

DMT INSIGHTS

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INVESTING IN CURRICULUM OR TEACHERS?

Are districts spending enough to develop the mathematical knowledge teachers need?

Introduction

If districts keep investing in curriculum and professional development, why aren't mathematics outcomes improving?

Districts continue to invest substantial resources in new mathematics curricula, assessments, and implementation training. However, many schools continue to struggle with mathematics achievement. Should districts reconsider how much they spend on purchasing new materials compared with developing teachers' mathematical knowledge?

Curriculum matters. Well-designed materials provide tasks, representations, and instructional guidance. Teachers, however, must understand the mathematics, interpret student thinking, connect mathematical ideas, and determine what instruction should come next.

Research on mathematical knowledge for teaching demonstrates the importance of what teachers know and how they use that knowledge during instruction (Ball et al., 2008; Hill et al., 2005).

Where Are Districts Investing Their Mathematics Dollars?

Most of a district's budget pays for people. In 2020–21, salaries and employee benefits accounted for 79 percent of current expenditures in U.S. public elementary and secondary schools (National Center for Education Statistics [NCES], n.d.). The remaining current expenditures cover purchased services, supplies, instructional materials, and other operating costs. Capital expenditures are accounted for separately.

National data do not separate spending on mathematics curriculum from spending on mathematics professional development, and districts record these costs in different ways. Instructional materials can be relatively inexpensive: one analysis noted that some of the highest-quality elementary mathematics curricula cost about \$36 per student (Boser et al., 2015). Professional development spending is harder to see because it is spread across staff positions, teacher time, substitutes, stipends, and contracted services. TNTP (2015) estimated that three large districts spent about \$18,000 per teacher per year on teacher development across all subjects, counting staff, teacher time, and salary increases tied to course credits. That estimate does not measure mathematics-specific professional development, and it should not be compared directly with curriculum purchase costs.

Consider a district with \$100 million in annual current expenditures. Using the national salary-and-benefits benchmark of 79%, approximately \$79 million would be allocated to personnel costs. For illustration, assume that curriculum and professional development across all subjects account for 4.5%, or \$4.5 million.

If mathematics curriculum expenditures average \$7–\$25 per student annually and mathematics professional development averages \$20–\$60 per student, a district serving approximately 5,400 students would spend between \$146,000 and \$459,000 combined. These are illustrative assumptions, not verified national spending averages.

An illustrative district: \$100 million in annual current expenditures



79% is the national benchmark for salaries and benefits (NCES, 2020–21). The other amounts are assumptions.

Reallocation scenarios within the same current expenditures

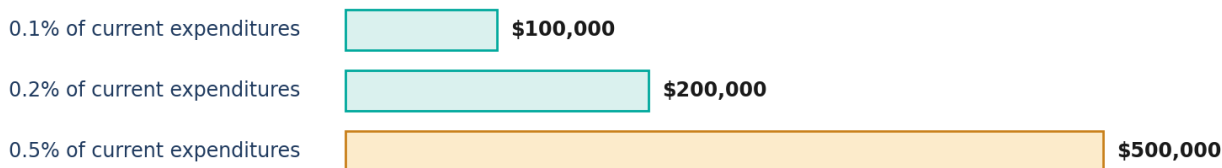


Figure 1. An illustrative district with \$100 million in annual current expenditures and three reallocation scenarios.

District leaders can replace these assumptions with their own records: what the district spends on curriculum purchases, publisher training, general professional development, and sustained, mathematics-content-focused learning.

Key Idea • Document spending on curriculum purchases, implementation training, and sustained mathematics professional learning separately. Otherwise, you cannot examine the balance among them.

Why a New Curriculum Is Not Enough

Districts often provide several days of training when adopting a new curriculum. Teachers learn how to navigate lessons, use the materials, and follow the instructional sequence. That support is necessary, but teachers also need opportunities to study the mathematics, examine student reasoning, and connect representations and procedures. Cohen and Hill (2001) found that curriculum-connected professional learning was associated with instructional practices aligned with California’s mathematics framework and with higher school test scores.

