistent with the intended use of the federal algebra practice guide.[2]

The companion framework also follows the implementation orientation of the Institute of Education Sciences algebra toolkit, which explicitly positions evidence-based algebra strategies as practices that educators integrate into existing instruction rather than as a scripted replacement curriculum. The toolkit organizes instructional improvement around Plan-Do-Study-

1National Center for Education Statistics, The Nation's Report Card, '2024 NAEP Mathematics: Grades 4 & 8 Results,' 2025, https://www.nationsreportcard.gov/reports/mathematics/2024/g4_8/
2Institute of Education Sciences, What Works Clearinghouse, Teaching Strategies for Improving Algebra Knowledge in Middle and High School Students, revised January 2019, https://ies.ed.gov/ncee/wwc/PracticeGuide/20

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Act cycles and professional learning communities, with educators collecting low-inference evidence about implementation and student response. ARITF uses the same disciplined improvement logic while adding an algebra-readiness diagnostic map, short-cycle intervention architecture, explicit response rules, and a staged replication pathway.[3]

Accordingly, the objective of implementation is not simply to complete twelve weeks of activities. The objective is to create a traceable chain from identified student need to selected instructional response, from instructional response to observable student work, from student work to a documented decision, and from repeated decisions to a defensible judgment about feasibility, refinement, continuation, or replication. Every major component of the pilot should therefore leave an evidence trail that can be reviewed by participating educators and school leadership.

2. Implementation Commitments: What Must Remain Stable and What May Adapt

A replicable model must distinguish fidelity from uniformity. Fidelity means preserving the function of the framework's essential components; it does not mean requiring every school to use the same bell schedule, commercial assessment, lesson context, digital platform, or grouping configuration. The implementation framework therefore separates core components from adaptable features before the pilot begins. This distinction protects the model from two opposite failures: over-standardization that makes local implementation unrealistic, and uncontrolled adaptation that makes it impossible to determine what was actually tested.

2.1 Core Components and Adaptable Features

Domain	Core - preserve function	Adaptable - localize responsibly
Diagnostic mapping	Multiple sources; domain-level analysis; attention to error patterns; baseline before intensification.	Specific school-approved measures, timing within the readiness window, and local data displays.
Targeted cycles	Short, bounded cycles tied to one or two priority constructs; explicit instruction; guided practice; reasoning and representation.	Session length, group size within feasible limits, examples, contexts, and supplemental materials.

3Regional Educational Laboratory Central, Institute of Education Sciences, Toolkit to Support Evidence-Based Algebra Instruction in Middle and High School, 2025, https://ies.ed.gov/ncee/rel/algebra-middle-and-high-school/intro

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Domain	Core - preserve function	Adaptable - localize responsibly
Progress monitoring	Frequent checks linked to the construct taught; response reviewed at predefined decision points.	Exact probe format, digital or paper administration, and local recording system.
Teacher learning	Job-embedded learning, student-work analysis, feedback, and iterative refinement.	PLC cadence, facilitator role, meeting format, and school-specific coaching arrangements.
Fidelity evidence	Document delivery of core components and student exposure.	Combination of teacher logs, brief observations, artifacts, or administrative records.
Replication	Expansion only after a revision cycle and documented feasibility.	Number and type of second-site classrooms, local schedule, and implementation support package.

This core-adaptation boundary should be approved by the pilot team before students are selected. If a core feature must change during implementation, the change should be recorded as an implementation deviation, not quietly absorbed into practice. The team can then determine whether the deviation was a necessary adaptation, a fidelity problem, or evidence that the original specification was impractical. This approach makes adaptation analyzable rather than anecdotal.

3. Governance and Implementation Team

ARITF should operate under school or district authorization. The framework developer may provide design leadership, instructional resources, professional-learning materials, and analytic tools, but institutional authority remains with the participating school. This separation is essential because student assignment, scheduling, curriculum alignment, data access, accommodations, special education services, English learner supports, privacy, and staff supervision are institutional responsibilities.

A small implementation team should be formed before the readiness phase. At minimum, the team should include an administrator or designated site lead, a mathematics instructional lead or department representative, participating mathematics teachers or interventionists, and a person responsible for data/evaluation coordination. Depending on local structures, a special education or multilingual learner representative may participate when the student population or implementation questions warrant that expertise. The team's purpose is operational: remove

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barriers, protect instructional coherence, monitor implementation, and make documented decisions at predefined review points.

