SECONDARY LENSES ON LEARNING FACILITATOR'S GUIDE

Introduction

Part I

WHY IS THIS PROGRAM NEEDED?

Secondary schools across the nation are struggling to redress inequitable student achievement in mathematics and to prepare all students for raised expectations for algebra. Held accountable to provide evidence of increased achievement on high-stakes tests, schools and district leaders are taking action: requiring algebra for all by Grade 8, adopting new mathematics curricula, expanding afterschool and tutorial support programs, and hiring mathematics coaches.

Many such actions have merit. However, experience tells us that single policies, programs, or new hires rarely, if ever, provide complete solutions to the unprecedented challenges of raised expectations for all students. Multiple innovations aren't the answer either, if they are poorly aligned or minimally understood or embraced. Without careful attention to supports needed or obstacles to be addressed, the innovations themselves are too often rejected. Such experiences reinforce the pervasive belief that the problem lies with the students themselves and buttress complacency and acceptance of the status quo.

Instructional and administrative leaders have the potential to transform policies, programs, and practices to help *all* students realize their mathematical potential. Together, they can develop the necessary knowledge, vision, and shared commitments to fuel much-needed changes. Jointly, they can embrace processes for building, revising, and sustaining improvement efforts over time. Collectively, they can move individual students, with all of their capabilities and difficulties, to the center of efforts to strengthen classroom practice and schoolwide programs.

What might result from such collaborative efforts? Improved mathematics scores on high-stakes tests are a start, and they are a necessary one. More profoundly, these efforts can narrow the engagement and empowerment gap and bring schools much closer to meeting their stated goal of mathematical proficiency for all. They can add value to students' present lives, enhance their prospects for success in college or the work force, and prepare them for broad participation in society. Such transformations can also bring to adults the satisfaction of working in schools that are making a real difference for students.

* * *

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Decades of research and practice point to key elements of strong middle and high school mathematics programs, including recognition of the following:

- Lessons need to be based on relevant and important mathematics.
- Mathematics programs need to encompass a coherent trajectory of mathematics content, instruction, and assessment practices across the elementary, middle, and high school spectrum.
- Mathematics classes need to be taught by teachers who know mathematics, pay attention to how students learn, implement effective instructional practices, and incorporate timely and accurate monitoring of learning and adjust instruction accordingly.
- School communities need to share a strongly held belief that all are capable of learning powerful and useful mathematics.
- Schools need to work actively to eliminate or severely limit policies and practices that track students or prevent access to higher level mathematics.
- Schools need to build effective systems and programs to provide targeted and timely support for students when they struggle.
- Schools need to foster the learning of teachers through professional development activities that are sustained, rich in opportunities to grow their content knowledge, and centered on the authentic work of mathematics learning and teaching.

Before plunging forward with new initiatives, though, there are three important ways in which leaders, in both administrative and instructional roles, can pave the way for deep and lasting change:

1. ***Develop a collective vision for school mathematics****. It is important for entire school communities to broaden their understanding of research-based practices associated with improved student learning and achievement in mathematics. Equally important is the opportunity to reexamine assumptions about answers to such questions as the following: What does it mean to know mathematics (rather than simply to know how to apply a series of procedures)? What does high quality mathematics instruction look like? How can assessment support learning and instruction in mathematics? What is the nature of support that enables all students to meet high expectations? What kinds of ongoing learning and planning opportunities for teachers lead to desired changes in instructional practices?*

2. ***Shake complacency with the status quo.*** *School communities need to reframe the stories they tell themselves about their mathematics programs and students. They need to ask themselves hard questions such as the following: Are we really doing OK by all students and according to what information? What counter-indications should we be looking at? To what do we currently attribute the lack of success of subsets of our student population? What assumptions lie behind those attributions? What factors that are under our control might make a difference for these students?*

3. ***Reexamine what drives planning for the mathematics program****. School leaders need to broaden the information they draw on, in addition to quantitative data to monitor student progress, when making decisions about the mathematics program. They need to ask themselves such questions as the following: What*

further information do we need in order to get a more complete view of the various components of our own school's mathematics program? What possible leverage points does this information open up? Based on what we are learning, what might be productive short- and long-term goals and actions? What steps can we take in order to build a process for continuous improvement into our mathematics program?

Through this critical work, school-based mathematics leadership teams can advance necessary changes in policy, programs, and practices that will make a real difference for students.

Secondary Lenses on Learning is designed to provide just such opportunities for building mathematics leadership teams, including the following:

- **Principals**, who are the gatekeepers for funds, time, and priorities for their schools
- **Influential teachers**, mathematics department chairs, and mathematics coaches and specialists whose professional life centers on mathematics, who have a detailed knowledge of the mathematics program, and who bring credibility with their peers
- **Guidance counselors**, who meet with students and are influential in decisions about course selection and placement
- **District curriculum directors**, who provide important support, follow-through, and advocacy
- **Other leaders** as is appropriate to the context

Part II

WHAT IS *SECONDARY LENSES ON LEARNING?*

Intended Context and Audience

Secondary Lenses on Learning is designed to be used in a 33-hour seminar comprised of six cumulative sessions of five and a half hours each, with a two- to three-3 week interval between sessions.

The intended audience is *building-based mathematics leadership teams,* so that those in critical roles for improving the learning of secondary mathematics can engage in explorations and conversations that develop a more closely shared vision for the work. Building on these experiences, leadership teams begin a process of school change by examining current practice through an extended and informed process and developing a mathematics program improvement plan based on what they learn. It is recommended that sites plan for two or three years of ongoing work after *Secondary Lenses on Learning*, in order to leverage the insights, relationships, and priorities developed during the seminar.

In order to take on the work of moving schools as systems, teams need to be strategically composed, and these key members need to make a commitment to attend every session. Schools are strongly advised to include the following roles in their seminar teams:

- Principals
- Influential mathematics teachers or department chair
- Guidance counselor
- District curriculum director

Other leaders are also suggested to join the team as fits the setting, such as a mathematics coach, director of special education, an English Language Learner (ELL) specialist, or a school psychologist.

