Strengthening Student Educational Outcomes


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EXECUTIVE SUMMARY
Engrossed Substitute Senate Bill (ESSB) 5946 passed the state Legislature in 2013. It requires the Office of Superintendent of Public Instruction (OSPI) to convene a panel of math experts to develop a menu of best practices and strategies to help low-achieving students in grades K–12 served by the state’s Learning Assistance Program (LAP).

ESSB 5946 also tasked OSPI to convene panels of experts to develop menus of best practices and strategies in English language arts and in reducing disruptive classroom behavior for students served by LAP in grades K–12. All three menus must be updated by July 1 every year.

In addition to best practices for struggling students, the menu developed by the math experts includes connections to best practice for all students as aligned with the Washington State K–12 Learning Standards for Mathematics (Common Core State Standards for Mathematics) and the work of the National Council of Teachers of Mathematics (NCTM).

School districts in Washington are expected to use practices from the menu beginning in the 2016–17 school year. Districts that wish to use a practice not on the menu must provide evidence of the effectiveness of the intervention and apply for approval by OSPI to use such intervention not on the menu.

The mathematics panel collaborated with the Washington State Institute for Public Policy (WSIPP) in the development of the menu. As required in separate legislation, WSIPP provided a companion report which identifies research-based and evidence-based practices, strategies, and programs that are shown to improve student outcomes. Many of the best practices and strategies identified for inclusion in the menu were also included in the WSIPP report. In addition, the WSIPP report identifies an average effect-size and a cost-benefit analysis for each intervention.

It is important to note that the menu, by itself, is not sufficient to ensure all students will succeed. The expert panel strongly feels that each of the instructional strategies and best practices described in the menu be designed to meet the diverse needs of students and implemented with fidelity. Additionally, educators must engage in a process of observation, analysis, action, and reflection in their classrooms, regardless of the interventions chosen. This approach helps solve problems as they arise, and can ensure that the interventions chosen by the teacher or district have a greater chance of succeeding.

This menu of best practices and strategies for mathematics is organized by type, based on the currently allowed LAP service categories. OSPI is charged with updating the menu annually by July 1st, and will seek input from districts and the expert panel on newly identified research on practices for struggling students.
BACKGROUND
Engrossed Substitute Senate Bill (ESSB) 5946–Strengthening Student Educational Outcomes
Washington’s 2013 Legislature passed ESSB 5946 in the 2nd Special Legislative session in June 2013. The overall bill sets forth a vision for improving educational support systems for every student in grades K–12. The first section of part 1 references the importance of collaborative partnerships essential to supporting students; using research- and evidence-based programs for all students, especially in the early years for grades K–4; and providing statewide models to support school districts in implementing a multi-tiered system of support.

Part 2 of the bill references LAP’s focus on evidence-based support for students struggling in reading (with primary emphasis on grades K–4), mathematics, and behavior across grades K–12. Section 203 tasks OSPI to convene “expert panels” to develop menus of best practices and strategies for ELA (K–4 and K–12), mathematics (K–12), and behavior (K–12).

The Menu of Best Practices and Strategies for Mathematics, as published July 1, 2015, must be undated by July 1 every year. Beginning in the 2016-17 school year, districts must select a practice or strategy from the menu or may use a practice or strategy that is not on a state menu for two years initially. If the district is able to demonstrate improved outcomes for participating students over two school years at a level commensurate with the best practices and strategies on the state menu, OSPI will approve use of the alternative practice or strategy by the district for one additional school year. Subsequent annual approval by OSPI to use the alternative practice or strategy is dependent on the district continuing to demonstrate increased improved outcomes for participating students.

Additionally, by each August 1st, school districts must report to OSPI:

  a) The amount of academic growth gained by students participating in the learning assistance program,
  b) The number of students who gain at least one year of academic growth, and
  c) The specific practices, activities, and programs used by each school building that received learning assistance program funding.

OSPI will analyze this data and summarize the effects of LAP on student achievement in a report to the legislature. The Learning Assistance Program Growth Data report to the Legislature for 2014 is currently available online.

To ensure that school districts are meeting the requirements of this legislation, OSPI is tasked to review districts through the Consolidated Performance Review process to monitor school district fidelity in implementing best practices.

WSIPP Inventory of Evidence-Based and Research-Based Practices
In addition to direction to OSPI per ESSB 5946, the 2013 Legislature directed the Washington State Institute for Public Policy (WSIPP) to "prepare an inventory of evidence-based and research-based effective practices, activities and programs for use by school districts in the learning assistance program" (Senate Bill 5034, Section 610). The WSIPP Inventory of Evidence- and Research-Based Practices: Washington’s K–12 Learning Assistance Program
classifies LAP strategies as evidence-based, research-based, or promising according to average effect-sizes for identified interventions, a cost-benefit analysis, and other criteria. Both OSPI and WSIPP consider the two reports to be companion pieces. As such, OSPI and WSIPP coordinated their tasks to ensure that the content of both reports were consistent while still adhering to the unique directives given to each agency.

Both agencies collaborated on identifying topics for consideration for best practices and strategies. WSIPP Assistant Director Annie Pennucci and Research Associate Matt Lemon were key participants in the expert panel sessions as non-voting members. They provided important research references to the panel members, and solicited panel member input regarding effective practices. The two agencies then followed different, complementary processes for identifying practices for the WSIPP inventory and best practices and strategies for inclusion in the Menu of Best Practices and Strategies for Mathematics.

WSIPP, as noted above, conducted a rigorous meta-analysis of each potential practice and identified evidence- and research-based practices for the inventory according to the average effect-size and a cost-benefit analysis of each practice. The identification of best practices and strategies in the OSPI report was informed by WSIPP’s findings and ultimately determined by the expert panel. OSPI included notation indicating whether the practices included in the menu are evidence-based or research-based, as determined by WSIPP. The items noted with an asterisk in the menu have been identified by WSIPP as evidence-based or research-based (see Table 1). Additional practices and strategies are included in the menu based on research reviewed by the expert panel.
PHILOSOPHY OF MATHEMATICS INSTRUCTION AND INTERVENTION

Vision of Mathematics Education

In July 2011, Washington adopted the Common Core State Standards for Mathematics (CCSS-M) (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010) as the new Washington State K–12 Learning Standards for Mathematics. These standards replace the state’s 2008 Mathematics Learning Standards. The Washington State K–12 Learning Standards for Mathematics are built on an intentional progression of the skills and knowledge necessary for all students to be ready for career, college, and life when they exit high school. The progressions of learning provide specific focus for each grade level. The standards lay the groundwork for this vision of mathematics that better fits the skills students need to be productive members of society.

Building on the work of the National Council of Teachers of Mathematics (NCTM), this vision of mathematics education requires students to be problem solvers and consumers of data and research. Previously, mathematics programs emphasized computation and memorization. Today, students not only need to be fluent and flexible with numbers and operations, students need the capacity to apply concepts and skills to novel situations, to approach real-world problems with stamina, and to understand that there may be multiple viable solution paths and solutions depending on the context of the problem and the assumptions of the problem-solver.

A key component of the Washington State K–12 Learning Standards for Mathematics (State Standards) are the Standards for Mathematical Practice. These standards reflect this vision of mathematics education and describe the expertise that mathematics educators at all levels should seek to develop in their students. The Standards for Mathematical Practice are:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

Mathematics instruction, then, should use the mathematical practices to engage students in the mathematics content and develop students as “practitioners of the discipline of mathematics.” For more information on the Standards for Mathematical Practice, see http://www.corestandards.org/Math/Practice/.