3.1 Role Matrix

Role	Primary responsibility	Key outputs	Decision authority
Framework Developer / Model Lead	Maintain model specifications; prepare tools; facilitate professional learning; synthesize implementation evidence.	Implementation manual, training materials, revision memo, replication package.	Recommends model changes; does not control school personnel or student services.
Site Administrator / Sponsor	Authorize scope, schedule, staffing, data access, and operational supports; resolve organizational barriers.	Site authorization, schedule, resource commitments, barrier log.	School-level operational decisions.
Math Lead / Facilitator	Coordinate diagnostic review, PLC cycles, instructional alignment, and peer support.	Meeting agendas, calibration records, instructional support notes.	Instructional coordination within school policy.
Participating Teachers / Interventionists	Deliver instruction; collect student evidence; apply decision rules; document adaptations.	Lesson artifacts, progress data, logs, student work samples.	Day-to-day instructional decisions within approved framework.
Data / Evaluation Coordinator	Maintain common definitions, protect data integrity, prepare descriptive summaries, track fidelity and exposure.	Data dictionary, dashboard, outcome summary, missing-data log.	Measurement procedures under institutional policy.

The implementation team should meet at least at four formal decision points: readiness approval, completion of Cycle A, completion of Cycle B, and post-pilot review. Shorter teacher-level meetings may occur more frequently. The formal team should use written agendas and

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decision records so that changes in grouping, instructional emphasis, measures, or schedules can later be distinguished from ordinary variation.

4. Site Readiness and Pre-Implementation Installation

A pilot should not begin merely because an instructional need is recognized. Before Week 1, the site should determine whether it has the minimum conditions necessary to implement the framework responsibly. Readiness is not a judgment of school quality; it is an assessment of whether the proposed intervention has a realistic operating environment. Launching without protected time, teacher participation, usable baseline data, or a clear student-selection process can produce an apparent program failure that is actually an implementation failure.

4.1 Readiness Criteria

- Leadership authorization: a designated administrator approves the pilot scope, target grades, staffing, schedule, and use of school-approved data.
- Instructional fit: the framework supplements rather than displaces the school's adopted curriculum, required supports, or legally mandated services.
- Protected delivery time: the school identifies when targeted support will occur and how missed sessions will be handled.
- Teacher commitment: participating educators understand the pilot purpose and agree to use core routines, collect brief evidence, and participate in collaborative review.
- Data readiness: the team has access to appropriate baseline information and can administer or construct focused algebra-readiness tasks without excessive testing burden.
- Measurement plan: constructs, data fields, scoring rules, decision points, and responsible staff are defined before the first baseline measure.
- Privacy and access: student information is handled under school policy; public or external dissemination uses de-identified or aggregated information unless separately authorized.
- Feasibility threshold: staffing, materials, technology, preparation time, and collaboration time are plausible within ordinary school operations or explicitly resourced for the pilot.

The readiness process should end with a one-page Site Readiness Record indicating: ready, ready with conditions, or not ready. A site rated ready with conditions should list the conditions and the date by which they must be resolved. The purpose is to prevent the pilot from absorbing unresolved structural problems that later obscure interpretation of outcomes.

5. Diagnostic Architecture and Student Entry

The framework's diagnostic stage is designed to answer a practical instructional question: what specific prerequisite or reasoning difficulty is most likely to limit a student's successful participation in emerging algebra? It is not designed to generate a permanent label or rank

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students by a single composite score. Federal mathematics intervention guidance supports screening and progress monitoring, explicit systematic instruction, visual representations, and focused treatment of rational-number content in the middle grades.4

ARITF therefore organizes baseline evidence into six domains: (1) rational-number meaning and operations; (2) ratio and proportional reasoning; (3) equality, equivalence, expressions, and equations; (4) variable and functional reasoning; (5) representation and graph interpretation; and (6) mathematical communication and strategic explanation. The diagnostic map should indicate both strengths and likely barriers because intervention is more efficient when it builds from what students already understand.

Multiple indicators should be used for entry. These may include recent course performance, benchmark or interim assessment data, teacher-identified patterns supported by work samples, and a brief common algebra-readiness diagnostic. No single source should automatically determine placement. A student with low performance attributable primarily to absence, interrupted schooling, language access, or unfamiliar task format may require a different response from a student who repeatedly shows a stable mathematical misconception.

Diagnostic reasoning should be hypothesis-driven. The National Center on Intensive Intervention recommends using diagnostic data to develop an explanation for why progress is insufficient that is accurate, specific, and actionable. In ARITF, the team translates that principle into a simple statement: 'The student appears to have difficulty with ___ when asked to ___, as shown by ___; therefore the next instructional cycle will emphasize ___.'[5]

Error analysis is especially useful when a score alone does not identify the problem. Recent NCII guidance describes error analysis as a process of identifying recurring types of mistakes in student work and using those patterns to align intervention more closely with student need. Teachers should therefore preserve a small sample of representative baseline work and classify errors before deciding that additional practice of the same kind is the appropriate response.[6]

5.1 Diagnostic Classification Protocol

1. Collect existing evidence and flag inconsistencies. Compare grades, benchmark data, recent work, and teacher observations. Large discrepancies trigger review rather than automatic averaging.

