METHODOLOGY / OCTOBER 2026

Maths fluency.

Practice. Measure. Progress.

A framework for accurate, efficient calculation.

27	81	3
ARITHMETIC SKILLS	PRACTICE LEVELS	CONNECTED TRACKS

What Numina provides

Numina is a practice and measurement instrument spanning number facts, mental strategies and their applications. It combines a broad skill framework with explicit accuracy and response-time criteria.

Learners work towards defined accuracy and response-time targets across **27 skills and 81 levels**. The aim is to help them calculate with greater ease and tackle more demanding mathematics.

An instrument for useful decisions

Each answer contributes to a skill-level record. This connects practice with evidence: where calculation is reliable, where accuracy or pace needs attention, and how performance changes over time.

This paper explains the shared framework of **Numina** for individual practice and **Numina for Schools** for school accounts and adult oversight. It sets out the standards, research rationale and use of results.

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For parents, educators and school leaders.

02 / THE NEED

Make the small steps more reliable

Numina aims to help learners calculate with greater ease, so they are better prepared for more demanding mathematics.

Seven notebooks cost £8 each. A learner pays with £100. How much change should they receive? They need to choose the operations, calculate **7 × 8 = 56**, then find **100 – 56 = 44**. Reliable calculation supports this sequence: understanding the situation, choosing operations and checking the result [1].

Figure 1. Calculation within a larger mathematical task



Numina focuses on calculation within this wider process. Learners still need to understand the problem, choose the operations and check their answer.

Finding a simpler route

Mental arithmetic involves choosing a useful method as well as getting the answer right. For **48 + 27**, a learner could add 20, then 7. Another route is to move 2 from 27 to 48 and calculate **50 + 25 = 75**. The second method replaces two additions with a round-number calculation. Numina gives learners practice with number relationships that make such efficient routes possible.

Sweller's work explains how searching for solution steps can compete with learning underlying patterns [2]. Numina's design applies this idea to arithmetic: its aim is to make familiar calculations easier to handle, leaving learners better equipped to tackle the rest of a problem.

Who this practice is for

Numina supports learners practising number ideas and operations they have already met. It provides a structured route from core facts to mental strategies and applications. Choose a starting skill from what the learner can currently do, then combine practice with teaching, worked examples and discussion.

For learners, the value is a clear task, feedback and a visible goal. For teachers and parents, the record offers a specific starting point for support: which skill to revisit, which method to discuss and what to practise next. The aim is useful progress in calculation alongside broader mathematical learning.

03 / DEFINING FLUENCY

Accuracy, efficiency and choice

Numina is an instrument for recording accuracy and response speed across a structured framework of mental-calculation tasks.

The National Research Council links five parts of learning maths: understanding ideas, using methods fluently, formulating and solving problems, explaining reasoning, and seeing maths as useful and learnable [1]. Fluency means choosing a suitable method and using it accurately and efficiently. These aspects of mathematical proficiency are connected.

Remember a fact or work it out

A familiar multiplication fact may come straight to mind. Another answer may come from a short calculation using something already known. For **19 × 6**, a learner can calculate **20 × 6 = 120**, then subtract 6 to get **114**. Both recall and a well-chosen method can be useful. Answer time alone does not reveal which one the learner used.

What the instrument measures

Numina records correctness and elapsed response time. In ordinary practice, timing runs from the displayed question becoming ready for input until the answer is submitted. Reading, thinking and entering the answer are included; loading and later feedback are outside this interval. If the page becomes hidden, that answer receives no pace credit, while correctness is still recorded.

Table 1. What one answer tells us

Answer	What it shows	What to explore
Correct, within target	Successful performance on this item at this pace.	How the learner worked it out and whether they will remember it later.
Correct, beyond target	A correct answer, but beyond the time target.	Whether reading, input or calculation took the time.
Incorrect, at any pace	The expected result was not entered.	Whether the cause was a slip, misunderstanding, method or input error.

Read performance in context

Repeated attempts build a record of accuracy and pace within each skill and level. Read the two together: correct but slower answers suggest a different next step from repeated errors. Ask the learner to explain a calculation to identify the method behind the result.

Response time includes reading and input, so language, motor access and assistive technology can affect it. It does not identify a mental strategy or prove understanding. Use later attempts and unfamiliar problems to check retention and transfer; use another suitable task when timing creates an access barrier.