Success in mathematics is not reserved for an elite few.
Additionally, the mindset that success in mathematics is reserved for an elite few is no longer viable. In fact, The National Academies (2002) asserts that “[s]tudents with a poor understanding of mathematics will have fewer opportunities to pursue higher levels of education and to compete for good jobs” (p. 12). As further described by The National Academies (2002):

Young people who are unable to think mathematically are denied many of the best opportunities that society offers, and society is denied their potential contributions. Many adults assume that differences in mathematics performance reflect differences in innate ability, rather than differences in individual effort or opportunities to learn. These expectations profoundly underestimate what children can do. The basic principles, concepts, and skills of mathematics are within reach of all children. When parents and teachers alike believe that hard work pays off, and when mathematics is taught and learned by using all the strands of proficiency, mathematics performance improves for all students. Careful research has demonstrated that mathematical proficiency is an obtainable goal. (p. 30)

It is our duty, therefore, to authentically engage all students in the discipline of mathematics as a foundation for approaching problems, data, and research to make meaning of information and gain proficiency in analyzing and solving problems.

**Focus, Coherence, and Rigor**
The Washington State K–12 Learning Standards call for shifts in the way we approach mathematics education. The shifts are:

- Greater focus on fewer topics
- Coherence: Linking content and thinking across grades
- **Rigor**: Pursue conceptual understanding, procedural skills and fluency, and application with equal intensity

“Focus” means deep engagement with the major work of each grade. Rather than racing to cover many topics superficially, the standards ask mathematics teachers to deepen the way time and energy are spent on fewer key concepts. “Coherence” requires that content be carefully connected across grades, intentionally building on prior knowledge. “Rigor” refers to deep understanding of mathematics concepts. Students must have the opportunity to access concepts from multiple entry points and perspectives. Students must also be fluent with calculations and procedures so they can access more complex concepts and procedures. Finally, students must have the opportunity to apply concepts and procedures to novel situations (Common Core State Standards Initiative, 2015).

**Mathematics Assessment**
Starting in the spring of the 2014–15 school year, students in grades 3–8 and 11 take the new Smarter Balanced tests aligned to the Washington State K–12 Learning Standards for Mathematics. The state summative assessment provides a clear indication of how well students are progressing toward mastering the academic knowledge and skills necessary for
college and career readiness. The assessment places emphasis not only on the content at each grade level, but the Standards for Mathematical Practice. These learning outcomes are organized around four assessment claims and represent the mathematics content and skills that are relevant to 21st century college- and career-ready students. These are:

- **Claim 1 – Concepts & Procedures** – The student can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency. (Associated Standards for Mathematical Practice: 5, 6, 7, 8)

In developing conceptual understanding and procedural fluency, students need to be aware of how concepts link together and why mathematical procedures work in the way that they do. Concepts should be built on students’ prior knowledge, and students should have the opportunity to make connections between concrete and abstract representations. Students should be able to carry out procedures, describe concepts, and communicate results. The mathematical tools that are appropriate for a particular grade level should be used strategically.

Examples of developing concepts and procedures in students can be found at: https://www.teachingchannel.org/videos/kindergarten-counting-cardinality-lesson

To see other examples, visit http://youcubed.org/category/teaching-ideas/growing-mindset/.

- **Claim 2 – Problem Solving** – The student can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem-solving strategies. (Associated Standards for Mathematical Practice: 1, 5, 7, 8)

Problem solving sits at the core of doing mathematics. Students who are proficient problem-solvers start by explaining the meaning of the problem to themselves and then look for an entry point. Students construct their own pathway through flexible thinking and the use of a variety of strategies, rather than having to follow a provided path to solve a problem. They use tools strategically and evaluate the reasonableness of their answers.

An example of high school students engaging in problem solving can be found at: https://www.illustrativemathematics.org/MP1

- **Claim 3 – Communicating Reasoning** – The student can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others. (Associated Standards for Mathematical Practice: 3, 6)

The content and practice standards often describe opportunities for students to construct and present a clear, logical, convincing argument. Students should have the ability to analyze a provided explanation, identify any flaws in the explanation, and then present, if needed, a logical sequence of proof or a complete, correct argument. Rigor
in reasoning is about the precision and logical progression of an argument. Communicating in precise language and symbols increases the strength of the argument.

An example of students communicating reasoning through discourse can be found at: http://vimeo.com/66204397

- **Claim 4 – Modeling and Data Analysis** – The student can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems. (Associated Standards for Mathematical Practice: 2, 4, 5)

Real-world problems do not come neatly packaged. They often are complex and contain too little or too much information. Students often have to model the problem to better understand how to solve it. As students use this abstract model to work through a solution, they must interpret the results and check for reasonableness in the context of the original problem.

An example of a Claim 4 mathematical task can be found at: https://www.illustrativemathematics.org/illustrations/114

These expectations for the Washington state assessment reflect the range of mathematical proficiencies students should exhibit.

**Struggling Students**

All students should receive high-quality instruction which includes the use of research-based materials and instructional methods implemented with fidelity. However, even with a high-quality, rigorous core program, no single program will meet the needs of all learners (Forbinger & Fuchs, 2014). “When the core program is effectively matched with the student population, the majority of students will successfully learn what is taught in the classroom…If screening data indicate that more than 20 percent of students in a school are struggling, then it is time to reexamine the core curriculum” (Forbinger & Fuchs, 2014, p. 65).

As a strategy for improving the achievement of struggling learners, accelerated learning operates in contrast to much remedial instruction. Too often, remedial instruction is slow-paced and concentrates only on lower-level skills. The goal of accelerated learning is to close the gap for struggling students as soon as possible by engaging them in concept-based mathematical experiences that focus on reasoning and sense-making. Accelerated learning strategies increase the amount of time spent on rich learning tasks. The pace of instruction should be rapid enough to keep students engaged and downtime should be minimized (Levin, 1988). Henry Levin, founder of the Stanford Accelerated Schools Project, has found that remediation actually slows students’ progress. Levin’s research suggests that remedial intervention models reduce learning expectations and marginalize students: once students are assigned to remedial interventions, their learning slows and the achievement gap, therefore, widens (Levin, 1987). Levin notes that the opposite needs to happen: “To close the
achievement gap, disadvantaged students must learn at a faster rate than other children. …[S]chooling interventions for the educationally disadvantaged must be based upon principles of accelerating their learning beyond their normal rate” (Levin, 1988, p. 3). In 1986, Dr. Levin founded the Accelerated Schools Project for economically disadvantaged students based on the principle that by “providing equal access to and deeper engagement with enriched learning experiences, schools could alter many students’ rate of learning” (Byrd & Finnan, 2003, p. 49).

Teacher expectations affect actual student behavior as a self-fulfilling prophesy (McKown, Gregory, & Weinstein, 2010). In fact, there is a large body of research that speaks to the power of expectations in shaping the behavior of others. Teachers form expectations of students based on their track placement that overrides the teacher’s awareness of individual academic capabilities (Ansalone, 2010). Therefore, students placed in intervention services or tracked with other struggling students may directly or indirectly produce outcomes in alignment with the teacher’s lowered expectations (McKown, Gregory, & Weinstein, 2010).

**Tracking**

Tracking students into courses by ability often begins formally as early as 6th grade or before. As described in the previous section, strategies to tailor instruction to students are valuable; however, tracking steadily increases the gap in content covered and exacerbates the disparity that already exists between advantaged and disadvantaged students. Lower tracks are more often presented with less of the intended curriculum (Ansalone, 2010). In fact, the same coursework covered in one year in a grade-level content class may be distributed over two or more years in a low-track class, thus increasing the gap in content covered (Worthy, 2010). This means that students in high-track classes make educational gains while students in low-track classes fall further behind (Gamoran, 1992). The differences in content covered between tracks could have implications for the futures of the students (Oakes, 1985). In general, students tend to remain in high- or low-level tracks year after year (Worthy, 2010). These students in low tracks are essentially “locked in” to the low-track level because topics omitted from instruction are prerequisites for advanced courses (Oakes, 1985).

In a study of actual class time devoted to instruction versus behavior management, routine procedures, and social activity, Oakes (1985) reported a clear difference in percentages of class time devoted to learning and instruction in high-track versus low-track mathematics courses. “Regardless of the causes of these differences, regardless of whether the students or the teachers or something else entirely is to blame, the actual circumstances of schooling are
such that these differences, in themselves, constitute an educational injustice if we believe that active student learning time is one of the most critical school-based contributions to achievement outcomes” (Oakes, 1985, p. 104). Time spent on learning, however, does not tell the whole story related to differences in student learning. Student learning rate is also a consideration. The time necessary for a student to master content is dependent on several factors, including the student’s aptitude, the quality of instruction, and the student’s language and cultural patterns (Oakes, 1985). It stands to reason, then, that students in low-track classes, especially minorities, are placed in an education “double bind” in which less time is spent on learning and more time is necessary to master the content (Oakes, 1985).