Having several building teams from the same district attend *Secondary Lenses on Learning* at the same time (for example, both a high school and its feeder middle schools) provides a context for important conversations about coherence and communication, working across the Grades 6–12 continuum.

It is recommended that teams have between 3 and 10 members. Depending on the size of teams that enroll, it is recommended that a seminar be attended by four to six teams so as to bring perspectives from a range of settings to the discussions.

Note

A field test facilitator notes that, while Secondary Lenses on Learning involves a substantial commitment from busy educators, such a commitment makes possible deep learning. She adds, "In my experience with the program . . . participants thought their time was well invested.

Flexibility of the Materials

While *Secondary Lenses on Learning* was designed for use in a six-day seminar, the materials can also be used in other formats to address a range of needs and audiences. The following comments from reviewers indicate some of these possibilities:

> No doubt, mathematics leaders at multiple levels will find many productive uses for these materials. My last task as a Mathematics Supervisor was to lead a program evaluation. I knew I needed to provide information on the latest research in mathematics teaching and learning for the committee of teachers, parents, administrators, and business folks on my committee. I looked for comprehensive and coherent materials like these and was unable to find them. This material would have been invaluable to me during that process. *(Reviewer 1)*
>
> From a professional development provider's perspective, I think these materials lend themselves to working with schools across a region or within a single school division. These materials can easily be used as the core of a graduate course for school-based mathematics leadership teams. *(Reviewer 2)*
>
> I could imagine purchasing the participant handbook just to have the collection of excellent readings and thoughtful DATA tools as a resource for some targeted work within districts. However, I do not think that doing a single session using these resources would have nearly the impact of looking at the program as a whole and then revisiting ideas from earlier sessions over time. *(Reviewer 3)*

Note

Orientation Session. Many facilitators have found it helpful to offer a general orientation session for a district's principals, mathematics coordinators, and district curriculum coordinators. These sessions, recommended to be three hours long, can combine an experience with the materials (perhaps a combination of working on a problem-based task from early algebra and discussing a reading that has particular relevance to the site) with an overview of the seminar. Such an orientation session can introduce a range of district leaders to important ideas about leadership for mathematics, on which they can build over time. At the same time, it can situate leaders from schools that are ready to make a commitment to the full Secondary Lenses on Learning seminar to think strategically about team composition and how to prepare its members for the work.

Facilitation and Recruitment

The facilitator notes are written for pairs of seminar leaders who have expertise in mathematics education at the middle and high school levels and bring complementary knowledge of the professional roles addressed in the seminar.

Well in advance of the first session of the seminar, facilitators will need to make connections with all participating sites in order to

- Help them formulate their teams strategically
- Help team members understand the nature of the commitments they are making to the seminar (attendance at all sessions, completion of individual homework reading and team data collection assignments, and team meeting between sessions)
- Help situate the mathematics leadership team for continued work after the conclusion of the seminar, to facilitate continuous mathematics program improvement in the school.

It is worth investing real time in communicating with schools that are contemplating sending a team to *Secondary Lenses on Learning,* so as to gain full value from the seminar.

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Program Goals

The goals of *Secondary Lenses on Learning* are as follows:

1. For participants, *individually,* to expand their notions of
- The mathematical knowledge and dispositions students need to have to be mathematically literate in today's world
- The learning opportunities that need to be created in order to make significant mathematics accessible to all students

2. For *mathematics leadership teams* to move their educational systems and classrooms forward in a state of continuous improvement in mathematics instruction and achievement.

What Happens in a Secondary Lenses on Learning Seminar

Secondary Lenses on Learning is anchored in algebra because this topic is currently of great current concern to schools and districts, given the following:

- Algebra is a prerequisite for virtually all other mathematics.
- Algebra is a significant academic gatekeeper, required by any two- or four-year college in the United States and Canada, and is necessary for doing many jobs and for entering many job-training programs.
- Algebra is built into high-stakes assessments required by districts and states.
- The focus on algebra provides a window into content, instruction, and assessment associated with broadening access to mathematics and developing a deep understanding of mathematical ideas.
- In the seminar, work with problem-based activities in early algebra provides a set of common mathematical experiences intended to help broaden and deepen participants' understanding of what is involved in learning and teaching algebra. These anchor explorations of both opportunities to strengthen the mathematics program, at the level of classrooms and schoolwide systems, in such a way that all students can become successful in mathematics (see Appendix C, Working With Problem-Based Mathematics Tasks from Early Algebra).

The content of the sessions is cumulative and includes the following:

Session 1	What does it mean to *know* algebra?	*Content*
Session 2	What does high quality instruction look like?	*Instruction*
Session 3	How can assessment support learning and instruction?	*Formative Assessment*
Session 4	How can we hold high expectations and provide strong support for *all* students?	*Equitable Practices*
Session 5	How can professional development enable teachers to improve student achievement?	*Practice-Based Professional Development*
Session 6	How can school leaders advance their mathematics program toward success for all?	*Mathematics Improvement Process*

It is important to note that each session, while focusing on a particular topic, also builds on the previous one. Core ideas that are developed over time include the following:

- All students (and educators) gain from having the opportunity to work with cognitively demanding mathematical tasks.
- Discourse plays an important role in supporting students (and educators) to make sense of mathematical ideas.
- It is important to attend to learners' mathematical thinking, both as a teacher and as an observer in classrooms.

See further elaboration on the content of each session in Part IV.

The following activities are designed around the primary goals of *Secondary Lenses on Learning*:

Goal 1: Expanding participants' notions of the following:

- The mathematical knowledge and dispositions students need to have to be mathematically literate in today's wor*ld*
- The learning opportunities that need to be created in order to make significant mathematics accessible to all students

Participants work with problem-based activities in early algebra that focus on representing and analyzing relationships among quantitative variables, modeling situations, and identifying and describing generalizations. They also discuss readings that link the topics addressed in each session to research; reflect on videotapes and written cases that provide insights into instruction, students' mathematical thinking, and teacher learning; and examine various leadership tasks and responsibilities that contribute to an effective mathematics program. (See Appendix B, Using an Instructional Model; Appendix C, Working With Problem-Based Mathematics Tasks From Early Algebra; and Appendix D, Viewing Video Clips of Teachers and Students at Work.)

