

About the

Mathematics Studio Program

Transforming a School's Culture of Mathematics Professional Learning



What are the Key Features of Mathematically Productive Teaching Routines?

During studio work, teachers learn and rehearse “mathematically productive teaching routines.” By design, these practices engage students in evidence-based learning experiences that –

- Align directly with how students learn mathematics
- Recur regularly in the everyday work of teaching mathematics
- Typically involve one or more challenging aspects of mathematics teaching
- Enable mathematical access and challenge for all students

What Happens in a Mathematics Classroom Studio?

Over the course of a year, a cohort of “resident” teachers, coaches, and administrators meets four or five times for a “studio day” in the studio teacher’s classroom to:

- Design a plan that involves the “live” rehearsal of one or more “*mathematically productive teaching routines*”
- Observe the enacted plan
- Gather student data
- Analyze the data as evidence about the impact of instructional decisions and the lesson design
- Set action steps

What Happens During Each Studio Cycle?

The following activities typically occur during a studio cycle:

1. One half-day of leadership coaching for the studio principal
2. One half-day of pre-studio inquiry with the studio teacher
3. One full “studio day” per cohort of 10-12 resident teachers and administrators (number of cohort depends on district/school size and resources)
4. Option. One or two full days of one-to-one job-embedded coaching for the math coach(es), teacher leaders, and/or one or more resident teachers.
5. Option. One half-day Instructional Leadership Seminar for all Studio and Resident Principals from across the district.

In the beginning, all studio sessions are facilitated by a Teachers Development Group consultant. Over 2-3 year’s time, the consultant’s focus shifts to providing coaching and support to local teachers, coaches, and/or principals who learn to facilitate studios, “mini-studios,” and/or other studio-related professional development.



What are the Purposes of a Math Studio?

While the Studio classroom provides the context for professional inquiry and individual teacher growth, *the studio school is the first-order unit of transformation*. That is, the primary purposes of the Studio work are to:

- ◆ Transform the mathematics understanding and achievement of *all* students in a school
- ◆ Transform mathematics instruction and the culture of mathematics professional learning across the school

To achieve these purposes, Studio activities:

- Bring *Best Practices in Teaching Mathematics* seminar learning to life in a real-time “live” classroom
- Increase the level, fidelity, and quality of implementation of research-based teaching

- Build participants’ shared images and understandings about meaningful practice
- Engage teachers as mathematical thinkers
- Focus on building professional norms and habits-of-practice
 - *productive planning*
 - *in-the-moment teacher reflection/ metacognition*
 - *relentless curiosity and inquiry about students’ mathematical thinking*
- Deprivatize practice to build powerful professional community
- Deepen the principal’s knowledge and skill re: (1) using her/his leadership voice to engender effective math instruction; (2) analyzing teaching; and (3) organizing the school for math learning

How Does a School Benefit Over Time from Studio Work?

Long-Term Outcomes for Schools

- ◆ **Increased Professional Development Capacity in Mathematics**
- ◆ **Increased Mathematical Knowledge for Teaching**
- ◆ **Established Studio Classrooms**
- ◆ **High-functioning Mathematics-based Professional Learning Communities**
- ◆ **Improved Teaching for Understanding**
- ◆ **Increased Mathematical Discourse**

Long-Term Impacts for Schools

- ◆ **Increased Student Achievement**
- ◆ **Increased Math Pursuits**
- ◆ **Sustainable Infrastructure**
 - *Specific school-based roles and responsibilities*
 - *Well-defined ongoing professional learning for each role*
 - *Research-based tools and structures that support effective implementation and sustenance of roles, responsibilities, and professional learning*
 - *Institutionalized mechanism – transcends people who come/go*
- ◆ **Decreased Achievement Gaps**
 - *Equity in the math achievement levels attained by students of differing ethnicity, gender, language, and socioeconomic status*

Who Participates in a Math Classroom Studio?

The studio model is applicable at all grade levels K-12. In addition to studios whose residents are teachers and leaders focused on classroom teaching, a studio may include residents who are all administrators focused on rehearsal of math leadership strategies, or coaches focused on math coaching. A studio may also focus on a special need (e.g., Special Education, English Language Learning, etc.). In the case of a classroom studio focused on instruction, the following individuals are the studio participants:

Studio Teacher

The teacher in whose classroom the studios take place across the school year. The studio teacher's classroom serves as a "greenhouse" environment where colleagues' learning about mathematics content, pedagogy, and leadership thrives. He/She is a highly reflective, accomplished teacher who is eager for coaching and hungry to work on new/refined practices during and between the studio cycles. The studio teacher meets for a half-day of pre-planning (typically outside of school hours) with the consultant and with all studio participants for one full studio day (sub required) during each of the five studio cycles. He/She receives close side-by-side coaching from the consultant, and, in addition to participating in the school's Online Math Collaborative (OMC), interacts periodically by e-mail or teleconference with the consultant between cycles.