Burris and Welner (2005) argue that tracking should be systematically dismantled entirely. They believe that no student should be relegated to remedial classes with inferior instruction and watered-down curriculum. They provide evidence that by providing challenging, grade-level curriculum and instruction to all students, we may finally succeed in closing the achievement gap.

Detracking is a reform in which students are intentionally placed into heterogeneous classes. Rubin (2006) suggests that committed implementation of detracking increases academic opportunities for all students. “[T]he most successful instances of detracking combine deep structural reform with thoughtful pedagogical change, and are undergirded by an engagement with students’ and teachers’ beliefs around notions of ability and achievement. When these facets converge, the positive results for students are startling” (Rubin, 2006, p. 7). In fact, “[r]ecent research has demonstrated that methodical detracking from middle school through high school is linked to a narrowing of the racial achievement gap and an overall raising of achievement for all” (McKown, Gregory, & Weinstein, 2010, p. 269).

Identification and Progress Monitoring of Struggling Students

As part of a Learning Assistance Program (LAP), a student is eligible for services in mathematics if he/she does not meet standard on multiple measures of mathematics academic performance. Measures of mathematics academic performance may include school- and district-developed assessments, teacher observation, standardized assessments, and the state summative and interim assessments. The Smarter Balanced assessment (state summative assessment) is one measure that schools may use to determine whether a student is in need of supplemental education services and eligible for LAP. Students should be identified for supplemental services in mathematics based on performance on valid and reliable screening measures.
Norm-referenced, standardized tests assess multiple skill strands and generally provide the most detailed information about student performance. However, assessments should be selected thoughtfully to align with the depth and complexity of the state assessment. Performance on a progress monitoring assessment should be predictive of student achievement on the state assessment.

Curriculum-based measurements (CBMs), for example, may be valid and reliable measures for determining mathematics proficiency. CBMs can be scheduled frequently for progress monitoring purposes because they only take a few minutes to administer (Stormont, et al., 2012). Short assessments that focus on discrete skills and especially rapid recall, however, should be used with caution as these tools may not reflect the range of expectations of the state assessment. As an example, the Kentucky Numeracy Project (http://knp.kentuckymathematics.org) offers resources that assess children’s mathematical fluency in a more comprehensive manner. It is important to consider other mathematics data sources to triangulate assessment results. There is always the possibility that a screening measure may under-identify or over-identify students for services. The use of multiple assessments provides greater specificity in identifying students. This is of particular importance when schools have limited resources to serve struggling students (Stormont, et al., 2012). The National Center for RTI website (http://rti4success.org) houses resources for identifying valid and reliable screening and progress monitoring tools as evaluated by a technical review committee.

It is important that the interventionist or classroom teacher use data to monitor progress and inform instruction. “Ongoing data collection that is valid and reliable is necessary to determine progress in mathematics over time, and diagnostic data can inform changes that may need to be made....For many students, this monitoring occurs as often as weekly or at least every other week” (Stormont et al., 2012, p. 142). Stormont et al. (2012) describe error analysis and mathematics interviews as examples of ongoing assessments in mathematics. In mathematics interviews, “students talk through problems as they solve them, so a professional can assess online processing and identify where errors are being made” (p. 143).

Curriculum of Supplemental Services
Curriculum includes both the process and content of instruction. For struggling students receiving supplemental services, it is imperative that the instructional practices provide students the opportunity to engage in the Standards for Mathematical Practice. To accelerate the learning of struggling students, the content of instruction must focus on the major work of the grade. Serious planning and consideration of these content standards are intended to lead to the study of algebra and should be undertaken as a further focus of work to support career- and college-readiness. See http://achievethecore.org/file/1453 for more information on the major work for grades K–8 and the progression to algebra.

The Process of Instruction
The National Research Council (Kilpatrick et al., 2001) recommends that the process of instruction include a blend of explicit instruction with open-ended problem solving approaches
The National Research Council (Kilpatrick et al., 2001) argues for a blend of explicit instruction with open-ended problem solving approaches (Baker, Gersten, & Lee, 2002). Research further suggests that intervention instruction should be explicit and systematic (Gersten et al., 2009; Steedly et al., 2009). Struggling learners need systematic instruction that teaches them the strategies and techniques necessary to understand and learn new content (Steedly et al., 2008). Explicit instruction may include teacher modeling of solving a problem type through a variety of examples and then giving students practice with the newly learned skills through similar problems. Explicit instruction should also include opportunities for students to think aloud through their problem-solving steps and decision-making processes. Additionally, students must receive extensive corrective feedback for each new skill and opportunities for frequent cumulative review (Gersten et al., 2009).

**Mathematical Representations and Manipulatives**

Instruction at all grade levels should incorporate the progressive use of concrete manipulatives, representational models, and abstract symbols (Forbinger & Fuchs, 2014). Much of traditional mathematics instruction focuses on computation and students’ ability to apply procedures quickly and accurately. According to the National Council of Teachers of Mathematics (NCTM), procedural fluency, however, includes “the ability to apply procedures accurately, efficiently, and flexibly; to transfer procedures to different problems and contexts; to build or modify procedures from other procedures; and to recognize when one strategy or procedure is more appropriate to apply than another” (NCTM, 2014, p.1). This definition of procedural fluency pushes the bounds of traditional mathematics instruction, as it requires foundational knowledge of concepts, reasoning strategies, properties of numbers and operations, and problem-solving methods (NCTM, 2014b). The rigor of the state standards includes balancing conceptual understanding, procedural fluency, and problem solving. Instruction, then, must be balanced to address the mathematics content and practice standards through a variety of approaches.

The use of models or representations to manipulate and communicate about mathematical ideas supports students in making connections among mathematical ideas, understanding computations, and solving problems. The more ways that students have to think about and test ideas, the better their ability to integrate them into their current conceptual understanding to develop a deep relational understanding. “Strengthening the ability to move between and among representations improves students’ understanding and retention of ideas” (Van de Walle, 2013, p. 22).

Mathematical representations can include words, manipulatives, pictures, number lines, diagrams, equations, and tables and graphs of functions and relationships. For struggling
students, the introduction of new representations or tools should be explicit and systematic. Teachers should show how they can represent the mathematical ideas and encourage students to create their own representations and select from all of the tools they have at hand. Students should use representations to share and explain their thinking, and teachers should look for opportunities to help students make connections between different representations.

Manipulatives, or concrete objects, can be very helpful in developing conceptual understanding. Research indicates that students who used manipulatives in their mathematics classes have higher algebraic abilities than those who did not use manipulatives (Chappell and Strutchens, 2001). Studies show that using manipulatives is especially useful for teaching low achievers, students with learning disabilities, and English language learners (Marsh and Cooke, 1996; Ruzic and O’Connell, 2001). Research also shows that when students work with manipulatives and then are given a chance to reflect on their experiences, not only is mathematical learning enhanced, mathematics anxiety is greatly reduced. (Cain-Caston, 1996; Heuser, 1999). However, students who have good conceptual understanding but who do not know computational algorithms are not likely to benefit from further use of manipulatives. “Rather, they need explicit teaching of the algorithm and opportunities for practicing it with carefully chosen written examples. Some children find concrete manipulatives a source of distraction and may do much better with visual or pictorial representations” (Spear-Swerling, 2006).

Games
Mathematics games may be used for extended learning time to support instruction and to help students meet the state standards. “Many studies have found that game-based learning is an effective way to enhance students’ learning motivation and learning performance” (Chung-Hung et al., 2013, p. 271). According to a study by Chung-Hung et al. (2013), both game-based and video-based supplemental instruction has a positive impact on students’ mathematics performance.