Goal 2: Strengthening building teams' capacity to move their educational systems and classrooms forward in a state of continuous improvement in mathematics instruction and achievement

Through work on the DATA (Data As a Tool for Achievement) strand, teams are taken through a structured process for collecting, analyzing, and interpreting data (both quantitative and qualitative) for the purpose of identifying current strengths and weaknesses in their mathematics program. In Session 6, they use these findings to set goals and generate a plan for improving the mathematics program, including the following: short-term and long-term goals, next steps they will take to work toward those goals, and plans for involving other critical players.

It is expected that building mathematics leadership teams (perhaps partially reconstituted to include other critical players) will continue to meet regularly after the conclusion of *Secondary Lenses on Learning.* Together these teams will provide leadership for implementing, studying, reflecting on, and further developing their mathematics program improvement plan.

The Role of a Reflective Community of Inquiry

A primary intent of *Secondary Lenses on Learning* is to help develop an inquiring, reflective community of learners among facilitators and participants in the seminar. The ideas and practices examined are complex and multifaceted. Many will push at participants' current assumptions and belief systems. From the start, it will be important to lay the groundwork for developing a reflective community of inquiry within which beliefs and assumptions can be held up for thoughtful reexamination and fresh ideas and perspectives can be considered thoughtfully. Building such a community of inquiry requires that facilitators plan and orchestrate sessions in a way that participants can be engaged in exploring, conjecturing, reasoning, and communicating. This is parallel to what is advanced here for mathematics classrooms, where discourse is cultivated so that participants can explain their thinking, listen carefully to others, and make connections among ideas articulated (see Appendix A, Setting Norms and Values for the Seminar).

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PART III

HOW TO USE THE *SECONDARY LENSES ON LEARNING* MATERIALS

Program Components

The *Secondary Lenses on Learning* professional development materials include a combination of print and DVD resources organized in the following two components:

Facilitator's Guide (Print, With DVD Component)

In Print

- Introduction
- Detailed facilitator notes for each of six sessions

On DVD

- Video clips for Sessions 1, 2, 4, 5
- Numbered handouts and overhead slides for each session, to be printed for use in each session
- Samples of related documents (promotional fliers, a registration form, an introductory letter to participants)

Note

The first number in the handouts signals the session number and is followed by a letter; the first number in the slides also signals the session number and is followed by a number.

Note

Each facilitator will need a copy of the Participant Book as well as the Facilitator's Guide (with accompanying DVD).

Participant Book (Print)

Part 1: Useful tools

- *The* Secondary Lenses on Learning Observation and Reflection Guide
- The Math-Talk Learning Community Rubric
- The Mathematical Task Framework

Part 2: Session introductions and readings

- Introduction
- Readings (both homework and in-session)
- Focus questions

*Part 3: Team DATA Assignments (**D**ata **A**s a **T**ool for **A**ssessing the Mathematics Program)*

- The DATA assignment for each session includes the following:
  - Part A: Overview of DATA Assignments for This Session
  - Part B: Templates for Data Collection
  - Part C: Whole Team Reflection

Session Organization

Each session in the Facilitator's Guide is organized in the following way:

- Introduction
- Session Agenda
- Session Big Ideas
- Materials for the Session
- Suggested Preparations for the Session

Each activity opens with an *Activity Overview* and then is followed by detailed notes for each section of the activity.

Slides and handouts for the session can be found on the DVD that comes with the Facilitator's Guide.

The following regular features are built into participants' work for each session:

At the Beginning of the Session

- An overview of the goals and content of *Secondary Lenses on Learning*
- A review of the ideas examined in the previous session(s)
- An opportunity to share, and to reflect on, the DATA assignment that teams worked on for homework
- An introduction to the session's Big Ideas and Agenda

At the Conclusion of the Session

- An invitation for individual reflection by responding to the questions on the Session Reflections handout (The guiding questions are the same for each session so as to provide consistent scaffolding for participants to reflect on the ideas examined in the session and where their own practice or school is in relation to them. Note that many facilitators get permission from participants to keep a copy of their writing at the conclusion of each session, so as to gain insights into what is on their minds. These can be handed back at the next session.)
- An introduction to the homework assignment: individual reading assignment and focus questions and team DATA assignment
- Distribution of a Further Resources list continuing learning about the topic examined in the day's session

Homework Expectations

Participants are responsible for two types of homework assignments in connection with each session:

1. An individual reading assignment, which links the topics addressed in each session to research
2. A team DATA collection and reflection assignment (described earlier)

The success of the seminar depends on participants completing both their individual and team homework assignments (including meeting with their teams to discuss the data collected by their teams). These assignments, around which each session is built, serve as bridges that follow up on one session and anticipate the next one. Most importantly, they are the foundations for the mathematics program improvement plan each building team will develop in Session 6.

From the outset (during initial recruitment communications as well as during the first session and continuing reminders as the seminar progresses), it is very important to establish how critical homework completion is to the success of the seminar. Participants should plan to devote approximately half a day to each homework assignment (combined individual reading and team DATA assignment).

> ***Note***
>
> *The reading homework assignment that precedes Session 1 needs to be sent out to participants at least one week prior to the first meeting of the seminar.*

Planning a Calendar for a *Secondary Lenses on Learning* Seminar

The following are recommendations to keep in mind when planning a calendar for offering *Secondary Lenses on Learning:*

1. Allow intervals of two to three weeks between sessions. This should allow time for completing the team DATA collection and reflection assignments and individual reading assignments, while still being close enough to keep track of ideas as they grow and develop.
2. Consider holding a seventh session, in which teams present and critique one another's mathematics program improvement plans, which they will have refined and discussed with relevant parties between Sessions 6 and 7.
3. Be aware that the sessions are very full, and careful attention to time is important so that key activities don't drop off at the end of the day. Some sites have found it helpful to extend the day with an informal coffee or sharing time prior to the start of the session. Others have extended them for 30–60 minutes longer than what is written into the materials.