04 / CURRICULUM

Three tracks, connected demands

Numina's fluency framework connects 27 skills and 81 levels, each with defined question demands and performance targets.

Core Facts / 5 skills

Core Facts practises basic relationships: for example, recalling a multiplication fact.

F1	Addition Facts
F2	Subtraction Facts
F3	Multiplication Facts
F4	Division Facts
F5	Number Bonds

Mental Strategies / 14 skills

Mental Strategies practises useful transformations: for example, finding 19 × 6 from 20 × 6.

M1	Place Value & Decimals
M2	Doubling, Halving & Number Relationships
M3	Number Decomposition & Friendly Numbers
M4	Two-Digit Mental Maths
M5	Multiplication Strategies
M6	Mental Multiplication: 2-Digit × 1-Digit
M7	Mental Division Strategies
M8	Estimation
M9	Squares, Cubes & Roots
M10	Number Structure (Primes, Factors, Multiples)
M11	Simplifying Fractions
M12	Number Sense & Magnitude
M13	Number Sequences
M14	Rounding

Applied Fluency / 8 skills

Applied Fluency uses arithmetic in related forms: for example, finding a percentage of an amount.

A1	Fractions, Decimals & Percents
A2	Fractions & Percents
A3	Percentage Increase & Decrease
A4	Integer Operations
A5	Multi-Step Calculations
A6	Ratio & Proportional Reasoning
A7	Fraction Arithmetic
A8	Decimal Arithmetic

Each skill has **Beginner, Intermediate and Advanced** practice: **27 × 3 = 81 levels**. **Mastered** is the achievement earned by meeting the Advanced requirements, rather than a fourth practice level. The companion *Practice syllabus* gives the level descriptions, examples, base time targets and curriculum references.

England's mathematics curriculum identifies fluency, reasoning and problem solving as aims [6]. Numina turns selected arithmetic content into explicit practice standards: what to answer, at what level and within which targets. These are Numina's own performance criteria; the syllabus maps their connections to the wider curriculum.

05 / RESEARCH RATIONALE

Reasons to retrieve, revisit and vary

Research on retrieval, spacing and mixed practice informs how Numina organises opportunities to practise.

Recall an answer: retrieval practice [3]

Roediger and Karpicke compared restudying prose with recalling it in tests without feedback [3]. Restudying gave better recall after five minutes; prior testing gave better recall after two days or a week.

In Numina, the learner produces or selects an answer before reviewing feedback. Fact questions offer opportunities to retrieve known relationships; mental-calculation questions also require working with those relationships. The aim is active use of knowledge.

Return over time: spaced practice [4]

Cepeda and colleagues brought together 317 experiments on spaced practice in verbal recall [4]. The useful gap between sessions depended on how long people needed to remember the material. Their review gives a reason to distribute practice over time.

Numina keeps earned achievements while allowing learners to revisit skills. A return visit provides another opportunity to practise and see what remains reliable. Teachers can use these visits to connect earlier work with the current topic.

Vary the task: interleaving [5]

Rohrer and Taylor studied college students learning mathematics [5]. One experiment compared spaced with concentrated practice; another compared mixed with grouped problem types. On tests a week later, spaced and mixed practice gave better results in their respective experiments. Spacing changes **when** practice happens; mixing changes **which task** comes next.

Numina offers focused skill practice and mixed activities. Focused work gives learners repeated opportunities to use a method; mixed tasks invite them to choose among methods. Both have a place in a practice programme.

What this means for Numina

The practical design is to attempt an answer, review feedback, revisit learning and apply it across related tasks. The studies used different learners and materials; they inform this design rather than test Numina itself. Page 9 sets out how its effects can be evaluated.

06 / PRACTICE DESIGN

A useful cycle of practice

A useful practice cycle gives the learner a suitable task, feedback and a clear next step.

Start with a suitable challenge

An initial placement check suggests a starting point. Later practice adds evidence within each skill and level. Learners can work towards a clear target, while adults can use the results and a short discussion to select manageable, useful practice.

Attempt, feedback, review, return

The learner attempts a question, reviews feedback and works towards the level's targets. If an error recurs, discuss the method. When answers are correct but slow, compare useful routes or practise a familiar strategy. Return later to see how the calculation has developed.