Choosing which game to play depends on the instructional goal and learning target. Games can be used both for inquiry (instruction) and rehearsal (practice). Games may also give students the opportunity to apply new learning. Games may not be appropriate in all situations and are more effective if they are embedded in instruction and include debriefing and feedback. Also, games should be used as adjuncts and aids, not as stand-alone instruction (Hayes, 2005; Randel et al., 1992).

Mathematics Teaching Practices
In 2014, NCTM published a book, Principles to Actions: Ensuring Mathematical Success for All. The principles in this text represent “strongly recommended, research-informed actions for all teachers, coaches, and specialists in mathematics” (NCTM, 2014a, p. 4) including any interventionists who will be working to assist children in their mathematics study. These eight mathematics teaching practices reflect the range of instructional strategies and approaches necessary to promote deep learning of mathematics.
1. Establish mathematics goals to focus learning.
   “Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions” (NCTM, 2014a, p. 12).
2. Implement tasks that promote reasoning and problem solving.
   “Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies” (NCTM, 2014a, p. 17).
3. Use and connect mathematical representations.
   “Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematics concepts and procedures and as tools for problem solving” (NCTM, 2014a, p. 24).
4. Facilitate meaningful mathematical discourse.
   “Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments” (NCTM, 2014a, p. 29).
5. Pose purposeful questions.
   “Effective teaching of mathematics uses purposeful questions to assess and advance students’ reasoning and sense making about important mathematical ideas and relationships” (NCTM, 2014a, p. 35).
6. Build procedural fluency from conceptual understanding.
   “Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems” (NCTM, 2014a, p. 42).
7. Support productive struggle in learning mathematics.
   “Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships” (NCTM, 2014a, p. 48).
8. Elicit and use evidence of student thinking.
   “Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning” (NCTM, 2014a, p. 53).

These practices align with the state standards and prepare students to be college- and career-ready in the 21st century.

The Content of Instruction
From the What Works Clearinghouse Practice Guide for Assisting Students Struggling with Mathematics, Gersten et al. (2009) suggest that “intervention curriculum for at-risk students should not be over-simplified and...in-depth coverage of key topics and concepts involving
whole numbers and then rational numbers is critical for future success in mathematics” (Gersten et al., 2009, p. 18). This also aligns with the major work of each grade and the emphasis of “focus” in the Washington State K–12 Learning Standards. “[T]he coverage of fewer topics in more depth, and with coherence, is...important for students who struggle with mathematics” (Gersten et al., 2009, p. 18).

Fact fluency in elementary and middle grades is important because a limited understanding of facts and fact families impedes conceptual understanding of rational numbers. The What Works Clearinghouse Practice Guide for Assisting Students Struggling with Mathematics (Gersten et al., 2009) recommends that five to ten minutes of an intervention session be spent building proficiency with basic arithmetic facts. In grades 2 through 8, students should use arithmetic properties to solve complex problems involving multiplication and division. “[B]y teaching the use of composition and decomposition, and applying the distributive property to situations involving multiplication, students can increasingly learn how to quickly (if not automatically) retrieve facts” (Gersten et al., 2009, p. 39). “Number Talks” is a teaching strategy that engages students in mental mathematics exercises that challenge students to think flexibly about number properties and operations to solve problems. For more information on number talks see: http://www.insidemathematics.org/classroom-videos/number-talks, http://www.mathperspectives.com/num_talks.html.

As mentioned above, the content of instruction must focus on the major work of the grade, especially the progression of the major work that leads students to success in algebra. “[T]he critical foundations of algebra should be taught in sequential order throughout the grades” (Stormont, Reinke & Herman, 2012, p. 126). Any intervention that prepares students for success in algebra must include the simultaneous development of conceptual understanding, computational fluency, and problem-solving skills.

There are many ways to build a foundation for algebra. As one concrete example of building flexible fluency and algebraic foundations, consider that practicing arithmetic combinations in traditional form only actually harms students (McNeil, 2008; McNeil, Fyfe, Peterson, Dunwiddie, & Brletic-Shipley, 2011). That is, consider student who practice only combinations such as $2 + 6 = \_\_\_\_$ and $5 + 4 = \_\_\_\_\_\_$.

The more children engage in such traditional practice, the lower their scores on equivalence problems such as $2 + 6 + 3 + 4 + 6 = 3 + 4 + \_\_\_\_\_\_$.$ U.S. students as a whole get worse on such problems from 7 to 9 years of age. They learn limited ideas such as “the equals sign
means compute and put in the answer.” Students who practice using different formats do better on all these competencies.

**Intervention Materials**

From the What Works Clearinghouse Practice Guide for Assisting Students Struggling with Mathematics, Gersten et al. (2009) suggest that intervention materials be reviewed by experts knowledgeable in mathematics instruction. Materials should meet four criteria:

1. The materials integrate computation with solving problems and pictorial representations rather than teaching computation apart from problem-solving.
2. The materials stress the reasoning underlying calculation methods and focus student attention on making sense of the mathematics.
3. The materials ensure that students build algorithmic proficiency.
4. The materials include frequent review for both consolidating and understanding the links of the mathematical principles. (p. 20)

A systematic curriculum builds proficiency gradually by presenting content in a logical sequence with multiple models to solve problems, numerous opportunities for practice and application, and sample think-alouds for explaining concepts and the reasoning behind the procedures (Gersten et al., 2009).

Interventionists should be highly trained in the State Standards, the Standards for Mathematical Practice, the Mathematics Teaching Practices, the core curriculum, as well as the supplemental curriculum.

For interventionists to explain a mathematical process accurately and develop a logical think-aloud, it is important for them to understand the underlying mathematics concept and the mathematical reasoning for the process. Professional development should provide participants with in-depth knowledge of the mathematics content in the intervention, including the mathematical reasoning underlying procedures, formulas, and problem-solving methods...[W]hen interventionists convey their knowledge of the content, student understanding will increase, misconceptions will decrease, and the chances that students solve problems by rote memory will be reduced. (Gersten et al., 2009, p. 24)


**Resources**


Center on Instruction: [www.center-on-instruction.org/index.cfm](http://www.center-on-instruction.org/index.cfm)
References


MENU OF BEST PRACTICES AND STRATEGIES

Overview

The expert panel worked together to develop a comprehensive menu of best practices and strategies based on the most current evidence and rigorous research available. Panelists concurred with WSIPP to use the following definitions for evidence-based, research-based, and promising practices.

Evidence-based

A program or practice that has been tested in heterogeneous or intended populations with multiple randomized, or statistically controlled evaluations, or both; or one large multiple site randomized, or statistically controlled evaluation, or both, where the weight of the evidence from a systemic review demonstrates sustained improvements in at least one outcome. "Evidence-based" also means a program or practice that can be implemented with a set of procedures to allow successful replication in Washington and, when possible, is determined to be cost-beneficial.

Research-based

A program or practice that has been tested with a single randomized, or statistically controlled evaluation, or both, demonstrating sustained desirable outcomes; or where the weight of the evidence from a systemic review supports sustained outcomes [...] but does not meet the full criteria for evidence-based.

Promising

A practice that, based on statistical analyses or a well-established theory of change, shows potential for meeting the evidence-based or research-based criteria.

RCW 71.24.025

The mathematics menu lists practices and strategies that have been shown to support mathematics improvement for struggling learners. Many of these strategies and practices are used in commercially available supplemental programs that districts can acquire and use. It is important to note that the work of the expert panel was to identify proven general practices and strategies, not specifically branded programs that might employ those practices. Districts that are contemplating acquisition or use of one or more branded programs are encouraged to determine if the strategies and practices included in the menu are utilized by the branded programs and positively impact student achievement.