Part IV

OVERVIEW OF THE CONTENT OF

SECONDARY LENSES ON LEARNING SESSIONS

The content of the sessions is cumulative. It addresses the following Big Ideas and includes work on the following mathematical tasks.

Session 1. What Does It Mean to *Know* Algebra? (Content)

Big Ideas

This session offers participants the opportunity to do the following:

- Examine characteristics of a challenging algebra curriculum that is accessible to all middle and high school students
- Explore what it means to develop a stance of inquiry and ongoing learning about mathematics education within a community of learners
- Consider the potential of a mathematics leadership team to facilitate continuous improvement in mathematics education
- Examine the connections among educators in different positions and consider that each has a practice that may need to grow in order to ensure that all students are successful in mathematics

Math Task: How Many Toothpicks? In this task participants examine how quadratic functions arise from a geometric situation, generalize about patterns and about the relationship between quantities in the task, seek to write symbolic expressions for the various approaches they develop, and examine how each expression relates back to the components of the figure and can be transformed into the other. The issue of recursive versus explicit expressions arises in the discussion of this task (and others). While many participants recognize a (recursive) pattern in the number of additional toothpicks required to create each subsequent figure, an explicit expression (that doesn't require knowing the number of toothpicks used in the previous figure) is harder to come by.

Readings

Reading 1.1 Usiskin, Z. (2005). Should all students learn a significant amount of algebra? In C. Greenes & C. Findell (Eds.), *Developing students' algebraic reasoning abilities* (pp. 4–16). Lakewood, CO: National Council of Supervisors of Mathematics.

Reading 1.2 Fey, J. T., & Phillips, E. D. (2005). A course called algebra 1. In C. Greenes & C. Findell (Eds.), *Developing students' algebraic reasoning abilities* (pp. 33–45). Lakewood, CO: National Council

of Supervisors of Mathematics.

Video Clips

Video Clip 1.1 *How Many Toothpicks?* Small Group 1
Video Clip 1.2 *How Many Toothpicks?* Small Group 2
Video Clip 1.3 *How Many Toothpicks?* Specialist Commentary (for use by facilitators in preparation for the session)

Session 2. What Does High quality Instruction Look Like? (Instruction)

Big Ideas

This session offers participants the opportunity to do the following:

- Examine what is known about how people learn mathematics
- Develop an understanding of instructional strategies that promote student learning in mathematics
- Examine the types of knowledge teachers need to effectively lead mathematics instruction
- Consider how various types of mathematical tasks directly impact what mathematics students have the opportunity to learn

Math Task: The Border Problem. In this task participants derive a formula to determine the number of 1 foot by 1 foot tiles that are required to create the border of an n foot by n foot square. The problem moves from finding the number of tiles needed for a specific square to writing an expression for the number of border tiles needed for any square. Participants are encouraged to think about the problem in different ways, leading to equivalent expressions and equations. The discussion focuses on justifying the equivalence of two or more symbolic expressions by linking them back to the geometric model.

Readings

Reading 2.1 Fuson, K. C., Kalchman, M., & Bransford, J. D. (2004). Mathematical understanding: An introduction. In M. S. Donovan & J. D. Bransford (Eds.), *How students learn: Mathematics in the classroom* (pp. 217–247). Washington, DC: National Research Council of the National Academies.

Reading 2.2 Stein, M. K., Smith, M. S., Henningsen, M. A., & Silver, E. A. (2000). *Implementing standards-based mathematics instruction: A casebook for professional development.* (This is a joint publication of the National Council of Teachers of Mathematics [Reston, VA] and Teachers College Press [New York]. See pp. 000.)

Reading 2.3 Hiebert, J., & Stigler, J. (2004). A world of difference: Classrooms abroad provide lessons in teaching math and science. *Journal of Staff Development, 25*(4), 1–7.

Reading 2.4 Boaler, J. (1999, March). Mathematics for the moment, or the millennium? *Education Week, 18*(29), 52.

Video Clips

Video Clip 2.1 The Border Problem Introduction
Video Clip 2.2 The Border Problem Day 2

Session 3. How Can Assessment Support Learning and Instruction? (Formative Assessment)

Big Ideas

This session offers participants the opportunity to do the following:

- Explore the scope, audience, and purposes of student assessment
- Review research findings on the role of assessment in supporting student learning
- Consider formative assessment practices that benefit student learning

Math Task: The Supermarket Problem. In this task participants are given an illustration of a single supermarket cart and of a set of 12 nested supermarket carts (drawn to 1/24th scale). They use this information to create a rule for the length of storage space needed as a function of the number of supermarket carts to be stored and to determine a method for figuring out the number of carts that can fit in a space s meters long. This task provides an opportunity to work on formulating an approach to a task that is not fully specified, to model a situation symbolically including identifying the variables and writing an appropriate equation, to use linear functions in a situation that calls for a discrete domain, and to find the inverse of a linear function, all in a metric context.

Readings

Reading 3.1 Stiggins, R. J. (2002). Assessment crisis: The absence of assessment for learning, *Phi Delta Kappan, 83*(10), 758–776.
Reading 3.2 Black, P., Harrison, C., Lee, C., Marshall, B, & Wiliam, D. (2004). Working inside the black box: Assessment for learning in the classroom. *Phi Delta Kappan, 83*(1), 8–21.

Session 4. How Can We Hold High Expectations and Provide Strong Support for *All* Students? (Equitable Practices)

Big Ideas

This session offers participants the opportunity to do the following:

- Examine ways in which assumptions, attitudes, and expectations intersect with students' race, ethnicity, and social class to affect student achievement, engagement, and curricular opportunities for various student groups
- Explore opportunities to address issues of equitable achievement at both the classroom level and at the schoolwide or systems level

- Consider broadening sources of data used in assessing what helps and hinders mathematics learning and achievement

Math Task: Basic Student Budget. In this task participants are asked to extrapolate from a limited data set (about the amount of money each of three college roommates have on three different days) to answer questions about each student's ability to pay rent at the end of the *xt*h day of the month and whether and how much money will be left over to pay for a concert. The task provides a context for finding a rule for the line of best fit, taking into account various starting amounts; extending solutions of problems to formulate predictions; generating expressions using algebraic symbolism; and comparing approaches (e.g., finding the line of best fit on the graph, using either estimated or actual data points; approximating the rate spent daily.)

