DMT INSIGHTS

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TIME MATTERS: HOW INSTRUCTIONAL TIME INFLUENCES MATHEMATICS LEARNING

Why Instructional Time Matters

Schools decide on mathematics instructional time when they set daily schedules, plan interventions, consider calendar changes such as four-day school weeks, and decide how to address extended breaks. These decisions affect how many opportunities students have to learn mathematics and how teachers can organize those opportunities.

Research from cognitive psychology and mathematics education provides evidence about how students learn mathematics and how explanation, investigation, discussion, practice, and review contribute to that learning. Students' opportunities to learn mathematics are related to what they learn (Hiebert & Grouws, 2007; National Research Council, 2001). This research does not show that adding minutes alone improves achievement; how the time is used matters as much as how much time is available.

This DMT Insight examines these findings and considers what they suggest about daily mathematics time, lesson organization, intervention, four-day school weeks, and extended breaks such as summer.

Working Memory, Practice, and Mathematics Learning

Working memory, the system people use to hold and process information while they reason, has limited capacity. Cognitive load theory proposes that learning depends on how much a task demands of working memory, especially when students encounter new procedures, representations, or multi-step problems (Sweller, 1988; Sweller et al., 2011). Instruction can manage these demands by sequencing ideas, connecting new ideas to what students already know, and giving students opportunities to process and discuss what they are learning.

Research on distributed practice shows that people generally retain information better when they space practice over time than when they mass it in a single session (Cepeda et al., 2006). The most effective spacing depends on how long people need to retain the information (Cepeda et al., 2008). Much of this research uses verbal learning tasks, and Rohrer and Pashler (2010) report evidence that spacing also benefits learning mathematics. Regular opportunities to retrieve and apply mathematical ideas, through cumulative review and repeated work with core relationships, support retention.

Fluency with basic number combinations develops through repeated practice that is connected to number relationships (Baroody, 2006). As students become fluent, they need fewer working-memory resources for calculation, leaving more available for reasoning in complex problems.

> **Key Idea • Regular, spaced opportunities to retrieve and apply mathematical ideas support retention.**

How Much Time Should Schools Allocate to Mathematics?

Research supports the importance of sufficient opportunities to learn mathematics, but it does not establish a single number of instructional minutes that guarantees achievement. The required time depends on the mathematical content, students' prior knowledge, instructional organization, and opportunities for practice and discussion.

DMTI recommends the following daily instructional time for core (Tier 1) mathematics.

Grade band	DMTI planning recommendation	What the time allows
Grades K–2	70–90 minutes daily	Working with models, discussing quantities and number relationships, and returning to ideas over several days
Grades 3–5	60–75 minutes daily	Solving problems, comparing strategies, and connecting representations to procedures
Grades 6–8	50–70 minutes daily	Problem solving, discussion, and formalizing relationships involving proportional reasoning, expressions, equations, geometry, and statistics

In Grades K–2, students are building number concepts through work with quantity, comparison, and structure. They need time to use models, explain their reasoning, represent quantities in more than one way, and revisit ideas.

In Grades 3–5, students work with multi-digit operations, fractions, and early algebraic reasoning. These ideas require time to solve problems, compare strategies, and discuss how they relate. When time is limited, teachers may have to choose between examining ideas in depth and covering more content. Hiebert and Carpenter (1992) describe understanding as the connections students build among ideas, and Schmidt et al. (2005) describe how coherent curricula organize content so those connections can develop.

In Grades 6–8, departmentalized schedules often provide 50 to 70 minutes of mathematics. Topics such as proportional reasoning, expressions and equations, geometry, and statistics require time for problem solving, discussion, and formalizing ideas.

Students need opportunities to examine mathematical relationships across representations. For example, understanding fractions involves partitioning a quantity into equal parts, identifying the unit, iterating unit fractions, and reasoning about equivalence. Teachers need time to investigate these relationships with students, connect their strategies, and develop increasingly efficient procedures.

> **Key Idea • The grade-band minutes are planning recommendations. Research supports sufficient opportunities to learn mathematics.**

How the Organization of Instructional Time Matters

Mathematics lessons may include opportunities to recall prior learning, investigate a problem, discuss and compare strategies, receive explicit instruction, and practice. The time each part needs depends on the mathematics and on what students already understand. Research does not identify a single sequence that every lesson must follow.

Research on productive failure offers one way to sequence these parts. In Kapur's (2014) study, ninth-grade students in Singapore either invented ways to measure data variability before receiving instruction on standard deviation or received instruction first and then practiced. Students who generated their own solutions first performed as well on procedural items and better on items measuring conceptual understanding and transfer. The design included instruction that built on students' attempts, so the time for discussion and consolidation after problem solving mattered.