The table below shows a summary of the practices that are proven to be effective in strengthening student educational outcomes, as determined by the expert panel. Each practice is described in more detail later in the report.
Table 1: Menu of Best Practices and Strategies for Mathematics

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Level of Evidence</th>
<th>Panel Opinion</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tutoring</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tutoring by an Adult*</td>
<td>Evidence-based</td>
<td>100%</td>
<td>26</td>
</tr>
<tr>
<td>Peer/Cross-Age Tutoring*</td>
<td>Research-based</td>
<td>100%</td>
<td>28</td>
</tr>
<tr>
<td><strong>Extended Learning Time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer Learning*</td>
<td>Evidence-based</td>
<td>100%</td>
<td>32</td>
</tr>
<tr>
<td>Double-Dosing*</td>
<td>Evidence-based</td>
<td>100%</td>
<td>33</td>
</tr>
<tr>
<td><strong>Professional Development</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Targeted Professional Development*</td>
<td>Evidence-based</td>
<td>100%</td>
<td>37</td>
</tr>
<tr>
<td>Professional Learning Communities</td>
<td>Promising</td>
<td>86%</td>
<td>41</td>
</tr>
<tr>
<td><strong>Consultant Teachers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructional Coaches*</td>
<td>Research-based</td>
<td>100%</td>
<td>46</td>
</tr>
<tr>
<td><strong>Family Involvement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Involvement Outside of School</td>
<td>Promising</td>
<td>100%</td>
<td>49</td>
</tr>
<tr>
<td>Family Involvement at School</td>
<td>Promising</td>
<td>100%</td>
<td>50</td>
</tr>
<tr>
<td><strong>Community Partnerships</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Student Mentoring by a Community Partner*</td>
<td>Research-based</td>
<td>71%</td>
<td>55</td>
</tr>
<tr>
<td><strong>Services Under RCW 28A.320.190—</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Extended Learning Opportunities Program</td>
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<td></td>
</tr>
<tr>
<td>Credit Retrieval</td>
<td>Promising</td>
<td>86%</td>
<td>58</td>
</tr>
<tr>
<td>Transition to High School</td>
<td>Promising</td>
<td>100%</td>
<td>59</td>
</tr>
</tbody>
</table>

*These practices have been identified by WSIPP (2015) as evidence-based or research-based.
TUTORING
Tutoring is defined as any interaction with a trained individual using an explicit, well-designed program or practice that is a match to a student’s needs. The continuous use of ongoing formative assessments should be utilized in the identification of individual student learning needs and to allow for differentiation strategies. Tutoring can help address the needs of students who struggle to understand concepts and skills they may not have mastered in earlier years (Wood et al., 1996).

Tutoring sessions should be aligned to classroom instruction and should never replace core instruction. Shorter sessions, multiple times per week, allow the students who need more intensive instruction to become proficient in the relevant concept or topic. Tutors and classroom teachers should work closely in the identification of specific content students need to be successful on grade-level standards.

Successful tutoring systems include attention to the Standards for Mathematical Practice, which emphasize active student learning, collaborative problem solving and question-answering, and deep explanatory reasoning. Tutors can serve as a bridge between existing knowledge and skills and the demands of engaging in rich tasks (Wood et al., 1996).

Competent tutors have substantial content knowledge, extensive training in effective tutoring techniques, and several years of experience. However, most tutors in a school system are peers of the students, slightly older students, paraeducators, and adult volunteers – not highly skilled teachers (Fitz-Gibbon, 1977).

Research on student success in a tutoring setting illustrates the importance of relationships among students, teachers, administrators, and the community, (Feldman & Ouimette, 2004; Jackson, 2009) as well as high expectations for all students (Cassellius, 2006). In a study by Caskey (2011), the use of in-district tutors significantly impacted student performance. The nature of the teacher-student relationship, the acknowledgement of student effort, and establishment of high expectations (e.g., conveying the message from the beginning that they were selected due to the likelihood of success) may have contributed to student success. Whether the curriculum affected student success is unknown, but having caring, committed educators appears to influence student engagement and success (Caskey, 2011). Caring teachers encourage and support students in developing and gaining confidence in their mathematical abilities and students learn that they can achieve success through dedication and hard work.

Tutoring by an Adult
Adult tutors, who receive specialized training in mathematics instruction, are an asset to the development of a comprehensive mathematics program. From one-on-one instruction to small group instruction, tutors can help students with concept and skill development. Carefully selected adult tutors can include specially trained teachers, intervention specialists, paraeducators, other classified personnel, and volunteers. Research has consistently shown that a tutoring program can contribute to the academic growth of students if it is well-
structured and includes professional training centered on best practices in mathematics instruction.

Tutoring sessions should be aligned to core classroom instruction and should never replace core instruction. Shorter sessions, multiple times a week, allow the students who need more intensive instruction to become proficient in the relevant concept or topic. With evidence-based, reliable, and replicable interventions specific to the diagnostic information provided by assessments administered at the beginning and throughout the program, students’ understanding of mathematics concepts and skills will improve. Through these carefully orchestrated processes and organized system-wide structures, students who require more intensive mathematics instruction will develop proficiency.

One-on-one tutoring and small-group tutoring (six or fewer students) have both been found to have positive effects on student achievement. In WSIPP’s inventory of evidence-based and research-based practices, one-on-one tutoring by an adult in a structured tutoring program was found to be evidence-based with an 87 percent cost-benefit percentage. The cost-benefit percentage indicates that the benefits to future economic consequences outweigh the costs of implementing a structured one-on-one tutoring program (Washington State Institute for Public Policy, 2014).

Two meta-analyses of small group tutoring were reviewed by the panel. Results indicated small group instruction is effective for at-risk students and students with learning disabilities. Lou et al. (1996) determined that small group instruction was most effective when groups consisted of three to four students, teachers received extra training and extra materials, and the intervention was intensive. Elbaum et al. (1999) found that small groups outperformed students in 23 whole-class instruction settings by 1.5 standard deviations, while those in student pairs only outperformed those in whole-classroom settings by 0.4 standard deviations. These reviews indicate small group instruction is an effective means of intervening with poor-performing students. In some cases, it may be more effective than student pairs, especially when the groups are composed of five or fewer students.

The results of a study conducted by Ellis (2014) provided empirical evidence that there exists a significant relationship between the intervention of small group tutoring and students' mathematics achievement scores. Results for the correlations showed significant, positive differences in achievement scores for students in the experimental group who received the treatment of small group tutoring as compared to the students in the control group who did not receive the treatment.

**Implementation Success Factors**
- Design and implement a highly structured program where knowledge is constructed from the integration of previously learned and newly acquired skill sets (Gordon, 2007).
- Provide tutors with professional development opportunities and specialized training to ensure that students are supported at all levels of learning (Gordon, 2007).
• Ensure an educational atmosphere (Gordon, 2007). A quiet, well-lit area that provides ample seating for the participants and the leader is essential. Ensuring a setting where minimal distractions occur is essential for helping the tutor understand each child’s learning ability (Gordon, 2007).
• Throughout the tutoring, the tutor must collaborate with the classroom teacher or program administrator to demonstrate short-term and long-term improvement (Gordon, 2007). A continuation of communication should extend to each stakeholder in the individual child’s education, including the parents/guardians.
• Tutoring by an external provider with limited connections to core classroom instruction is not recommended.

Peer and Cross-Age Tutoring
Peer tutoring can be classified in a number of ways. Peer tutors may include students who are in the same class or age group, or may be cross-age tutors. Peer tutoring can be effective if the peer is trained in practices such as following directions, using prompting and reinforcement, providing effective feedback, and systematic error correction (Center for Prevention Research and Development, 2009).
Like any intervention for students struggling in mathematics, peer-tutoring should not be solely skill-based. Students should have the opportunity to engage in rich mathematics tasks to develop conceptual understanding. Peer tutors should be trained to engage tutees in critical thinking, problem solving, and mathematical discourse.
The practice of peer tutoring is widely supported because it improves learning for both the tutor and the student receiving the tutoring (Topping, 2008). As Hattie notes, research demonstrates that peer tutoring has numerous “academic and social benefits for both those tutoring and those being tutored” (Hattie, 2009). Peer tutoring is, in fact, especially effective in improving peer relationships, personal development, and motivation (Topping, 2008).
Baker, Gersten, and Lee (2002) summarize the benefits of peer tutoring:

Using peers as tutors or guides enhances achievement. Research shows that the use of peers to provide feedback and support improves low achievers’ computational abilities and holds promise as a means to enhance problem-solving abilities. If nothing else, having a partner available to provide immediate feedback is likely to be of great
benefit to a low achiever struggling with a problem. A crucial feature of this approach is that the topics being covered are the ones on which curriculum-based measurement data suggest areas where a student needs extra practice and support. (p. 67-68)

In addition to one-on-one peer tutoring or cross-age peer tutoring, in which the roles of tutor and tutee are static and defined by ability or age, reciprocal peer tutoring can also be used to increase learning time. Reciprocal peer tutoring is an intervention strategy where students alternate between the tutor and the tutee. Whenever reciprocal peer tutoring is used, keeping the group small is important. Most importantly, when implementing reciprocal tutoring arrangements, administrators should combine organized structures and group-reward contingencies to experience positive results (Fantuzzo and Rohrbeck, 1992). The teacher who is monitoring the peer tutors should determine the selection of tutoring groups based on the goal of the activities.