Readings

Reading 4.1 Schoenfeld, A. H. (2002). Making mathematics work for all children: Issues of standards, testing, and equity. *Educational Researcher, 31*(1), 13–25.
Reading 4.2 The Case of the Rafter School District
Reading 4.3 Ladson-Billings, G. (1997). It doesn't add up: African American students' mathematics achievement. *Journal for Research in Mathematics Education, 28*(6), 697–708.
Reading 4.4 Boaler, J. (2002). Learning from teaching: Exploring the relationship between reform curriculum and equity. *Journal for Research in Mathematics Education, 33*(4), 239–241, 245–256.
Reading 4.5 Moschkovich, J. (2002). A situated and sociocultural perspective on bilingual mathematics learners. Mathematical Thinking and Learning, 4(2 & 3), 189–190, 192–197, 200–208.

Video Clip

Video Clip 3.1*Student Voices*

Session 5. How Can Professional Development Enable Teachers to Improve Student Achievement? (Practice-Based Professional Development)

Big Ideas

This session offers participants the opportunity to do the following:

- Broaden their understanding of the nature and potential of professional development
- Experience professional development approaches centered in the practice of teaching
- Explore instructional decisions that influence student learning and achievement

Math Task: Hexagon Trains. Participants investigate a pattern of change in the perimeter of a train of pattern block hexagons. They identify the pattern of change as linear and what about the pattern or context that lets them know it is linear. They note

the different approaches to finding solutions—geometric, numeric (tabular), or expressions using algebraic symbolism. They make connections among the different approaches for finding the perimeter. The relative efficacy of recursive and explicit expressions arises again in this session as participants search for a formula for the perimeter of a given train that does not require knowing the perimeter of the previous train. The context again enhances opportunities to make sense of the variables in the algebraic expressions because they are directly connected to a concrete context.

Readings

Reading 5.1 Smith, M. S. (2001). *Practice-Based professional development for teachers of mathematics.* Reston, VA: National Council of Teachers of Mathematics. (See pp. 000.)

Reading 5.2 Loucks-Horsley, S., Love, N., Stiles, K., Mundry, S., & Hewson, P. (2003). *Designing professional development for teachers of science and mathematics* (2nd ed.). Thousand Oaks, CA: Corwin. (See pp. 000.)

Reading 5.3 Stein, M. K., Smith, M., Henningsen, M., & Silver, E. (2000). *Implementing standards-based mathematics instruction: A casebook for professional development.* Reston, VA: National Council of Teachers of Mathematics. (See pp. 000.)

Reading 5.4 Smith, M. S., Silver, E. A., & Stein, M. K. (2005). *Improving instruction in algebra: Using cases to transform mathematics teaching and learning* (Vol. 2, pp. 10–27). New York: Teachers College Press. (The Case of Catherine Evans and David Young; see pp. 000.)

Reading 5.5 Hufferd-Ackles, K., Fuson, K. C., & Sherin, M. G. (2004). Describing levels and components of a math-talk learning community. *Journal for Research in Mathematics Education, 35*(2), 81–116.

Following is a reading selection for a homework study group activity:

Reading 2.3 Hiebert, J., & Stigler, J. (2004). A world of difference: Classrooms abroad provide lessons in teaching math and science. *Journal of Staff Development, 25*(4), 1–7. (This is from pre-Session 2 homework.)

Video Clip

Video Clip 5.1 *The Basic Student Budget*

Session 6. How Can School Leaders Advance Their Mathematics Program Toward Success for All? (Mathematics Improvement Process)

Big Ideas

This session offers participants the opportunity to do the following:

- Examine the interconnectedness of the elements of school that contribute to mathematics achievement and the necessity of adjusting multiple aspects of the system and educators' practice to continuously move achievement forward
- Explore the use of data beyond state or nationally normed assessments to identify problems and with research plan for improvement
- Develop building mathematics program improvement plans for increasing student achievement (short and long term)
- Consider the benefits of building support for changes in mathematics education from teachers, administrators, students, parents, boards of education, and the wider community

Reading

Reading 6.1 Elmore, R. F. (2002). *Bridging the gap between standards and achievement: The imperative for professional development in education.* Washington, DC: Albert Shanker Institute.

Part V

OVERVIEW OF THE DATA STRAND

Rationale for the DATA Strand

Thoughtful leadership for mathematics programs, like thoughtful mathematics teaching, grows out of honing our vision for the work, gathering and reflecting on relevant information about the current situation in light of that vision, and building next steps from what we learn. For the most part, though, schools make decisions about the mathematics program (e.g., replace the textbook) based on a very narrow slice of the work, primarily student achievement on unit assessments and state tests—that is, summative assessments. Schools and districts tend to have very minimal, if any, systems in place for collecting data—both quantitative and qualitative—about other aspects of the mathematics program (e.g., content and curriculum, instruction, assessment, classroom and systems-level practices related to equity, professional development, students' perspectives on expectations and support) that are central to the learning and teaching of mathematics in schools.

The DATA strand has been developed as a tool for teams' use in self-assessing their mathematics program. Teams collect and discuss rich and relevant data about current practice in their schools and classrooms with respect to each of the key topics addressed in the seminar. Team DATA assignments are also designed to extend participants' understanding of the ideas presented in the *Secondary Lenses on Learning* sessions and to help mathematics leadership teams *transfer* ideas explored in each of the sessions into their own settings.

The DATA assignments are discussed at the beginning of each new session and drawn on again when teams develop their mathematics program improvement plan in Session 6.

Components of the Team DATA Assignments

Each team DATA assignment has three components, all of which can be found in the section of the Participant Book titled, *A Compilation of the Team DATA Assignments (Data As a Tool for Assessing the mathematics program),* starting on page 000:

A. Overview of DATA Assignments (Part A)

This section provides a summary of assignments and the roles to which they are

assigned; note that some data collection assignments are for all team members, and others are intended to be carried out by individuals in particular roles. If not all roles are represented on a team, other members need to find a way to gather all data outlined for role-specific data collection. All of the data listed will be important to take into consideration when team members make plans for their mathematics program improvement plan (Session 6).

