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The research case for short learning cycles

What four decades of published evidence say about checking, reflecting, responding and re-measuring inside the classroom. A companion to The Mathematics Resource Landscape.

Version 1.7 · October 2026 · Published by Knowledgehook

The claim

> Mathematics outcomes move when the loop between evidence and instruction is short, specific to a concept, and run by the classroom teacher. That sentence is not a vendor's. It is the common finding of five research strands: formative assessment, feedback, progress monitoring, mastery learning, and the cognitive science of retrieval.

The term "short cycle" comes from the literature. Wiliam and Thompson (2008) distinguish long-cycle formative assessment (across terms and years), medium-cycle (within and between units) and short-cycle (within and between lessons, minute by minute and day by day), and Leahy, Lyon, Thompson and Wiliam (2005) describe the classroom practice. The research below is organized by the four steps of such a cycle.

The four steps and their evidence

1. Check for understanding

Frequent, concept-level checks for every student; the check itself strengthens retention

Black and Wiliam (1998a, 1998b) drew on about 250 research sources and reported effect sizes of 0.4 to 0.7, largest for students who had previously done poorly, and defined assessment as formative only when the evidence is used to adapt teaching. Roediger and Karpicke (2006) showed that being tested on material improves long-term retention more than restudying it. Dunlosky et al. (2013) rated practice testing and distributed practice the only two high-utility techniques among ten.

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2. Teacher reflection	Teachers reading item-level patterns with decision rules; gains depend on the teacher acting on the data Fuchs and Fuchs (1986), a meta-analysis of 21 studies, found an effect size of 0.70 when teachers measured progress frequently and adjusted instruction. Fuchs, Fuchs, Hamlett and Stecker (1991) found that, in mathematics operations, CBM improved achievement only when teachers also received instructional recommendations. Stecker, Fuchs and Fuchs (2005) found the strongest gains when teachers used the data to change instruction.
3. Targeted intervention	Task-specific, timely feedback and explicit instruction aimed at the identified gap Hattie (2009) reports an average effect of 0.73 for feedback; Hattie and Timperley (2007) specify that it works when it answers where am I going, how am I going and where to next, about a specific piece of work. Kluger and DeNisi (1996), across 607 effect sizes, found over a third of feedback interventions lowered performance, with effects weakening as feedback drew attention away from the task and toward the self. Bangert-Drowns et al. (1991) found feedback that supplied the correct answer outperformed right-or-wrong marks. The Education Endowment Foundation Toolkit rates feedback at about six months' additional progress based on extensive evidence, noting a wide range. The IES practice guides (Gersten et al., 2009; Fuchs et al., 2021) recommend explicit, systematic instruction for students identified by screening.
4. Measure growth	Re-checking the same objective after corrective instruction, spaced over days, before moving on Bloom (1984) framed the 2 sigma problem: finding group methods as effective as one-to-one tutoring, with mastery learning as a starting point. Kulik, Kulik and Bangert-Drowns (1990) found a mean effect of 0.52 across 108 controlled evaluations, with lower-aptitude students tending to gain more. The EEF Toolkit rates mastery learning at about five months, rising to about six in mathematics and science. Cepeda et al. (2006), a synthesis of 317 experiments, found spaced practice beats massed practice, with the optimal gap depending on how long retention must last.

Why short, on two separate grounds

Latency of feedback. Kulik and Kulik (1988) found that applied studies using real classroom materials usually favoured immediate feedback.

Compounding in mathematics. A gap left open at one unit becomes a prerequisite failure at the next. The screen-then-intervene logic of the IES guides only works if the intervention lands before the curriculum moves on, which a termly cycle cannot guarantee.

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Who runs the loop

Across every strand, the effect appears when the teacher acts, not when a system reports. Stecker, Fuchs and Fuchs (2005): gains were greatest when teachers acted on the data. Wiliam, Lee, Harrison and Black (2004): 24 mathematics and science teachers developing their own formative practice produced a mean effect size of 0.32, which the authors estimate as about half a GCSE grade per student per subject. The EEF's Embedding Formative Assessment trial (Speckesser et al., 2018), randomized across 140 English secondary schools, found about two months' additional progress on an external exam, with the program run through monthly teacher learning communities.

The implication for resource design: the research does not support tools that take the loop away from the teacher. It supports tools that make the loop fast enough for a teacher to run inside a normal lesson.

The honest version of the numbers

Later meta-analyses found smaller averages than the range reported in 1998. Kingston and Nash (2011) pooled the 13 studies that met strict criteria and reported a mean effect of 0.20, with 0.17 in mathematics (as corrected in a 2015 erratum). Bennett (2011) argued the original claims were overstated and that effects depend on domain and on a specific theory of action. Briggs et al. (2012) questioned Kingston and Nash's study selection and methods, concluding that the 0.20 figure should not be treated as a settled baseline.

What the evidence does not say

• Averages hide ranges. Every headline figure is an average over studies with very different designs. A product does not inherit the literature's average.

• No study tests this exact loop. The strands support each step and the short-cycle principle. No independent trial yet isolates a four-step, teacher-run, same-concept cycle as a unit. Any vendor's claim about that design rests on the vendor's own evidence.

• Mathematics effects run smaller. Generic formative assessment showed modest effects in mathematics; the strongest mathematics results cited here come from teachers who acted on the data with specific instructional recommendations (Fuchs et al., 1991).

• Dose and fidelity decide. Gains were greatest when teachers acted on the data. Any evaluation should ask how often cycles actually ran, not only whether a resource was licensed.

These limits are also the right evaluation questions for any vendor, including the publisher of this document.

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Published by Knowledgehook, a vendor of a learning-cycle system for K to 12 mathematics.