**Implementation Success Factors**

- As with adult tutors, peer tutors must receive opportunities for developing their skills as a tutor. Peer tutoring can be effective if the peer is trained in practices such as following directions, using prompting and reinforcement, providing effective feedback, and systematic error correction (Center for Prevention Research and Development, 2009). Peer tutors must be versed in content, skills, and cultural competencies (Barley et al., 2002; Bixby et al., 2011; Center for Prevention Research and Development, 2009).
- Programs that use peer tutors, or students teaching other students, must be facilitated with structures that are put in place by a qualified teacher or trained coordinator.
- Student tutors should be trained to model study skills, communication skills, work habits, questioning skills, and other helpful educational behaviors.
- Tutors should be trained not only in skill implementation, but also in social behaviors that allow for an appropriate, effective learning environment.
- Peer tutoring should reflect the Standards for Mathematical Practice, including problem solving, reasoning, and discourse, as opposed to being primarily skill-based.
- Peer tutoring is more effective with heterogeneous groups.

**Resources**

- [Peer and Cross-Age Tutoring](http://www.educationnorthwest.org) from Education Northwest
- *Growth Mindset and Motivation*, Carol Dweck, Stanford University

Research in educational psychology has illustrated the importance of motivation in relation to achievement. Dr. Carol Dweck from Stanford University has been a pioneer in this field of study. Watch the short video and answer the questions. Give careful
consideration as to how Dweck’s work can be used within the context of tutoring: http://ed.ted.com/on/UA77F1Tc

References


Center for Prevention Research and Development. (2009). *Background research: Tutoring programs*. Champaign, IL: Center for Prevention Research and Development, Institute of Government and Public Affairs, University of Illinois.


EXTENDED LEARNING TIME

Extended day learning programs can be an effective way for students to solidify mathematics instruction that has taken place during the regular school day and receive extra practice and time on those concepts and skills. Extending the day is intended to increase the amount of academic learning time for a student in an area of targeted need. Research indicates that increasing the amount of learning time can result in “reducing learning loss, learning gaps, and achievement gaps” (Hidden Curriculum, 2014). Extended day learning occurs outside the required basic education allotted time period and can include before-school hours, during a non-academic time, after-school hours, and during the summer. The practice of extended day learning can be a short 10-minute burst of instruction, up to 1.5 hours as extended through an after-school program, or a longer period during summer months. To be effective, extended learning time should not be punitive nor take away from students’ recess time.

Extended day learning programs should be well designed with services provided by certified teachers or well-trained professionals. Programs focusing on mathematics content or skills that were taught during the regular school day can reinforce the learning of this content. In addition, regular and close communication with the students’ classroom teacher will ensure instruction stays focused. A well-designed extended day program can show gains in students’ achievement and test scores in core subject areas such as mathematics (Afterschool Alliance, 2011). More information on research and best practices for extended learning can be found in the Tutoring section of this report.

Parsley (n.d.) states that extended day learning programs in mathematics should include a focus on problem solving, math talks, and collaborative work amongst students. In addition, further research suggests hands-on and engaging activities, mathematics centers for individual and group work, instruction that connects to real-world problems, and family connections contribute to students’ overall success during extended learning time.

Summer Programs

According to McCombs et al. (2011), summer learning loss equates to approximately one month of instruction. This means that in the fall, students perform, on average, one month behind their spring performance. However, not all students experience ‘average’ learning loss, and summer learning loss disproportionately affects low-income students. Repeated episodes of summer learning loss results in low-income students falling further behind, and learning loss for mathematics is, on average, greater than that for reading. An academic summer program has the potential to minimize learning loss and even positively impact academic achievement.
Both mandatory and voluntary academic summer programs have been shown to be effective, especially for mathematics (McCombs et al., 2011). Research shows that smaller class sizes (20 or fewer students) for summer programs are more effective in producing achievement gains and instructional quality is directly related to improved achievement. Summer instruction should be aligned to the regular school-year curriculum. “This content alignment can take two forms. First, the content of summer programs might be aligned with that of the prior grade to provide remediation on core concepts that students have failed to master. Second, the content could align to the upcoming school year so that students have previewed core concepts and have a head start toward mastery” (McCombs et al., 2011, p. 33).

Summer programs must be engaging and rigorous. Instruction must go beyond drill and practice to include “expanded learning through innovative instruction that accelerates learning” (McCombs et al., 2011, p. 33). Summer programs should also involve parents and be of sufficient duration. Programs should be a minimum of 80 hours of instruction and may be as long as 360 hours (McCombs et al., 2011).

Implementation Success Factors
A well-implemented extended day program consists of many components that improve academic performance:

- Teachers or trained professionals should be familiar with the students’ academic program needs (Hidden Curriculum, 2014).
- Provide professional development to teachers to improve quality and consistency (McCombs, 2011).
- Program should offer a lower student-to-instructor ratio than the regular school day (McCombs, 2011).
- Program should build and maintain parent outreach and buy-in (McCombs, 2011).
- Programs should incentivize student participation (McCombs, 2011).
- Program should create a ‘summer culture’ promotes a sense of community (McCombs, 2011).
- Extended day programs should not rely too heavily on online activities.

Resources
Illustrative Mathematics
Inside Mathematics
Illuminations (NCTM)

Double Dosing
Double dosing provides students with more time to learn the mathematics they need to meet their grade-level standards in mathematics. This takes place in addition to their regular classroom instruction. Often in elementary schools, double dosing happens during the school day through tutoring or small group instruction. The small group receives about 30 minutes of
focused instruction. The results of a study with at-risk students, whose double dose was tightly aligned with their core mathematics instruction, performed the best (Newman-Gonchar, Clarke, & Gersten, 2009).

As research around the importance of rigorous mathematical course-taking emerges, double dosing is a strategy used often in secondary schools to provide support to low-achieving students. Double dosing is often used with a first-course algebra class, where students take an extra period of algebra to support the regular algebra course. Across the United States, several different formats for double dosing exist where typically the regular course consists of students with mixed ability, with the additional course occurring in a variety of formats: consecutive to the regular course or a different period of the day, taught by the same or different instructor (Kratofil, 2014).

The strongest impact of the double-dose algebra intervention was for students that were just below grade-level proficiency rather than students with the most severe gaps in mathematics. While the impact of intervention may not result in necessarily lower rates of failing for algebra, evidence exists that points to students who had a double dose saw an impact on future course-taking and improved graduation rates and standardized test scores. This seems to be especially true if the intervention infuses supporting conceptual development with an emphasis on academic discourse along with skills development (Cortes et al., 2014).

Success with extended learning time depends on how effectively the time is used and is dependent on quality mathematics instruction during the existing regular classroom time. It is more effective with students of lower socio-economic status, and research shows that it has been more effective in primary and high school grades.

Secondary Considerations
Since double dosing often requires a loss of a student’s elective course options, there should be careful consideration when selecting students who may benefit from an extra mathematics course. Students who are significantly below grade level may require a more intensive intervention and may not be the best candidates for double dose intervention.