Studio Principal

The principal of the school in which the studio teacher works. During day one of each two-day studio cycle, the principal receives a half-day of coaching that emphasizes developing a leadership voice for math, organizing the school for math learning, and analyzing math teaching. This includes a Data Snap walk-through in the studio and resident teachers' math classrooms. The purposes of the Data Snap are: (1) to assess and support the impact of the Studio work on mathematics learning across the studio school, (2) to provide context for coaching the principal as the school's "lead learner" for mathematics, and (3) to inform the consultant's emphases during the remainder of the cycle. The principal also participates actively in day two of each studio cycle, attending the full studio session and providing a powerful opening and closing to the day.

Resident Teachers and Administrators

Up to twelve teachers of mathematics per studio cohort. If any residents are teachers from schools other than the studio school, their principals are also residents. Each resident attends one full studio day during each of the five studio cycles (five total sub days per resident). A cohort of residents for a studio remains intact and participates together in each studio day throughout the year. All studio participants explore mathematics, plan, observe, gather and analyze data, and determine related action steps for their practice. They build professional community and use the studio work as rich context for reflection and to identify their individual and collective between-cycle commitments (e.g., teaching practices to work on work on, student work/data to collect for discussion at the next studio cycle).

Lead Math Teacher (e.g., Math Coach)

A teacher leader who supports mathematics instruction in the studio school. Depending on the teacher leader's background and leadership/coaching focus, he/she may receive direct coaching and support from the consultant during the studio day. Between the consultant's visits, this individual also provides the studio and resident teachers support re: classroom applications of their studio learning. Not all studios include a lead teacher/math coach, and in some settings, the studio serves as context for identifying/developing individuals for that role.

District Office Administrator

A district office administrator responsible for principal and math curriculum leadership. To underscore district sponsorship of the studio work, a district office administrator may share in providing a powerful opening or closing for a studio in which he/she participates.

Teachers Development Group Consultant

An external resource who is an accomplished mathematics educator and classroom coach. The TDG consultant provides coaching/professional learning for the studio and resident teachers, principal, and district administrators, and is always purposeful and transparent about teaching and coaching decisions/actions.

What is the Intellectual Framework that Grounds the Studio Model?

How Students Learn Mathematics

Drawing on a robust and seminal body of research on how students learn mathematics, all studio related work on instruction emphasizes engaging students consistently in evidence-based learning experiences that involve –

- Cognitively demanding mathematical tasks
- Adherence to mathematically productive classroom norms and relationships
- Productive disequilibrium about mathematical ideas and relationships
- Mathematical discourse that focuses on students' mathematical reasoning, sense making, representations, justifications, and generalizations
- Reflection and metacognition about their own and each other's mathematical thinking

The studio design is guided by a well-defined, research-based vision of effective mathematics learning experiences for students. This vision is articulated in the following **theory of action**:

Student mathematics achievement will improve if teachers consistently use research-based instructional practices to develop both computational fluency and a deep understanding of mathematics concepts by engaging all students consistently and effectively in the following mathematical practices:

- **Providing Explanations** – Students explain how they think about the meanings of ideas and the mathematical reasoning they use to make sense of calculations, problems, and/or ideas.
- **Making Justifications** – Students use mathematical reasoning (both inductive and deductive) to justify why their own or others' ideas are or are not valid/accurate. They identify relevant and age-appropriate mathematical definitions, properties, processes, counter examples, and/or established generalizations to present a robust logical argument and demonstrate precision.
- **Formulating Conjectures & Generalizations** – Students make and test conjectures and generalizations about the application of their own and others' mathematical ideas and processes to the general case, special cases, and/or different contexts.
- **Using Multiple Representations** – Students make, use, and connect multiple mathematical representations – equations, verbal descriptions, graphs, concrete models, charts, tables, everyday life situations, and diagrams – to “mathematize,” make sense of, solve, and/or communicate about the questions, quantities and relationships in problems and ideas.
- **Engaging in Metacognition** – Students practice mathematical metacognition by reflecting about: (1) what/how they think about a math idea or problem; (2) disequilibrium, breakthroughs, and “stuck-points” in their thinking; (3) ways their mathematical understanding is developing; and (4) specific ideas or learning episodes that influenced their thinking.
- **Making Connections** – Students make and discuss connections between their prior understandings and the new mathematical concepts and skills they are learning, between their thinking and others' ideas, and between the mathematics they are learning and other contexts/content.