4Institute of Education Sciences, What Works Clearinghouse, Assisting Students Struggling with Mathematics: Response to Intervention (RtI) for Elementary and Middle Schools, April 2009, https://ies.ed.gov/ncee/wwc/PracticeGuide/2/Published

5National Center on Intensive Intervention, Using Diagnostic Data to Inform Intervention Planning, June 2023, https://intensiveintervention.org/resource/using-diagnostic-data-inform-intervention-planning

6National Center on Intensive Intervention, Error Analysis in Math, October 2025, https://intensiveintervention.org/resource/math-error-analysis

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2. Administer a focused task set. Use a brief set of items that samples the six readiness domains and includes selected explanation or representation tasks.
3. Analyze response process. Distinguish computational slips, conceptual misunderstandings, notation or language confusion, representation difficulty, and strategy-selection problems.
4. Create a priority profile. Identify no more than two primary intervention targets for the first cycle. A long list of weaknesses is not an actionable plan.
5. Confirm access factors. Note attendance, accommodations, language supports, and whether the student had a reasonable opportunity to learn the assessed content.
6. Assign a flexible starting group. Group students by current instructional need, not by global labels. Groups may change after each decision point.

6. Short-Cycle Intervention Architecture

The intervention is organized into two- to four-week cycles. Each cycle has one or two explicit mathematical targets, a small set of recurring instructional routines, a baseline indicator, at least two interim checks, and an end-of-cycle transfer task. The cycle is intentionally bounded so that teachers can observe response and change course without waiting for the end of a grading period.

Project AIM provides a relevant example of how algebra-readiness intervention can combine conceptual, strategic, and procedural knowledge with explicit instruction, modeling of problem solving, verbalization of thinking, guided practice, corrective feedback, and cumulative review. Its federal project description also emphasizes dosage and fidelity measurement. ARITF does not adopt Project AIM as a packaged program and does not claim its results; instead, it draws on these design features to specify what a coherent supplemental mathematics cycle should make observable.[7]

6.1 Standard Session Anatomy

A typical 30- to 45-minute intervention session can be organized into five phases. Schools may adjust exact minutes, but the instructional functions should remain visible.

1. Retrieval and connection (3-5 minutes). Revisit one or two prerequisite ideas and explicitly connect them to the day's target. The purpose is activation and cumulative review, not a separate worksheet block.

2. Explicit model and reasoning focus (7-10 minutes). The teacher models a worked example, error analysis, or representation link while naming the mathematical structure and explaining why each step is valid.

7Institute of Education Sciences, Project AIM: Algebra-readiness Intervention Modules for Middle School Students with Mathematics Difficulties, https://ies.ed.gov/use-work/awards/project-aim-algebra-readiness-intervention-modules-middle-school-students-mathematics-difficulties

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3. Guided practice with high response opportunity (10-15 minutes). Students solve, compare, explain, represent, or correct examples while the teacher elicits frequent responses and provides immediate, specific feedback.

4. Transfer or contextualized application (7-10 minutes). Students apply the target in a new representation or concise real-world context without being told exactly which procedure to use.

5. Evidence capture (3-5 minutes). A short exit task records whether the student can perform and explain the targeted idea independently enough to inform the next lesson.

6.2 Six Recurring Instructional Routines

The companion implementation manual preserves the six routines defined in the white paper and adds observable indicators for each routine.

Routine	Essential implementation feature	Observable evidence
Diagnostic error analysis	Students explain or inspect reasoning; teacher identifies the nature of the error rather than recording only correct/incorrect.	A work sample or teacher note identifies the error pattern and the resulting instructional response.
Worked-example comparison	Students compare valid and/or intentionally flawed solution paths and discuss efficiency, validity, and structure.	Student annotations, discussion notes, or exit responses show analysis of solution steps.
Representation linking	Students connect at least two forms - verbal, tabular, graphical, symbolic, pictorial - and identify the relationship preserved across forms.	Task artifacts show explicit translation or explanation across representations.
Contextualized transfer	Students determine how mathematics applies in a new setting rather than copying a signaled procedure.	Transfer task is not isomorphic in surface features to the modeled example.
Retrieval and cumulative review	Previously taught prerequisites reappear briefly across sessions.	Lesson record identifies spaced review items linked to current content.
Student explanation and mathematical language	Students justify choices and interpret symbols with	Teacher prompts and student responses capture reasoning, not

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Routine	Essential implementation feature	Observable evidence
	increasingly precise language.	answer-only participation.