Elementary Considerations
Successful programs are evidence-based and data-driven and involve support from parents and community members. They need to be aligned with core instruction and involve teacher leadership and commitment. Promising research suggests students respond positively to self-regulation learning strategies during such an intervention (Newman-Gonchar, Clarke and Gersten, 2009).
Implementation Success Factors

- Teachers or trained professionals should be familiar with the students’ academic program needs (Hidden Curriculum, 2014).
- Development of conceptual understanding as well as skills is important in successful implementation of a double dose.
- Students often need to strengthen their ability to persevere in mathematics and a belief that they can be successful in mathematics.
- Double dose interventions should be tightly aligned to core instruction, but not a direct repeat of core instruction, and include conceptual development.
- Double dose interventions should not be portrayed as punitive.

References


PROFESSIONAL DEVELOPMENT

Professional development for the Learning Assistance Program may be provided for professionals working with LAP students on topics relevant to the needs of struggling learners. According to WSIPP’s inventory of evidence-based and research-based practices for LAP (2014), targeted professional development was determined to be evidence-based with an 84 percent cost-benefit percentage. Targeted professional development refers to a focus on improving teaching practices in a particular content area and/or a particular grade level. General, not-targeted professional development was determined by WSIPP to produce null or poor outcomes and is not included in this Menu of Best Practices and Strategies (Washington State Institute for Public Policy, 2014). Professional learning communities also has a strong research base and may be support by LAP for educators working with LAP students on topics relevant to the needs of struggling learners.

Targeted Professional Development

The Common Core State Standards require changes to traditional instructional practices for mathematics. A comprehensive system of professional development that addresses instructional approaches is necessary to “help teachers understand the difficulty and complexity of implementing new practices” (Killion, 2012, p. 8). Mathematics teaching practices must promote deep learning of mathematics. The National Council of Teachers of Mathematics (NCTM) recommends eight Mathematics Teaching Practices for strengthening the teaching and learning of mathematics (National Council of Teachers of Mathematics, 2014a). These teaching practices are described earlier in this technical report and include establishing mathematics goals to focus learning, implementing tasks that promote reasoning and problem solving, using and connecting mathematics representations, facilitating meaningful mathematics discourse, posing purposeful questions, building procedural fluency from conceptual understanding, supporting productive struggle in learning math, and eliciting and using evidence of student thinking. “To create dynamic, engaging, high-level learning for students, teachers’ expertise must expand well beyond basic content knowledge and pedagogy” (Killion, 2012, p. 12). This expertise is critical for all education professionals working with struggling students.

A recent review of the most current research on best practices in professional development, “Professional Learning in the Learning Profession” (Darling-Hammond, Wei, Andree, Richardson, & Orphanos, 2009), notes that professional development is most effective when it is targeted to address specific content that has been explicitly tied to goals for student achievement and school improvement. Professional development shown to improve student achievement is focused on “the concrete, everyday challenges involved in teaching and learning specific academic subject matter, rather than focusing on abstract educational principles or teaching methods taken out of context” (Darling-Hammond et al., 2009, p. 10). Further, effective professional development should be aligned to learning standards and/or instructional strategies, and must be aligned to the needs of learners.
Evidence suggests that, in order to positively impact student achievement, professional development must be contextualized and sustained; that is, effective professional development must be provided as an ongoing, systematic process informed by evaluation of student, teacher, and school needs, and embedded within a comprehensive plan for school improvement (Darling-Hammond et al., 2009; Garet, Porter, Desimone, Birman, & Yoon, 2001; Yoon, Duncan, Lee, Scarloss, & Shapley, 2007). As noted by McREL’s (Snow-Renner & Lauer, 2005) report “Professional Development Analysis,” professional development that is long-lasting, content-focused, and based on student and teacher performance data, takes more time and effort to implement when compared to less effective types of professional development. Innovative professional development that is transformative for teachers—that helps teachers reconstruct their practice in order to promote more lasting, conceptual student learning—is far more extensive and demanding (Thompson & Zeuli, 1999). Instead of “make it and take it” workshops, or formulaic introductions to new teaching techniques, transformative professional development asks teachers to carefully scrutinize mathematics, and mathematics teaching and learning (Fennema & Nelson, 1997; Schifter & Fosnot, 1993; Simon & Tzur, 2004).

According to Joyce and Showers (2002), professional development should consist of a continuum in which participants receive a presentation of the theory, see demonstrations, practice and receive feedback around an applied practice, and are ultimately provided with coaching or other classroom supports to self-evaluate with the goal of positive growth. In a study by Weiss and Pasley (2006), it was found that “impacts on teachers and their teaching were typically evident after approximately 30 hours of PD, with further impacts detected through 80 hours of PD” (p. 14). But as Garet et al. (2001) state, “[a] professional development activity is more likely to be effective in improving teachers’ knowledge and skills if it forms a coherent part of a wider set of opportunities for teacher learning and development” (p. 927).

**Targeted Professional Development Focused on Mathematical Knowledge for Teaching**

Mathematics professional development should be rich in learning experiences that deepen teachers’ content knowledge. This content knowledge should be related to the content taught as opposed to advanced mathematics content, such as calculus. Hill, Rowan, & Ball (2005) found that teachers’ mathematical knowledge was significantly related to student achievement gains in 1st and 3rd grades after controlling for key student- and teacher-level covariates. In a project coordinated by the University of Arizona, mathematics education experts developed
progression documents that describe the progression of a mathematics content topic across grades, informed both by research on cognitive development, and by the logical structure of mathematics (Common Core Standards Writing Team, 2013). The progression documents “note key connections among standards, point out cognitive difficulties and pedagogical solutions, and give more detail on particularly knotty areas of the mathematics” (Common Core Standards Writing Team, 2013, p. 4). The progressions documents are intended to inform teacher preparation and professional development on the mathematical knowledge for teaching. These learning progression documents are tools which help teachers understand the missing foundational skills from prior grade levels and define what students should learn next. A deep understanding of these learning progressions is critical for teachers working with students who are performing below grade level. For more information, see http://ime.math.arizona.edu/progressions/.

Mathematics educators and researchers have noted that innovative instructional materials, on their own, can only go so far toward promoting students’ deep and powerful mathematical learning. To make effective use of instructional materials, teachers need to develop not only an understanding of the “learner-centered” pedagogy that underlies the materials (Bransford, Brown, & Cocking, 1999) but also, importantly, a deep and flexible understanding of the mathematical ideas involved (Ball & Bass, 2000; Ma, 1999).

Targeted Professional Development Focused on Mathematical Instructional Strategies: Studio Classroom/Studio Days
The mathematics Studio Classroom or Studio Day is a form of professional learning designed to support teacher reflective practice and the transfer of specific instructional strategies from workshop learning to classroom practice. All mathematics studio work emphasizes deepening teachers’ knowledge of the content needed to effectively teach mathematics (Ball, Hill and Bass, 2005; Ball, Thames and Phelps, 2008).

The studio model has similarities to Japanese lesson study in that teachers collaboratively observe and analyze a lesson. Unlike lesson study, studio work focuses teachers’ attention on public work with students as a way to reflect and refine evidence-based mathematically productive instructional strategies – putting the emphasis on improving practice versus improving a whole lesson (Kazemi, Franke & Lampert, 2009).

During a mathematics studio day, teachers typically do the mathematics task/lesson together before observing the studio teacher’s instruction. They share their own mathematical thinking and approaches, and consider how students might engage with the task. The teachers use a protocol to focus their instructional observation and post-observation discussion on specific instructional strategies and approaches that are part of a coherent professional learning program.

Targeted Professional Development Focused on the Use of Data to Guide Instruction
A number of recent studies have demonstrated that professional development on the use of student data to guide instruction has a positive impact on student achievement. This research suggests that it is essential that teachers are trained to collect data on student performance
and use this data to develop learning goals and inform instructional practices. Professional development that is focused on supporting teachers in these kinds of practices has been shown to make instruction more effective and improve student learning. For example, in Al Otaiba et al. (2011), a randomized controlled study demonstrated that teachers provided more effective differentiated instruction after being trained to use data to develop and provide individualized instruction. According to the study, this improved instruction resulted in higher student achievement. Further, WSIPP’s meta-analysis of all available studies found an overall positive effect of using data to guide instruction on student academic outcomes.