Bransford et al, 1999; Cohen, 1994; Donovan & Bransford, 2005; Franke et al, 2007; Kilpatrick, 2001; Lotan, 2003, 2006; Stein et al, 2000; Common Core State Standards Initiative, 2010

Mathematically Productive Teaching Routines

Work in the studio school emphasizes the planning and rehearsal of several specific research-based teaching practices that meet criteria for “mathematically productive” because they:

- engage students in activity that aligns directly with how students learn mathematics
- recur regularly in the everyday work of teaching mathematics
- typically involve one or more challenging aspects of mathematics teaching
- enable mathematical access and challenge for all students

Because of these features, a teacher's repeated use of such practices will leverage mathematical sensemaking, understanding, and proficiency by all students, and will carry over into other aspects of the teacher's practice.

Franke, 2008; Franke & Kazemi, 2009; Ball, 2008; Marzano, 2006, 2009; Ghouseini, Lampert, et al, 2008; Weiss et al, 2003

Mathematical Discourse

An evidence-based premise of the studio work is the notion that orchestrating productive mathematical discourse increases students' opportunities to learn and, in turn, raises achievement and participation levels in mathematics. Embracing this premise requires developing teachers' knowledge, skills, tools, and disposition for building classroom communities of mathematical discourse. *Leahy, Lyon, Thompson, and Wiliam, 2005; Yackel & Cobb, 1996; Hufferd-Ackles & Sherin, 2004; Stein, Engle, Hughes & Smith, 2008; Weaver & Dick, 2006*

What is the Intellectual Framework that Grounds the Studio Model?

Specialized Mathematics Content Knowledge

In order to orchestrate purposeful and mathematically productive discourse, teachers need a deep understanding of the math content they teach and its trajectory over time. Whether in a related Knowing Mathematics for Teaching course or during a studio day, all studio work emphasizes deepening teachers' knowledge of the content needed to effectively teach mathematics. *Ball, Thames and Phelps, 2008; Ball, Hill and Bass, 2005*

Cognitive Demand

Not all math tasks are “discourse worthy.” The Math Task Framework and the role of cognitive demand in student learning provide a theoretical underpinning for identifying and designing high-cognitive tasks, and a basis for planning and analyzing “live” studio enactments of those tasks. *Stein, Smith, Henningsen and Silver, 2009; Bloom, 1956*

Professional Learning Community & Student Achievement

Built into the design of the studio program are research-based features of professional community that correlate positively to student achievement. A primary focus of all mathematics studio work is transforming the culture of mathematics professional learning across each studio school. *Boaler, 2006; DuFour, 2009; Little, 1990, 2000; Louis et al, 1996; McLaughlin & Talbert, 2001, 2006; Weaver & Dick, 2009*

Generative Learning

Teachers learn to attend relentlessly to their students' mathematical thinking. Administrators learn that understanding students' mathematical thinking is central to effective teaching, and they learn to support teachers in developing the norm of being curious about students' mathematical thinking – the single most important factor in developing into a teacher who continues to learn. Students develop metacognitively – learning to attend carefully to their own mathematical thinking and relationships to others' thinking. Through this process, learning becomes self-generating for students, teachers, and administrators, who continually add to their understandings. *Franke, Carpenter, Levi, & Fennema, 2001*

Formative Assessment

A teacher's relentless focus on understanding students' mathematical thinking is also fundamental to formative assessment – a practice that shows an effect size larger than most known educational interventions. In particular, formative assessment is especially effective for students who have not done well in school, thus narrowing the gap between low and high achievers while raising overall achievement. *Black et al, 2004; Wiliam, 2007*

Lesson Study

The studio model applies elements of Japanese lesson study in that teachers collaboratively plan, observe/enact, and analyze a lesson. While contextualized in deep planning, unlike lesson study, studio work focuses teachers' attention on public work with students as a way to rehearse and refine evidence-based mathematically productive teaching routines – i.e., emphasis is on polishing practice vs. polishing a whole lesson. *Stigler & Hiebert, 1999; Lewis, 2006; Watanabe, 2003; Lampert et al, 2008; Kazemi & Franke, 2009.*