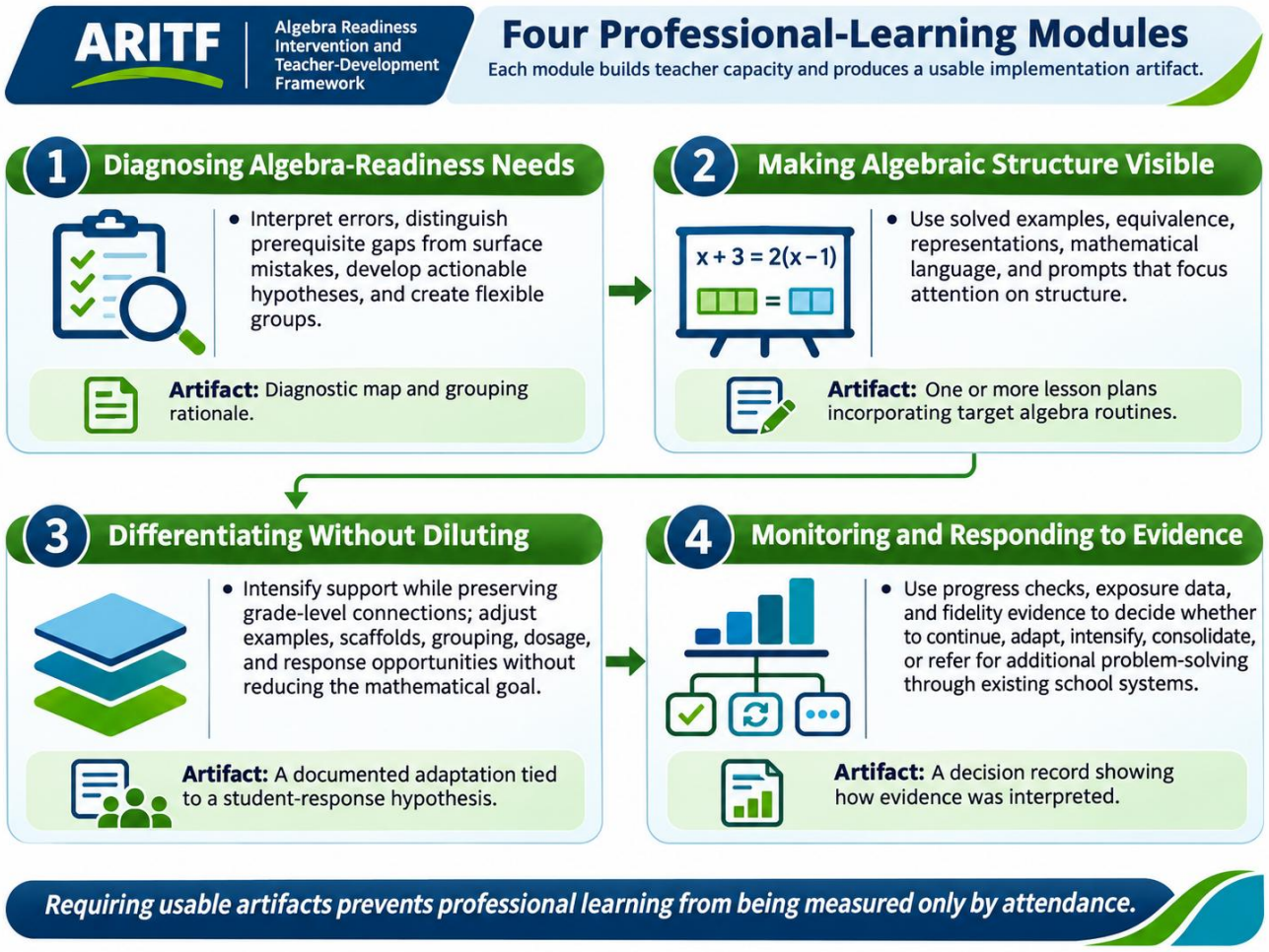
7. Teacher-Development and Coaching Architecture

The teacher-development strand is not a pre-pilot workshop followed by independent implementation. It is a repeated learn-apply-review process tied directly to student evidence. The IES algebra toolkit uses professional learning communities, teacher self-reflection, classroom visitation tools, student surveys, knowledge assessments, and repeated PDSA cycles to support evidence-based algebra instruction. ARITF adopts that practice-based structure while aligning it to the six algebra-readiness routines and the pilot's diagnostic domains.[8]

7.1 Four Professional-Learning Modules

8Regional Educational Laboratory Central, Institute of Education Sciences, Toolkit to Support Evidence-Based Algebra Instruction in Middle and High School, 2025, https://ies.ed.gov/ncee/rel/algebra-middle-and-high-school/intro

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Module 1 - Diagnosing Algebra-Readiness Needs. Interpret errors, distinguish prerequisite gaps from surface mistakes, develop actionable hypotheses, and create flexible groups.

Module 2 - Making Algebraic Structure Visible. Use solved examples, equivalence, representations, mathematical language, and prompts that focus attention on structure.