Note that each team DATA assignment includes an observation of a mathematics lesson, using the relevant component of the *Secondary Lenses on Learning Observation and Reflection Guide* (See Appendix E, Working with the *Secondary Lenses on Learning Observation and Reflection Guide*).

B. Templates for Data Collection (Part B)

This section provides templates for recording data collected.

C. Whole Team Reflection (Part C)

This section outlines tasks and focus questions for a whole team meeting, which is to take place between each *Secondary Lenses on Learning* session and is a crucial component of the DATA assignments. Teams are expected to compile the data they have collected and discuss and take notes on the focus questions. Based on this meeting, they should be prepared to share their findings with other teams in the next *Secondary Lenses on Learning* session.

At the end of the DATA packet, there is a template entitled *Areas to Pursue.* Before they wrap up their whole team reflection (part C of the team DATA homework assignment), teams should record on this template one or two issues, policies, or practices that they think need further investigation and may need to be addressed in their mathematics program improvement plan. They are to state what evidence they have from the data they collected that supports the importance of digging more deeply into the issue, policy, or practice they have identified. They will draw on these notes when they develop their mathematics program improvement plan during Session 6.

Because this whole team reflection time is so important and also so easy to let slip in the midst of the busyness of school life, it is highly recommended that facilitators provide time at the end of each *Secondary Lenses on Learning* session for teams to set a day and time for the whole team reflection.

DATA and Continuous Mathematics Program Improvement

The DATA strand is central to the mathematics program improvement framework for *Secondary Lenses on Learning,* which draws on Larry Lezotte's work on effective schools (Lezotte & McKee, 2002). The diagram below [see print version of introduction for this diagram] shows the continuous improvement process cycle used by Lezotte and introduced to participants in Session 6 as they shift to the process of developing their mathematics program improvement plan, based on the data they have collected and reflected on in connection with the previous five sessions.

One might think of the DATA strand as comprising the *Study, Reflect,* and *Plan*

phases of the Effective Schools Cycle, to be followed by *Implement* (and later cycling back again to incorporate ongoing opportunities for study, reflection, planning, and implementation).

From the beginning, it is important to help participants bring an orientation of inquiry to their work with the DATA assignments as they collect and reflect on quantitative and qualitative data about various facets of the mathematics program in their schools. Facilitators, too, can contribute to this orientation of inquiry by listening hard to participants and thinking of teams' work on the DATA strand as a formative assessment: What questions are they asking about their mathematics program? What are they currently identifying as potentially productive next steps? What understandings and evidence is this based on? What data sources are they currently using to inform them about their mathematics program? What other important sources might be helpful to them in identifying the strengths and needs of their mathematics program?

With support, over time, teams will come to generate important questions such as these:

What are contributing factors to the high failure rate of second-semester ninth-grade students?

What can we do to get students to spend more time on complex mathematical tasks without giving up?

How well aligned is the content and pedagogy in the middle school and high school mathematics programs or curricula (across grades, across course levels)?

How reflective of research-based "best practices" is mathematics instruction in our school?

How might we better use assessment to strengthen instruction and learning in mathematics?

How well suited to our needs are our current professional development offerings?

What is the effect of current placement practices on students' opportunities to learn mathematics?

How effectively are we supporting students when they struggle with mathematics?

Are we hiring and placing teachers well?

Part VI

HOW MIGHT *SECONDARY LENSES ON LEARNING* HELP YOU?

HOW HAVE OTHERS BENEFITED?

Reasons a Site Might Enroll a Team

Teams that enroll in *Secondary Lenses on Learning* are likely to come from districts that are in a variety of places in the mathematics improvement process. The following are several examples of questions around which a school leadership team might be formed to enroll in *Secondary Lenses on Learning:*

Something needs to change, but what?

This school has been trying harder than ever, but student results have not budged. It forms a mathematics leadership team, comprised of key leaders in both administrative and instructional roles, to enroll in *Secondary Lenses on Learning* with the goal of finding out what can be done to make a difference.

We're doing just fine, but why does the performance gap persist?

This school has invested significantly in National Science Foundation-supported curriculum and professional development and while achievement has improved, the school is still struggling to bridge performance gaps among groups of students. Its long-time mathematics leadership team members enroll in *Secondary Lenses on Learning* with the goal of pushing themselves to understand what more they could do to make success for all students become a reality.

How can we become more consistent in what we do, and what should we prioritize as we do so?

In this district the high schools have been struggling with the fact that students

from various feeder schools have been coming from very different mathematics programs (both curriculum and approach to instruction). They compose a mathematics leadership team that includes key players from the middle and high schools, the district office, and also the K–5 mathematics coordinator. They enroll in *Secondary Lenses on Learning* with an eye to building coherence in the mathematics materials, pedagogy, and expectations across all schools in the district.

How can we build effectively on what we've begun?

In this district the middle schools have been working with National Science Foundation-supported curriculum for some years. The mathematics curriculum director wants to use the team's participation in *Secondary Lenses on Learning* as a means to paving the way for a thoughtful adoption process for a new high school curriculum and a successful subsequent implementation.

What is at the heart of these ideas?

This district forms a mathematics leadership team to enroll in *Secondary Lenses on Learning* with care and cautious optimism. Its members are well aware of the district's earlier history with adopting National Science Foundation-supported curricula only to toss them out again because of backlash from teachers, parents, and the school board. They hope that getting to the heart of the ideas examined in the seminar will help them better understand the nature of what is needed in their own setting and to take thoughtful steps forward.