Table 2. From practice design to practical use

Design choice	Purpose in the practice cycle	How to use it
Answer attempts and feedback	Work out an answer, then review the result.	Discuss recurring errors and try the method again.
Focused skill practice	Use a method reliably across examples.	Look for consistent accuracy across different examples.
Mixed activities and return visits	Revisit knowledge and require a choice between related methods.	Compare later attempts and ask how the method was chosen.
Visible targets and earned levels	Show what has been achieved and what comes next.	Recognise achievement and identify the next requirement.

Different activities, different evidence

The level requirements on page 7 apply to practice that counts towards progression. Other activities use their own selection and scoring rules. Their scores should be read in the context of those activities; a high challenge score is not the same as completing a practice level.

Earned levels and rewards make progress visible. They give learners milestones to work towards and adults concrete achievements to recognise. Keep attention on the learner's method and experience as well as the score, using a manageable pace and useful feedback.

07 / PROGRESSION RULES

How a level is earned

Numina's performance standards combine accumulated successful practice with recent accuracy and pace.

A **qualifying answer** is correct within the question's time target. The criteria below make achievement explicit and inspectable. The first three checks apply at each level; the fourth applies only at Advanced.

Table 3. Requirements for earning a level

Requirement	What is needed
Qualifying count	**40** correct answers within time at the current level.
Recent accuracy	**17 of the latest 20 attempted answers** correct (85%). Beginner with two answer choices: **18 of 20** (90%).
Recent pace	**14 of the latest 20 attempts with valid timing** correct within time.
Advanced: faster answers	**10** qualifying answers on eligible question forms that also meet the faster-answer time target. These count **within** the required total, not in addition to it.

Two examples: what still needs work?

Enough qualifying answers, but accuracy is low. A learner has 40 qualifying answers at the level, but only 16 of the latest 20 are correct. They still need to meet the recent accuracy requirement.

Recent answers meet the targets, but the total is low. With no timing interruptions, a learner has 18 correct and 15 within time in the latest 20, but only 25 qualifying answers overall. Without a placement boost, they still need to reach 40. These are fictional examples.

Placement and time allowances

For eligible learners, a placement boost reduces the required qualifying count to **20 for 14 days**. The other checks still apply. Time allowances vary by skill, level and question format; some forms have extra allowances or minimum times. The syllabus lists the base targets; the app applies the allowance for the actual question form.

Why use these checks?

The count records accumulated success. Separate 20-answer windows check recent accuracy and pace: interrupted attempts can count for accuracy but are excluded from pace. Two-choice tasks require higher accuracy because guessing is more likely to succeed. These stated requirements make the framework criterion-based; the exact cut-offs are Numina's design choices.

08 / THE MEASUREMENT INSTRUMENT

From answers to a skill profile

Numina connects task performance to specific skills and criteria, giving learners and teachers a profile they can act on.

Each result belongs to a **skill, level and question form**. Correctness and response time are read against the relevant target; repeated answers build evidence of accuracy and pace. Across **27 skills and 81 levels**, this shows where performance is reliable and where support is needed. Raw seconds across unlike tasks are not directly comparable.

Table 4. Fictional learner: two 20-answer windows per skill

Skill / level	Earlier → later	Reading and next step
Multiplication Facts / Intermediate	Correct: **18 → 20** Within target: **16 → 18**	Consistently accurate and within target. Check the remaining progression requirements.
Two-Digit Mental Maths / Intermediate	Correct: **16 → 19** Within target: **9 → 14**	Both readings have improved. Ask about the method and continue towards the level target.
Fraction Arithmetic / Beginner	Correct: **13 → 13** Within target: **8 → 9**	Accuracy remains the priority. Discuss recurring errors before increasing pace.

These fictional windows have no timing interruptions, so accuracy and pace use the same 20 attempts. Each row holds level and question mix comparable. In actual practice, the two windows can differ (page 7). These are illustrative records, not study results or an app screen; recent windows alone do not establish an award.

Different records answer different questions

Practice and earned achievement. Accumulated success and recent accuracy and pace determine progression (page 7). **Mastered** records meeting the Advanced requirements; it can be earned as soon as they are met and remains earned. Its promotion windows then stop updating. **Later attempts and checks** provide separate evidence about current performance and retention; the award records the earlier achievement.