Module 3 - Differentiating Without Diluting. Intensify support while preserving grade-level connections; adjust examples, scaffolds, grouping, dosage, and response opportunities without reducing the mathematical goal.

Module 4 - Monitoring and Responding to Evidence. Use progress checks, exposure data, and fidelity evidence to decide whether to continue, adapt, intensify, consolidate, or refer for additional problem-solving through existing school systems.

Each module should produce an artifact. Module 1 produces a diagnostic map and grouping rationale. Module 2 produces one or more lesson plans incorporating target algebra routines. Module 3 produces a documented adaptation tied to a student-response hypothesis. Module 4

produces a decision record showing how evidence was interpreted. Requiring usable artifacts prevents professional learning from being measured only by attendance.

Teacher learning should also be evaluated separately from student outcomes. An IES randomized evaluation of content-intensive mathematics professional development found positive effects on teachers' mathematical knowledge and the quality of their mathematical explanations but did not find a positive impact on student achievement. The implication for ARITF is not that professional development lacks value; it is that changes in teacher knowledge, changes in classroom practice, and changes in student learning are distinct links in an implementation chain and should be measured as such.[9]

Experienced mathematics educators should be used as co-designers and peer resources when appropriate. A Regional Educational Laboratory study found that middle-school Algebra I teacher performance on mathematics certification examinations and years of mathematics-teaching experience were among the qualifications most strongly associated with student Algebra I achievement. Because the study is correlational, the framework does not treat experience as proof of effectiveness; it treats substantive content knowledge and accumulated instructional judgment as resources to be deliberately engaged in implementation.[10]

8. Progress Monitoring and Decision Rules

Progress monitoring is useful only when it changes instruction. ARITF therefore requires every short cycle to specify, before instruction begins, what evidence will be collected, how often it will be reviewed, and what response each pattern will trigger. This is consistent with federal guidance that places data within an ongoing cycle of instructional improvement rather than treating assessment as an endpoint.[11]

The preferred monitoring unit is the targeted construct rather than a broad total mathematics score. If Cycle A targets proportional reasoning and representation, the progress measures should sample those ideas directly. Measures may include three- to six-item probes, constructed-response prompts, error-analysis tasks, representation-matching tasks, or curriculum-aligned exit tickets. The same scoring logic should be used across the cycle so that change can be interpreted consistently.

9Michael S. Garet et al., Focusing on Mathematical Knowledge: The Impact of Content-Intensive Teacher Professional Development, NCEE 2016-4010, Institute of Education Sciences, September 2016, https://ies.ed.gov/use-work/resource-library/report/evaluation-report/focusing-mathematical-knowledge-impact-content-intensive-teacher-professional-development

10Trudy Cherasaro et al., Associations between the Qualifications of Middle School Algebra I Teachers and Student Math Achievement, Regional Educational Laboratory Central, January 2019, https://ies.ed.gov/use-work/resource-library/report/descriptive-study/associations-between-qualifications-middle-school-algebra-i-teachers-and-student-math-achievement

11Institute of Education Sciences, What Works Clearinghouse, Using Student Achievement Data to Support Instructional Decision Making, September 2009, https://ies.ed.gov/ncee/wwc/practiceguide/12

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8.1 Response Categories

Pattern	Evidence	Default response	Required check
Adequate response	Consistent improvement across aligned checks and successful transfer with acceptable exposure.	Reduce intensity or move to consolidation/extension while continuing core instruction.	Confirm that success is not limited to memorized item formats.
Partial response	Some growth but inconsistent performance, weak transfer, or one persistent error pattern.	Continue another short cycle with a specific adaptation to representation, examples, grouping, feedback, or practice.	State the adaptation hypothesis in writing.
Minimal response	Little or no growth despite adequate exposure and acceptable fidelity.	Conduct deeper diagnostic review and intensify support through approved school processes.	Verify fidelity, attendance, task validity, accommodations, and opportunity to learn before attributing nonresponse to the student.
Uninterpretable response	Insufficient sessions, missing data, major schedule disruption, or inconsistent delivery.	Do not classify the intervention as ineffective; restore implementation conditions or repeat the measurement window.	Document the implementation barrier and corrective action.

When a student shows limited response, intensification should be purposeful rather than simply 'more of the same.' NCII's mathematics application of the Taxonomy of Intervention Intensity provides a useful decision structure for evaluating and intensifying interventions. ARITF can use dimensions such as dosage, alignment to need, comprehensiveness, behavioral support, attention to transfer, and implementation quality to guide adaptations. A decision to increase minutes should therefore follow an analysis of why additional minutes are expected to address the observed problem.[12]

12National Center on Intensive Intervention, Using the Taxonomy of Intervention Intensity Within the Data-Based Individualization Process: A Mathematics Example, August 2020, https://intensiveintervention.org/resource/using-taxonomy-mathematics

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9. Twelve-Week Pilot Roadmap

The pilot remains a bounded 12-week implementation, but this companion framework specifies weekly outputs and decision points. The calendar is a template; schools may shift dates while preserving the sequence of readiness, intervention, evidence review, adaptation, and post-pilot synthesis.