A Window Into *Secondary Lenses on Learning*

Consider a recent orientation session for *Secondary Lenses on Learning,* which addressed mathematics coaches, principals, curriculum supervisors, and teacher leaders from a range of districts. Participants had just finished reading The Case of the Rafter School District, excerpted here:

> *Some years ago, the Rafter School District had put into place a policy of algebra for all in the eighth grade. The decision had been hailed by parents, who had complained bitterly about the disparities in educational opportunities for different groups of students.*
>
> * * *
>
> *Now, four years after the mandate, it was clearly time to reconsider. Large numbers of students were, indeed, failing the eighth-grade Algebra 1 class, and so they had to retake it in ninth grade—again with a high failure rate. Scores on the state test had not improved. Morale was low among teachers; nobody wanted to teach the lowest level class. Once again, parents were clamoring for change.*
>
> *This time the district set up an Algebra Task Force to study the situation.*
>
> *The committee was made up of the assistant superintendent, the middle and high school principals, a guidance counselor, the special*

education director, two teachers from each school, and an influential representative from the Parent Advisory Council.

Over the course of several meetings, they worked on several problem-based tasks from early algebra. They discussed articles about mathematics, algebra, and equity. They emerged from these meetings with a series of questions around which they decided to study their district in order to better understand their situation:

1. *How does the content of the Algebra 1 classes offered to different levels of students compare?*
2. *What approaches to teaching algebra are taken in each level, and what is the cognitive demand of tasks used?*
3. *What opportunities for professional development are offered to support teachers in learning about how to make algebraic concepts and skills accessible to a wide range of students?*
4. *What teachers are assigned to the different levels of Algebra 1 classes and what criteria are used in making decisions for teachers' assignments to mathematics classes?*
5. *What choices about enrolling in further mathematics classes are students making, beyond what is required?*
6. *What is the process currently in place for advising students about placement in mathematics courses?*
7. *What opportunities for additional support are offered to students who are struggling in mathematics, what is the nature of these supports, and how timely is it?*

The Algebra Task Force formed teams to investigate each question and agreed to share their findings at the next scheduled meeting.

* * *

Among other things, the Algebra Task Force learned the following:

- *Students in lower levels of Algebra 1 worked with significantly different content than their peers in higher tracks. Students in lower levels had little opportunity to learn through "math talk," make connections (among concepts, representations, strategies, symbolic expressions), or to make and test out mathematical conjectures.*
- *Teacher professional development for mathematics was limited and there was little time for teachers to meet together.*
- *New hires were often assigned to teach the Algebra 1 classes.*
- *Student enrollment data showed that many students had stopped taking mathematics beyond the required Algebra 1 course, and among these a disproportionate number were low income and minority.*
- *There was great variation in the amount of guidance offered to students with respect to selection and placement in mathematics classes, and in who was involved in these consultations with students.*

The case goes on to describe the short-term and longer-term goals and actions that the Algebra Task Force identified as a result of its findings.

Following are reflection and follow-up discussion questions from the case:

1. What strikes you as particularly valuable about the processes and priorities for strengthening the mathematics program at the Rafter School District described here?
2. What issues might the Math Task Force encounter as it sets about enacting its plans?
3. What might task force members be missing?

Participants were deeply involved in the small and whole group discussions that followed. Several made comments such as, "This could be my school." One participant said, "I wish I could be working with a task force like that." The following are additional comments from the discussions:

> *These are difficult things to face. The Algebra Task Force is willing to ask difficult questions and to take on the issues they uncover.*
>
> *All students should have the opportunity to take part in challenging coursework in mathematics. They recognized that, although computational proficiency helps in higher level mathematics, for some students a weakness in computation does not mean that they are not ready for algebra or other higher level mathematics courses.*
>
> *But it is not enough simply to mandate different enrollment patterns by requiring all students to take algebra or higher level integrated mathematics courses by a certain grade—adequate preparation and support for students, and therefore for teachers, is necessary.*
>
> *They're making a real effort to get informed: doing math; reading articles and reporting research findings about mathematics, assessment, and equity; learning from other schools.*
>
> *They're not just talking about algebra as a course; they're talking about building a set of ideas and competencies over time.*
>
> *I like the fact that they did math together and read research articles, but I'm not convinced that they are sharing the same lenses when they view mathematics lessons. Shouldn't they view and discuss video of classroom practice as well?*
>
> *How might they address the K–8 scope and sequence so that they really take advantage of the learning opportunities prior to middle school?*
>
> *They're trying to figure out what actions to take with reference to their long-term goals.*
>
> *They're committed to equity. They're not lowering expectations for students, but they're figuring out what they need to do in order to make it possible for them to succeed.*
>
> *They're not taking the easy way out. It will take bringing a lot of people on board.*

I'd never thought that guidance counselors should be part of our conversations. I'm rethinking that now. We have to find a way to bring the right people together for this work so that we can move our whole system forward. We've been working at cross-purposes with each other.

They're really listening. They could have written off parents who were creating the buzz. Instead they took in their concerns and asked themselves hard questions about what they were or weren't doing well to support students to be successful in math.

I'd be excited to be part of something like that. It would be so helpful to have people in all these different roles working together. And I wouldn't feel so alone and up against the wall.

Two participants (the assistant superintendent in charge of curriculum and the mathematics coordinator from the same district, who had pressed for their attendance at the orientation) came forward eagerly after they had finished reading the case, saying, "This is *just* what we need. We want to bring it to our principals, and to their math department chairs, and to their guidance counselors. This case speaks to the issues we're all struggling with. *Secondary Lenses on Learning* would build opportunities for the conversations that are so desperately needed in our district."

At the end of the orientation session, several other participants came forward to strategize about how they might bring key players to the table for a *Secondary Lenses on Learning* seminar.

What did these leaders find so promising in the Case of the Rafter School District? We cannot know for sure, but following are some possibilities:

- The content of the case resonated with their own struggles with ramifications of raised expectations and policy shifts.
- The short- and long-term goals and actions chosen by the Rafter's Algebra Task Force suggested leverage points that these participants had not previously considered for their own school.
- The processes undertaken by the Rafter's Algebra Task Force were akin to formative assessment in the classroom, in this case brought to the level of the school as a system.
- The Rafter's team approach to taking on a complex and many-faceted problem, involving individuals in a range of roles, was compelling.
- The fact that it is embedded in a longer seminar that provides opportunities for extended explorations and conversations among those in critical roles for improving the learning of secondary mathematics was encouraging.