Key Idea • Curriculum training helps teachers use the materials. Mathematics professional learning develops the knowledge teachers need to teach mathematics.

Mathematical Knowledge for Teaching

Mathematical knowledge for teaching includes the mathematics teachers use when interpreting student strategies, examining representations, explaining why procedures work, and determining whether an approach is mathematically valid. This knowledge goes beyond simply solving the problem correctly. Ball et al. (2008) distinguish common content

knowledge, the mathematics a well-educated adult uses to solve a problem, from specialized content knowledge, the mathematics teachers use to analyze student errors, choose representations, and explain why a procedure works. In first- and third-grade classrooms, teachers' mathematical knowledge for teaching was significantly related to students' achievement gains over a year, after controlling for key student and teacher characteristics (Hill et al., 2005).

When a student adds $\frac{1}{3} + \frac{1}{4}$ and obtains $\frac{2}{7}$, the teacher needs to understand how the student is reasoning about the fractional units. The student may be treating the numerator and denominator as separate whole numbers. One-third and one-fourth represent units of different sizes. By partitioning the same whole into twelfths, students can see that one-third is four twelfths and one-fourth is three twelfths. The sum is seven twelfths.

The goal is not simply to correct the answer or demonstrate the common-denominator procedure. It is to help the student understand the unit and why combining quantities requires equal-sized units.

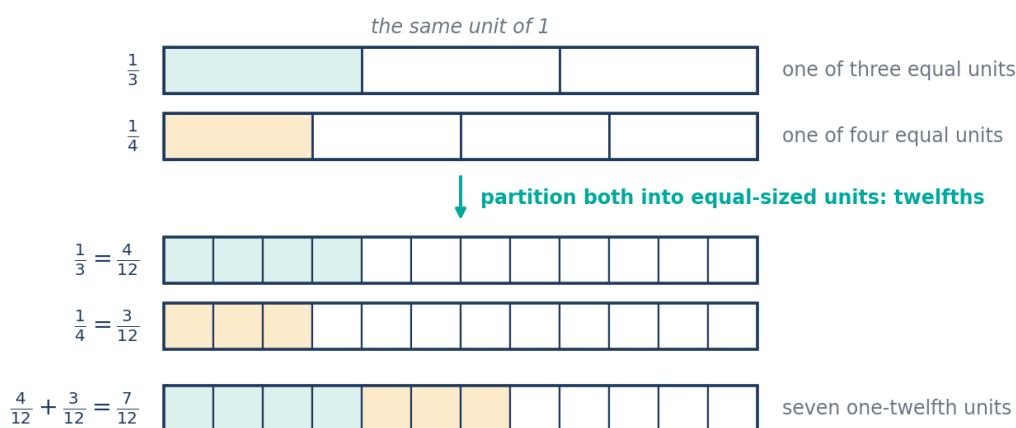


Figure 2. Partitioning the same unit of 1 into equal-sized units makes the sum visible.

Mathematics professional learning should help teachers recognize the units and quantities students are working with, how those quantities are composed and decomposed, and how representations and procedures show mathematical relationships. It should also develop connected practices that help teachers:

- Take students' mathematical ideas seriously.
- Encourage and connect multiple strategies and representations.
- Press students to explain their mathematical reasoning.
- Focus on mathematical structure and relationships.
- Identify and address misconceptions.

What Research Shows About Professional Development

Participation in professional development is not the same as professional learning.

In a national sample of more than 1,000 mathematics and science teachers, Garet et al. (2001) found that content-focused professional development, with active learning and coherence with teachers' other work, was associated with

teachers' reports of greater knowledge and changes in practice. Desimone (2009) proposed a core set of features for studying professional development: content focus, active learning, coherence, duration, and collective participation. Yoon et al. (2007) reviewed studies of effects on student achievement and found nine that met their evidence standards. In those studies, programs offering more than 14 hours of professional development showed positive effects.