Week	Primary activity	Required evidence	Decision / output
1	Installation and orientation	Site readiness record; roles; schedule; measure inventory.	Go/no-go decision and unresolved conditions list.
2	Baseline diagnostic mapping	Common diagnostic; work samples; access/exposure information.	Priority domains and flexible starting groups.
3	Cycle A launch	Lesson logs; baseline target probe; first teacher reflection.	Confirm delivery conditions and initial fit.
4	Cycle A implementation	Progress check 1; selected work samples; implementation notes.	Minor in-cycle adjustment if needed.
5	Cycle A review	End-of-cycle task; transfer item; fidelity/exposure summary.	Continue, regroup, adapt, intensify, or consolidate.
6	Cycle B launch	Revised grouping rationale; adaptation hypothesis; lesson plan.	Approve Cycle B target and adaptation.
7	Cycle B implementation	Progress check 1; peer/coach observation or artifact review.	Feedback to teacher; barrier resolution.
8	Cycle B review	End-of-cycle task; response classification; student work.	Determine Cycle C versus consolidation path.
9	Cycle C or consolidation	Targeted lessons or mixed cumulative	Check generalization across

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Week	Primary activity	Required evidence	Decision / output
		practice; transfer tasks.	representations/contexts.
10	Cycle C / consolidation review	Progress evidence; implementation burden notes.	Finalize post-assessment plan and missing-data recovery.
11	Post-pilot measurement	Aligned post-measure; teacher reflection; feasibility survey.	Prepare descriptive outcome and fidelity summaries.
12	Implementation review and revision	Dashboard; barrier log; adaptation record; team review.	Revision memorandum and decision on continuation/second-site readiness.

The pilot team should use Plan-Do-Study-Act logic across the cycle: define the change and expected evidence, implement and collect data, compare what happened with the prediction, then adopt, adapt, or abandon the change. IES continuous-improvement guidance emphasizes that PDSA cycles are structured tests of change in real settings, with metrics specified during planning and evidence reviewed before broader implementation.[13]

10. Fidelity, Adaptation, and Implementation Learning

A pilot cannot be interpreted solely from student outcomes. If results are weak, the team needs to know whether the framework itself was insufficient, whether it was incompletely delivered, whether students received too little exposure, or whether the measures were poorly aligned. If results are positive, the team likewise needs to know what was actually implemented and at what level of effort. Fidelity is therefore a condition for interpretation, not a compliance score imposed on teachers.

IES guidance on implementation research recommends defining each key component, identifying the unit at which it is delivered and measured, specifying observable indicators, and stating how each indicator will be scored. ARITF applies that principle to diagnostic mapping,

13Karen Shakman et al., Continuous Improvement in Education: A Toolkit for Schools and Districts, Regional Educational Laboratory Northeast & Islands, Institute of Education Sciences, October 2020, https://ies.ed.gov/use-work/resource-library/resource/other-resource/continuous-improvement-education-toolkit-schools-and-districts

targeted instructional cycles, core routines, progress monitoring, teacher collaboration, and implementation review.[14]

10.1 Minimum Fidelity Indicators

- Dosage: proportion of planned intervention sessions delivered and approximate instructional minutes received.
- Target alignment: evidence that sessions addressed the priority construct identified for the cycle.
- Routine use: presence of the relevant instructional routines, such as worked-example analysis, representation linking, explanation, and transfer.
- Progress monitoring: aligned checks administered at the planned points and reviewed before the next decision.
- Teacher learning: participation in the agreed learn-apply-review activities and production of required implementation artifacts.
- Decision integrity: documented rationale for regrouping, adaptation, intensification, consolidation, or exit.
- Access: record of absences, missed sessions, major schedule disruptions, or accommodation/access barriers that affect interpretation.

Adaptations should be logged using five fields: what changed, why it changed, who authorized or made the change, whether the change affected a core or adaptable feature, and what evidence will indicate whether the adaptation helped. This simple structure prevents local innovation from disappearing into undocumented practice. It also creates a record that can later inform the replication package.

11. Evaluation and Learning Agenda

The first pilot should be evaluated as an implementation-and-learning study unless a separate, appropriately designed causal study is established. The framework should not describe ordinary pre/post classroom change as proof that ARITF caused the improvement. The immediate goal is to determine whether the model is coherent, feasible, implementable, and associated with promising patterns of student learning that justify refinement or stronger future evaluation.

11.1 Four Evaluation Domains

Student learning. Change on targeted algebra-readiness constructs, progress trends, transfer performance, and patterns of persistent misconception.