When a lesson ends before students discuss and compare their work, students may complete the task without connecting their strategies to the mathematical ideas the lesson was designed to develop. Planning time for discussion and consolidation is one way schools can support the instruction this research describes.

> **Key Idea • How time is organized within a lesson matters as much as how much time is available.**

How Should Intervention Time Be Added Without Weakening Core Instruction?

Within a Multi-Tiered System of Support (MTSS), a widely recommended principle is that intervention supplements, rather than replaces, core mathematics instruction (Fuchs et al., 2008; Gersten et al., 2009). Removing students from core mathematics for intervention reduces their access to grade-level content. That concern increases when schedules are compressed or instructional days are reduced.

As a planning guideline, DMTI recommends Tier 2 intervention of 20 to 30 minutes, three to four days per week, in small groups. Tier 2 instruction should be diagnostic and targeted. It should focus on specific mathematical concepts, relationships, and procedures identified through student work and diagnostic assessment, using varied representations and feedback.

For Tier 3, DMTI recommends 30 to 45 minutes of daily, individualized instruction as a planning guideline. Many schools schedule a school-wide intervention or enrichment block so that students receive this support without missing core mathematics.

Four-Day School Weeks

Research on four-day school weeks raises concerns about mathematics achievement, particularly when the change reduces total instructional time. Findings vary across studies and settings, so it is important to examine instructional minutes, attendance, the distribution of learning opportunities, and student outcomes rather than assuming longer days fully compensate for fewer school days.

In Oregon, Thompson (2021) found that the four-day school week had small negative effects on mathematics and reading achievement for students in Grades 3 through 8. Research on the number of school days points in a similar

direction: Fitzpatrick et al. (2011) estimated that additional school days in kindergarten and first grade were associated with gains in mathematics and reading.

This evidence concerns total school days and instructional time. Research on distributed practice, described earlier, concerns how practice is spaced, and it does not directly test four-day calendars. It does suggest that regular review is worth planning for when students have longer breaks between school days. Districts that adopt four-day weeks can monitor instructional minutes, attendance, and student outcomes, and plan structured review and protected intervention time.

Extended Breaks, Including Summer

Students' mathematics achievement can decline over extended breaks. In a meta-analytic review, Cooper et al. (1996) found that achievement test scores declined by about one month over the summer on a grade-level equivalent scale, on average, with larger declines in mathematics computation than in many other areas. Estimates vary across studies, tests, and time periods, and some recent studies have found smaller losses than earlier ones (Quinn & Polikoff, 2017).

Summer achievement patterns also differ among students. In a longitudinal study of Baltimore students, Alexander et al. (2007) found that differences in summer learning during the elementary years accounted for a substantial share of the later reading achievement gap between students from higher- and lower-income families. Although this finding concerns reading, it illustrates how differences in summer learning opportunities can contribute to later achievement gaps. Cooper et al. (1996) reported related concerns in mathematics.

Research on summer programs addresses a different question: whether a program improves outcomes. In a study of voluntary summer learning programs in five urban districts, Augustine et al. (2016) found near-term benefits in mathematics after the first summer, and students who attended regularly showed benefits in mathematics and reading after the second summer. Quinn and Polikoff (2017) review responses that include summer programs and changes to school calendars.

Conclusion

Research on mathematics learning, distributed practice, intervention, and instructional time points to the importance of sufficient and regular opportunities to learn mathematics. It does not identify a single number of minutes that guarantees achievement.

Students need sufficient time to investigate mathematical relationships, discuss and compare strategies, connect representations, and practice procedures over time. The time needed depends on the mathematics and what students already understand.

School and district leaders influence these opportunities through decisions about daily schedules, intervention, calendars, and extended breaks. Evidence from instructional minutes, attendance, student work, and achievement can inform those decisions.

Increasing instructional time alone does not ensure improved achievement. Instructional time provides opportunities to learn mathematics. How effectively teachers use those opportunities depends on their mathematical knowledge, the tasks they select, the questions they ask, and how they respond to student thinking.

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Social Media

How much mathematics time do students need?

Schools decide on daily mathematics minutes, intervention, four-day weeks, and summer learning. Each one affects students' opportunities to learn mathematics.

In DMT Insight 40, we review research on working memory, distributed practice, lesson organization, intervention, four-day school weeks, and summer learning.

Research supports sufficient, regular opportunities to learn mathematics. It does not set a single number of minutes that guarantees achievement. How teachers use the time matters as much as how much time there is.

Read the full Insight at mathsuccess.io/dmtinsights.

How does your school decide how much time to give mathematics each day?