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Comments From Former Facilitators and Participants

Secondary Lenses on Learning was piloted and field tested in sites around the country: Greater Boston; Albuquerque, NM; Colorado Springs, CO; Greater Philadelphia; Oregon; Charleston, WV; and several sites in Michigan and Washington states. The following quotes attest to the experience of facilitators and participants in these seminars:

> The effectiveness of *Secondary Lenses on Learning* was demonstrated to me through the evolution of our school district. All of our secondary mathematics principals, lead teachers from their schools, the district Federal Programs Coordinator (who is largely responsible for professional development efforts in the district), and the Associate Superintendent for Instruction all attended the sessions . . . . Since then, the district administrative team has consistently made decisions that support the teaching and learning of mathematics for all students in the district (e.g., hiring a secondary mathematics coach to accompany the elementary mathematics coach; principals volunteering to attend week-long workshops with their teachers to become familiar with their newly adopted mathematics curriculum; involving board members and parents in the process). We are now considered by many to be at the top of a short list of districts in the state who are leaders in systemic mathematics reform. When asked about how we came to be in this place, district administrators credit their attendance in the *Secondary Lenses on Learning* field test.
>
> —Facilitator

> Our district's team included high school principal, high school assistant principal, high school mathematics department chair, high school mathematics coach, district mathematics curriculum supervisor, middle school mathematics liaison, and middle school instructional coach. If we were formulating the team with what we know now, we would also include a middle school guidance counselor, high school guidance counselor, and secondary special education supervisor.
>
> The data collection and analysis component of the course refocused the group's attention on aspects of our data that we had not previously been considering carefully or at all. This experience was different because we were looking at the data as a team with both administrators and lead teachers. Although each group had been looking at aspects of the data separately, the conversation around the data changed as the team members who have a broad view of the implications of the data got together with those who are very close to the students and the data. The diversity of the perspectives represented by the group stimulated new ways of seeing and thinking about the data. There was also a higher level of accountability in these conversations about the data because there were two building administrators and one central office administrator engaged in the conversation as well.

—Facilitator

The data collection impact on our team was huge. Once we gathered the data and began to examine it closely, our team shifted to a cohesive, focused, and functioning group with some clear goals, all aimed at improving student achievement. We did not have all the answers, nor does any group, so we shifted to a more open, listening style. After our classroom observations, we realized that the teacher professional development workshops were not creating as much change in the instructional practices as we had believed. I am convinced that analysis and reflection of data was one of the most effective catalysts for change.

—Math coach

The assistant superintendent and the math coordinator in our district had a long conversation about the potential impact of *Secondary Lenses on Learning*. They feel that a bond has been forged between teachers and their principal around improving practice that far exceeds any previous exchanges they might have had. This is coming from a district where the principals see themselves, and are seen, as instructional leaders, so I think it's worth paying attention to.

—Facilitator

As the principal of a middle school, I was able to participate in the *Secondary Lenses on Learning* training. The research articles and other materials have been invaluable as our district has adopted the Connected Math standards-based math curriculum in grades 6–8. *Secondary Lenses on Learning* provided the necessary background to be able to firmly support the need for this kind of math instruction in order to defend the district's adoption to a few disgruntled parents. The training also provided me with hands-on experiences so that I better understand the student and teacher behaviors associated with developing a deep understanding of math and the process standards associated with it.

—Principal

Participation in *Secondary Lenses on Learning* has and will continue to impact the teaching and learning of mathematics at my school. My colleagues and I are having regular discussions about some of the articles read in *Secondary Lenses on Learning*, best practices, math-talk communities, and equity and access for all students. Our goal is to create a program that will reach out to our struggling learners and help improve academic achievement for all students. However, we are especially working hard to bridge the gap for students not meeting standard.

Secondary Lenses on Learning has motivated me to take chances, be flexible, and make changes in my teaching practice to help improve student achievement. At some point in the school, year after attending a few sessions of *Secondary Lenses on Learning*, I closed my eyes and thought about the kids in my three accelerated classes and my standard (remedial) class. In my three accelerated classes, about 4 out of 90 students are African American or Hispanic. In my standard class, 8 out of 22 students are African American or Hispanic.

So, I decided to take a risk and teach my standard class all of the content that my accelerated class was getting and in the same way. I wanted to expose all of my kids in my standard class to curriculum they usually don't see until years later. At times there have been struggles and I have needed to adjust my pace or adjust homework assignments, but there has been much success. Students are engaged in conversations, teaching each other, asking why, asking how, asking questions, but most importantly, feeling successful and wanting to share their ideas and strategies. I will continue to use information and strategies learned in the *Secondary Lenses on Learning* class to help improve student achievement in my classroom and my school.

—High school mathematics teacher

As a result of this data collection, I am interested in discussing further with our counselors the criteria they use for placing students in math classes. I know that we have districtwide guidelines, but they don't seem to be followed very closely. Perhaps parental or another source of pressure is affecting the placement process.

—High school mathematics teacher

There is ample evidence that *Secondary Lenses on Learning* influenced the teaching and learning of mathematics this school year. Terms such as cognitive demand, assessment for learning, and student-teacher discourse crept into our conversation and began appearing in principals' observation write-ups. I have seen that the time together provided by *Secondary Lenses on Learning* for teachers and principals to focus their thinking and discussion on substantial topics related to the improvement of mathematics education, to examine and reflect on their own school data and to develop plans of action, has had a positive impact on both their professional relationship and their work. Sitting in on a number of those conversations, teachers talked about sharing what they learned with their colleagues, so clearly the influence of the course was extended beyond the immediate participants.

And the influence of the course has not been limited solely to the subject of mathematics. The entire Curriculum Department read and discussed *Working Inside the Black Box: Assessment for Learning in the Classroom.* Several of the curriculum developers shared this article with teachers in their own subject area.

The content of this course has informed my own thinking and planning. I have been struggling with how to focus all the curriculum

developers and curriculum coaches on addressing our thorny 30% problem (students who are not achieving at the level of their peers) in a very specific and intentional manner, how to provoke all of them to purposefully examine and analyze the collection of data their assessments are producing—and how to integrate all these issues and come to a decrease in the 30%.

—Assistant superintendent