14Institute of Education Sciences, Conducting Implementation Research in Impact Studies of Education Interventions: A Guide for Researchers, https://ies.ed.gov/ies/2025/01/conducting-implementation-research-impact-studies-education-interventions-guide-researchers

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Implementation quality. Fidelity to core components, dosage, exposure, documented adaptations, and implementation barriers.

Teacher practice and learning. Use of target routines, quality of instructional reasoning, analysis of student work, and confidence or competence with the framework's decision processes.

Feasibility and sustainability. Preparation time, scheduling fit, staffing burden, material/technology needs, leadership support, teacher acceptability, and plausibility of continued use without extraordinary external support.

Measures should be construct-aligned, psychometrically appropriate when formal measures are used, and not so closely tailored to the intervention that they merely reproduce practiced items. The IES Standards for Excellence in Education Research emphasize high-quality measures, documentation of implementation and treatment contrast, fidelity measurement, and attention to both immediate and more distal outcomes. Those principles provide a useful standard even when the first ARITF pilot is descriptive rather than an impact study.[15]

At minimum, the final pilot report should show baseline and post-pilot descriptive results, within-cycle progress patterns, intervention exposure, fidelity indicators, teacher-learning evidence, feasibility findings, and a transparent account of missing data and deviations. Results should be disaggregated only when sample size and privacy permit responsible interpretation. The report should identify non-improvement and implementation problems as clearly as successes.

A practical dashboard may include six indicators: percentage of planned sessions delivered; percentage of students with adequate exposure; percentage of participating students showing growth on the primary targeted construct; percentage successfully transferring the concept to a new representation or context; percentage of observed or documented lessons showing the core routine; and percentage of participating teachers completing the learn-apply-review cycle. None of these indicators alone defines success. Together they help the team locate where the implementation chain is strong or weak.

12. Equity, Access, Attendance, and Privacy

ARITF is designed to increase access to algebra readiness, not to create a durable lower track. Student entry, continuation, and exit should therefore be reviewed at each cycle. A student should not remain in intervention simply because of an initial label if current evidence indicates readiness for reduced intensity. Conversely, a student should not be denied support because a broad average masks a specific prerequisite gap.

15Institute of Education Sciences, Standards for Excellence in Education Research (SEER), https://ies.ed.gov/use-work/standards-excellence-education-research-seer

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Teachers should distinguish mathematical difficulty from access barriers. English learners may require explicit support for relational vocabulary, sentence structures used in word problems, and opportunities to express reasoning through multiple modalities. Students with disabilities should receive required accommodations and specialized supports through existing school procedures. The framework does not supersede individualized education programs, Section 504 plans, multilingual learner services, or district intervention procedures.

Attendance and intervention exposure must be incorporated into interpretation. The U.S. Department of Education defines chronic absenteeism as missing at least 10 percent of school days and continues to identify attendance as a major barrier to student engagement and achievement. When a student receives substantially fewer ARITF sessions than planned, the outcome should be coded as limited exposure rather than automatically interpreted as intervention nonresponse.16

For privacy, implementation data should use school-approved identifiers and access controls. External presentations, manuscripts, or replication reports should rely on de-identified or aggregated information unless the institution has authorized another approach. Small-cell reporting that could permit re-identification should be avoided. Student work used in teacher collaboration should be handled according to school policy, and the pilot should collect only data necessary for instructional and evaluation purposes.

13. Sustainability and Responsible Replication

Replication is an implementation test, not a dissemination event. The first site may succeed partly because the framework developer provides informal support that is not documented or scalable. For that reason, ARITF requires a consolidation phase after the first pilot and a deliberately supported second-site implementation before any broader multi-site expansion.

13.1 Replication Gate 1 - Site Consolidation

After the first pilot, the team should revise the framework based on actual barriers, fidelity evidence, student response, teacher feedback, and resource burden. The goal is to convert tacit support into explicit tools. The revised package should contain: a framework overview; readiness checklist; role matrix; 12-week calendar; diagnostic map and scoring guide; sample task bank; intervention-session template; six routine guides; progress-monitoring templates; response decision rules; four teacher-learning modules; fidelity tools; adaptation log; evaluation dashboard; and post-pilot review protocol.

16U.S. Department of Education, Supporting Student Attendance and Engagement, https://www.ed.gov/teaching-and-administration/supporting-students/seac/supporting-student-attendance-and-engagement

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13.2 Replication Gate 2 - Second-Site Test

The second site should be sufficiently different to test transfer but not so different that the framework is simultaneously rewritten. The central question is whether educators who did not participate in the original development can understand and implement the model using the documented package and specified support. The developer should track what questions arise, what additional coaching is required, which tools are unclear, and which adaptations are necessary. Those observations are themselves replication evidence.