Complementary school instruments. Numina for Schools adds broad Snapshots, Facts Checks and Mix-up Checks. Fact records distinguish correct answers with and without valid timing; sampled forms can help investigate recurring errors. Read each result against what was actually assessed. These school records add evidence to the wider framework; a separate sitting is not interchangeable with accumulated practice progress.

The **0-100 progress measure** summarises saved levels and progress within them. Use the skill profile to identify strengths, set priorities and compare later work under similar conditions. The total is a within-app measure, not a national percentile or school grade; answers and timing do not directly reveal the learner's mental strategy.

09 / USE AND EVALUATION

Turn results into useful next steps

Use the record to choose a useful next step, then listen to how the learner explains their work.

Three steps for the next practice session

1. Look for a pattern. Review a skill and its recent answers.
2. Ask how. Discuss a calculation, especially when an error repeats.
3. Choose a useful next step. Offer an explanation, focused practice or a return to an earlier skill. Consider reading and input demands when interpreting pace.

A shared language for learning

Learners can see which requirement they are working towards. Parents can recognise a specific achievement and help with a next step. Teachers can use skill-level records to plan practice and discussion alongside classroom evidence. Ask how practice feels, and adjust the support when a learner is frustrated or unsure.

What the combination adds

Numina's distinctive contribution is the combination: broad mental-number content, task-specific targets, accumulated and recent evidence, and complementary school assessments. Its scope extends beyond XtraMath's four-operation facts [7]. Rocket Math covers wider tracks [8], and Reflex offers detailed fact and growth records [9]. Numina connects these kinds of evidence within its own framework. Aggregate success does not establish coverage of every fact or question form.

How the programme should be evaluated

Table 5. Evidence needed to evaluate the programme

Question	How to investigate it
Does it improve arithmetic?	Describe who takes part and what they practise. Use independent tasks before and after, with a suitable comparison group where feasible.
Does improvement last and transfer?	Check again after a delay and use unfamiliar problems as well as familiar tasks.
Who benefits, and at what cost?	Report who takes part or drops out, barriers to access, learner experiences and differences between groups.

This paper reports no controlled study of Numina's learning effects or validation of its exact thresholds. The next step is to test the programme against its aims, using independent outcomes and reporting participation, missing data and differences between learners. The table sets out that evaluation agenda.

10 / REFERENCES AND EDITION

Research and references

The sources below inform the design. The links identify the chapter, abstract or official text consulted.

[1] National Research Council (2001). *Adding It Up: Helping Children Learn Mathematics.* Chapter 4, The strands of mathematical proficiency. National Academies Press. doi:10.17226/9822.
Full chapter

[2] Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science, 12*(2), 257-285. doi:10.1207/s15516709cog1202_4.
Publisher record and abstract

[3] Roediger, H. L., III, & Karpicke, J. D. (2006). Test-enhanced learning: Taking memory tests improves long-term retention. *Psychological Science, 17*(3), 249-255. doi:10.1111/j.1467-9280.2006.01693.x.
Publisher record and abstract

[4] Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychological Bulletin, 132*(3), 354-380. doi:10.1037/0033-2909.132.3.354.
Indexed record and abstract

[5] Rohrer, D., & Taylor, K. (2007). The shuffling of mathematics problems improves learning. *Instructional Science, 35*, 481-498. doi:10.1007/s11251-007-9015-8.
Publisher record and abstract

[6] Department for Education (2013; updated 2021). *National curriculum in England: Mathematics programmes of study.* Aims and key stages 1 and 2.
Official curriculum

[7] XtraMath. *What program options are available?* Operations, problem sets and fluency thresholds. Checked 18 October 2026.
Official product documentation

[8] Rocket Math. *The Rocket Math Online Tutor.* Learning-track scope. Checked 18 October 2026.
Official product documentation

[9] ExploreLearning (2024). *Understanding Individual Reflex Reports.* Fact detail and fluency growth. Checked 18 October 2026.
Official product documentation

About this paper

18 October 2026. This paper explains the shared practice and measurement framework of Numina and Numina for Schools. The companion *Practice syllabus* contains the detailed curriculum, level descriptions, examples and base time targets.

This is a selective account of research relevant to the design. Sources were checked at the depth identified by each link: a full chapter, publisher or indexed abstract, or official curriculum text. Product comparisons use public documentation checked on 18 October 2026; they compare stated scope, not results from head-to-head testing.