Effective Professional Development

By design, all studio-related work aligns tightly with the research-based characterization of effective professional development as:

- intensive, ongoing, and connected to practice
- focused on students' learning
- supportive of teachers while they rehearse teaching in “real time”
- designed to align with local school goals and priorities and other initiatives
- focused on the development of strong working relationships among teachers

The studio program embodies all five of these principles in a structured way that is sustainable for the long-term within a school. *Darling-Hammond et al, 2009; Stiles et al, 2009; Franke et al, 2001; NSDC, 2001*

Powerful School Leadership

Focusing on the school as the “unit of change” and a distributed view of leadership requires specialized learning for principals and district administrators, who receive coaching to develop their leadership voice for mathematics, organize their school for mathematics learning, and analyze mathematics teaching. *Elmore, 2002; City et al, 2009; Nelson et al, 2005; Lambert, 2003; Grant et al, 2009*



What Are a School's Commitments During a Year of Studio Work?

There are typically five studio cycles spread across the academic year in each studio school with the following participants:

One Studio Teacher

- 1 half-day per cycle, after school inquiry with the consultant
- 1 "studio day" per cycle (requires a substitute)
- Mid-cycle communications with consultant
- Mid-cycle applications of instructional practices
- Mid-cycle reflection on the school's OMC (see right)

One Studio Principal

- 1 half-day per cycle, Data Snap and coaching
- 1 studio day per cycle
- Mid-cycle communications with consultant and with teachers via the school's OMC (see right)
- Mid-cycle applications of studio learning
- 1 half-day per cycle, Instructional Leadership Seminar for all studio principals from across the district.

Resident Teachers (up to twelve per cohort)

- 1 studio day per cycle per resident (requires a substitute for each resident)
- Mid-cycle classroom applications of studio learning
- Mid-cycle communications with studio colleagues and TDG consultant via the school's OMC
- May receive side-by-side coaching from consultant during days three/four of a studio cycle
- May receive side-by-side coaching from Lead Teacher/Coach during mid-cycle

One Lead Math Teacher

- 1 half-day per cycle, after school pre-planning with studio teacher and consultant
- 1 studio classroom day per cycle
- Mid-cycle communications with consultant
- Mid-cycle applications of studio learning and communication with colleagues via the school's OMC
- May receive side-by-side coaching from consultant during days three/four of a studio cycle

What Are Other Math Studio Program Expectations and Opportunities?

Best Practices in Teaching Mathematics Seminars

Prior to the first studio cycle, all participating teachers and teacher leaders are expected to complete at least three days of the Best Practices seminar, *How Math Teaching Matters* (the remaining two days may be completed during the academic year). Emphasis during all classroom studios is bringing the experiences and research studied during this seminar to life in the everyday math classroom. During subsequent years, additional Best Practices seminars attend to more specific aspects of learning/teaching math.

Online Math Collaboratives (OMC)

Studio participants design and post individual and school Action Plans in their OMC and regularly review, refine, and expand those plans between cycles. They reflect regularly in their OMC Teaching Journals, and they interact in an OMC Discussion Forum, moderated by their TDG consultant. Participants upload artifacts (e.g., student work, video clips, photos) to their OMC as context for online discussions of successes and "problems of practice" they encounter between cycles.

Instructional Leadership Seminars and Studio

Administrators from across the district attend this 3- to 5-day seminar, which includes a mix of workshop sessions and live "leadership studio" activities in schools.

Mathematics Leadership Seminar and Studio

Coaches/teacher leaders from across the district attend this seminar, typically offered as one day attached to each studio cycle. Includes a mix of workshop sessions and live "coaching studio" activities in schools.

Knowing Mathematics for Teaching Content Courses

These 30-hour courses deepen teachers' mathematical knowledge for teaching. While adaptable to specific grade levels, these are designed to include teachers from across K-12 and to support teachers' understanding of the trajectory of important math ideas. Courses include: *Algebra, Geometry, Measurement & Change, Data & Chance, Number & Operations, Discrete Math.*

Online Courses on Math Content/Pedagogy

Online courses can be used to enhance learning by focusing on content that relates directly to the focus of the studio work.

Teachers Development Group is a nonprofit organization whose mission is to improve all students' mathematical understanding and achievement through meaningful, effective professional development for teacher and school leaders.

E-mail: linda.foreman@teachersdg.org

Phone: (toll-free) 877-650-1914; (local) 503-650-1914
www.teachersdg.org