13.3 Replication Gate 3 - Multi-Site Learning

Multi-site use should begin only after the first and second sites demonstrate acceptable feasibility and a stable core. Participating schools should use common definitions for minimum exposure, core routines, fidelity, and primary outcomes while preserving local control of curriculum, schedules, staffing, and approved assessments. Cross-site learning can then examine which components are consistently implementable, which adaptations recur, and whether student-response patterns remain promising across contexts.

Sustainability should be evaluated in practical terms. A framework that requires extraordinary preparation, constant developer presence, or staffing levels unavailable in ordinary schools is not yet sustainable. By the end of the pilot, the team should estimate recurring teacher preparation time, collaboration time, intervention minutes, material costs, technology dependencies, data-management needs, and coaching requirements. The preferred design is not necessarily the most intensive design; it is the least burdensome design that reliably delivers the intended instructional functions.

14. Role of the Framework Developer and Professional Contribution

The framework developer's role is to translate extensive secondary mathematics teaching experience into a documented, testable improvement system. That work includes defining the instructional model, developing diagnostic and instructional resources, facilitating teacher learning, supporting implementation analysis, and revising the framework from evidence. The developer's professional experience across Grades 7-10, work with contextualized mathematics instruction and individualized or small-group support, graduate preparation in education and educational management, and current U.S. middle-school mathematics teaching provide a practitioner foundation for this work.

Those qualifications should be understood as capacity to undertake the endeavor, not as evidence that the proposed framework has already been proven effective. The credibility of ARITF should increasingly rest on documented implementation, transparent evaluation, independent institutional use, and cumulative evidence generated across authorized sites. This distinction is

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central to the model's professional integrity: experience motivates and informs development; evidence determines whether the model warrants continuation and replication.

15. Conclusion

The Algebra Readiness Intervention and Teacher-Development Framework becomes meaningful only when its design principles can be implemented consistently enough to be observed and improved. This companion paper therefore turns the white paper's five-component model into an operating system for Grades 7-9 mathematics improvement. It establishes a bounded pilot, explicit governance, site-readiness conditions, domain-based diagnostic mapping, short-cycle intervention, six recurring instructional routines, embedded teacher development, aligned progress monitoring, pre-established response rules, fidelity measurement, transparent adaptation, and staged replication.

The central implementation discipline is simple: identify a specific need, select a defensible response, deliver it with documented exposure, examine student reasoning, adjust from evidence, and preserve a record of what changed and why. That cycle protects the framework from becoming either a static manual or an unstructured collection of promising practices. It also creates a basis for institutional learning because future sites can see not only what the model recommends, but how it was tested, where it failed, what was revised, and which components proved usable across contexts.

The 12-week pilot should therefore be judged neither by enthusiasm nor by a single pre/post score. A credible first implementation will answer a set of narrower but consequential questions: Were students accurately matched to priority needs? Could teachers use the routines within ordinary instructional constraints? Did progress measures generate actionable information? Were adaptations purposeful and documented? Did students show promising growth and transfer on targeted constructs? Did teachers strengthen instructional decision-making? Could the school sustain the model without unrealistic burden? If the answers are sufficiently positive, the framework moves to a second-site test with a clearer package and stronger evidence. If they are not, the evidence directs revision before expansion.

This staged approach makes replication a product of evidence rather than aspiration. The intended long-term contribution is a usable, non-proprietary implementation framework that schools can adapt responsibly while preserving core instructional functions: diagnostic precision, algebraic reasoning, representation, targeted support, frequent evidence, and teacher learning. Its value will ultimately depend on whether it helps participating schools strengthen students' transition into algebra and whether those gains can be reproduced with transparent supports across more than one setting.

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About the Author



Marites B. Jarina is a secondary mathematics educator with more than two decades of experience in mathematics instruction across Grades 7–10 and current professional experience teaching 9th-grade mathematics in the United States. Her academic preparation includes a Doctor of Education in Educational Management, a Master of Arts in Education in Administration and Supervision, and a Bachelor of Secondary Education major in Mathematics. Throughout her career, she has developed contextualized mathematics lessons and instructional materials, provided individualized and small-group instruction, and applied varied instructional strategies and technology to support student engagement and mathematical understanding.

Her professional interests focus on algebra readiness, targeted mathematics intervention, differentiated instruction, formative assessment, and teacher capacity-building. Drawing from her classroom experience and graduate preparation, she developed the **Algebra Readiness Intervention and Teacher-Development Framework (ARITF)** as a practice-oriented model designed to connect diagnostic mapping, targeted instructional cycles, contextualized algebra tasks, progress monitoring, and job-embedded teacher learning. Her continuing work centers on refining, piloting, evaluating, and responsibly replicating practical instructional systems that can strengthen students' transition into algebra while supporting educators in making more precise, evidence-informed instructional decisions.