Experimental results are mixed. A meta-analysis of 95 experimental and quasi-experimental studies of STEM professional development and curriculum programs found an average effect of 0.21 standard deviations on student outcomes across both types of programs. Programs that helped teachers learn to use curriculum materials, focused on content knowledge, pedagogical content knowledge, or how students learn, and included meetings to discuss classroom implementation had stronger outcomes (Lynch et al., 2019). In a randomized study, content-intensive professional development for fourth-grade teachers improved teachers' mathematical knowledge and some aspects of instruction without improving student achievement (Garet et al., 2016). Increasing professional development expenditures alone does not ensure improved student achievement. Districts need to examine what teachers learn, how that learning influences instruction, and what students subsequently understand.

Rebalancing the Investment: More Mathematics Learning for Teachers

District leaders can compare what the district spends on curriculum adoption and implementation with what it spends on sustained mathematics professional learning, and what teachers learn from each.

A \$1 Million Planning Example

Consider a district that allocates \$1 million annually to professional development across all subjects. In this example, \$100,000 supports sustained opportunities for teachers to study mathematics, examine student thinking, and improve instruction.

If the district currently allocates \$100,000 to mathematics content-focused professional learning, reallocating an additional \$100,000 would increase the total to \$200,000. Alternatively, reallocating \$200,000 would increase the total to \$300,000.

These are illustrative amounts, not estimates of what districts currently spend or predictions of achievement gains. They show how a relatively small change in allocation could substantially increase the resources available for mathematics professional learning.

A hypothetical \$1 million professional development budget

Current allocation (hypothetical)

\$500,000	\$250,000	\$150,000	\$100,000
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☐ Instructional coaching, all subjects

☐ General professional development

☐ Curriculum orientation and publisher training

☒ Mathematics content

Shift \$100,000: mathematics content doubles to \$200,000

\$450,000	\$200,000	\$150,000	\$200,000
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Shift \$200,000: mathematics content triples to \$300,000

\$400,000	\$150,000	\$150,000	\$300,000
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All amounts are hypothetical. They are not estimates of what districts spend or predictions of achievement gains.

Figure 3. A hypothetical \$1 million professional development budget and two reallocation scenarios.

In a district with \$100 million in annual current expenditures, one-half of one percent represents \$500,000. That amount could support a substantial mathematics professional-learning initiative. District leaders should consider whether reallocating a portion of existing resources could give teachers more sustained opportunities to study mathematics, student reasoning, and instructional practices.

Key Idea • Examine actual expenditures and the quality of the professional learning they provide.

Equity and Access

Access to the same curriculum does not ensure access to the same quality of mathematics instruction. Goldhaber et al. (2015) documented differences in teacher experience and qualifications across student populations. Districts should examine whether all teachers, particularly those serving students with the greatest instructional needs, have sustained opportunities to develop their mathematical knowledge and instructional practices.

Conclusion

Districts have invested substantial resources in purchasing, replacing, and implementing mathematics curricula. These materials matter, but they cannot replace teachers who understand the mathematics and can develop that understanding with students.

Research on mathematical knowledge for teaching and professional learning gives district leaders reason to examine how they allocate their resources. The question is not simply how much districts spend on professional development, but what teachers learn and how that learning influences instruction and student understanding.

Before adopting another mathematics curriculum, districts should examine how much they have invested in developing the mathematical knowledge of the teachers who use it.

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Social Media

Districts continue to purchase new mathematics curricula. How much are they investing in the teachers expected to use them?

A curriculum can provide the task and the model. The teacher must recognize the mathematics, interpret student reasoning, and decide what instruction comes next.

In DMT Insight 39, we examine district spending, research on mathematical knowledge for teaching, and what it would mean to invest more in sustained mathematics professional learning.

Read the full Insight at mathsuccess.io/dmtinsights.

Before your district adopts another mathematics curriculum, how much is it investing in teachers' mathematical knowledge?