Formative assessment processes can be a means for educators to use data to guide instruction. Formative assessment can be defined as a “cycle of instruction,” (Sawchuk, 2011) which includes gathering data, analyzing data, designing instruction, providing feedback to the learner, and giving opportunities for the learner to revise their work (Sawchuk, 2011; Stiggins, 2008; Wiliam et al., 2004; Wisconsin Center for Education Research). Formative assessment is conducted while the students’ learning is forming; it is diagnostic and informal in nature. A strong research base exists that supports the effectiveness of formative assessment. Black & Wiliam’s (1998) research on formative assessment shows that utilizing this technique, “produces significant and often substantial learning gains” (p. 3). In addition, according to Stiggins (2006) “…while all students show achievement gains, the largest gains accrue to the lowest achievers” (p. 37).

Professional Development in formative assessment should include the following features in order to be most effective:

- Teachers should possess a deep content knowledge in order to be able to determine students’ misconceptions and then design appropriate instruction (Sawchuk, 2011).
- Professional development should include strategies to analyze and determine the quality of assessments that align with the learning targets and standards being taught.
- Professional development should include collaborative work, possibly through a Professional Learning Community (PLC) model described later in this report, with an opportunity to apply the learning directly to the classroom and reflect together on the practice (Trumbull & Gerzon, 2013).

Implementation Success Factors
Planning for professional development should be systematic, explicit, and based upon rigorous data analysis. Effective professional development should be job-embedded, which provides context and focus for the learning (Knowles, 1983).

Effective professional development is:

- Delivered by well-trained providers (Weiss & Pasley, 2006).
- Of considerable duration—time spent in theory, demonstration, practice and feedback, and classroom support (Darling-Hammond et al., 2009; Yoon et al., 2007).
• Focused on specific content and/or instructional strategies rather than a general approach (Darling-Hammond et al., 2009).
• Part of a coherent program clearly aligned with school improvement goals and student achievement standards (Darling-Hammond et al., 2009; Yoon et al., 2007).
• Focused on the modeling of strategies for teachers and opportunities for “hands-on” work that builds knowledge of content (Garet et al., 2001; Supovitz, Mayer & Kahle, 2000; Yoon et al., 2007).
• Collaborative; it involves building of relationships among teachers (Darling-Hammond et al., 2009).

Professional Learning Communities
A large body of rigorous research suggests that the most effective professional development should involve relationship-building among teachers. While this research does not involve comparison-group studies, evidence in support of professional learning communities (PLCs) is credible, large-scale, longitudinal, and empirical (Darling-Hammond et al., 2009; Hord, 1997; Newmann & Wehlage, 1995). In fact, in Learning Forward’s (Darling-Hammond et al., 2009) recent review and analysis of the most credible research on effective professional development, “collaboration” is one of four identified characteristics of the kind of professional development that positively impacts student achievement. As the authors of the report write, “[a] number of large-scale studies have identified specific ways in which professional community-building can deepen teachers’ knowledge, build their skills, and improve instruction” (Darling-Hammond et al., 2009, p. 11). The development and utilization of professional learning communities as a strategy for professional development capitalizes on the positive effects of collaborative learning.

A professional learning community, or PLC, can be defined as a group of teachers, administrators, coaches, or school staff (or a combination of people in these roles) that meets on a regular, planned basis with the goal of collaboratively improving practices in the classroom and school in order to improve student learning outcomes. Shirley Hord (1997) provides a simple definition: “[p]rofessionals coming together in a group—a community—to learn.” As Richard DuFour (2008) notes, however, effective PLCs must be developed and implemented on the basis of clearly articulated shared goals for student achievement and school improvement. According to DuFour (2008), an effective professional learning community is more than just a given group of educators. A PLC needs to work collaboratively as part of a coherent, comprehensive improvement plan, developed in response to an evaluation of student learning data, focused on a shared vision, and in the service of a clear set of goals for improved student achievement.
Implementation Success Factors

- Clear and shared mission, vision, values, and goals (DuFour, 2008): Teachers, paraeducators and administrators share a vision focused on student learning and a commitment to improvement (Reichstetter, 2006).
- Collaborative culture: “A PLC is composed of collaborative teams whose members work interdependently to achieve common goals—goals linked to the purpose of learning for all—for which members are held mutually accountable” (DuFour, 2008, p. 15).
- Focus on examining outcomes to improve student learning: A central component of PLCs is a focus on continuous improvement that is driven by outcome data. Data is continually scrutinized and improvements to teacher practice are made when growth in student outcomes is not demonstrated (Louis, 2006).
- Action orientation: PLCs have a strong focus on bridging the knowing-doing gap. As DuFour (2008) notes, within PLCs, “aspirations are turned into action and visions into reality” (p. 16). Using the continuous improvement model, each action is evaluated for effectiveness. The central question is whether this action resulted in improved outcomes for students.
- A meeting of a small group of teachers does not constitute a PLC unless the teachers have a clear agenda and protocol for impacting student outcomes.

Coaching

Coaching is a LAP-allowable form of professional development. For more on coaching as a best practice, see the section on Consultant Teachers.

References


Hord, S. (1997). *Professional learning communities: What they are and why they are important?* Austin, TX: Southwest Educational Development Library.


CONSULTANT TEACHERS

In this document, consultant teachers are defined as mathematics specialists, such as Mathematics Instructional Coaches, who work with educators. Recent reports have suggested that school-based mathematics specialists, leaders, or coaches may support the improvement of mathematics teaching and learning in schools by targeting teachers’ understanding and action (e.g., National Council of Teachers of Mathematics [NCTM], 2000; National Mathematics Advisory Panel, 2008; Kilpatrick et al., 2001). The intent is for a knowledgeable colleague with a deep understanding of mathematics and of how students learn, as well as pedagogical expertise, to serve as an on-site resource and leader for teachers. The role of a mathematics coach is to break the culture of teacher isolation whereby teachers work in private, without observation or feedback, and to collaborate with other professional development efforts in order to increase a school’s instructional capacity (Neufeld & Roper, 2003). Many rural areas are turning to on-site teacher leaders as a means of offering leadership to small populations of teachers spread over large geographical areas, and a number of urban districts are positioning mathematics coaches within their schools in an effort to advance test scores (Keller, 2007).

Instructional Coaches

Instructional coaches partner with teachers to help them incorporate research-based instructional practices into their teaching. They are skilled communicators who work with teachers to improve student learning. A mathematics coach is an individual who is well-versed in mathematics content and pedagogy and who works directly with classroom teachers to improve student learning of mathematics. An instructional coach must be prepared to take on a collegial, non-evaluative role and serve as a leader in the school and/or building. Mathematics instructional coaches may be expected to:

- **use mathematics-focused instructional leadership skills to improve mathematics programs at the school and district levels, e.g., serve as coach/mentor/content facilitator – providing feedback to colleagues to strengthen practice and improve student learning; develop appropriate classroom- or school-level learning environments; build relationships with teachers, administrators and the community; collaborate to create a shared vision and develop an action plan for school improvement; establish and maintain learning communities; partner with school-based professionals to improve each student’s achievement; mentor new and experienced teachers to better serve students. (AMTE, 2013, p. 9)**

This definition describes the expectations for an effective mathematics coach. According to Polly, Mraz, and Algozinne (2013) and the Association of Mathematics Teacher Educators (2013), the coach must be specifically skilled/knowledgeable in the following areas to achieve these expectations:

- Leadership
- Learners and learning
- Mathematics content
The role of a coach is different from the traditional roles found in schools. Coaches support the work of teachers and are not administrators or evaluators. Coaching thrives in a context in which there are positive relationships and a sense of community in the school; in other words, schools recognize the importance of human and social capital (Leana & Pil, 2006).

Coaching holds much promise and potential; it provides the support that enables teachers to design and implement the best possible instruction for their students. It is based on a model that identifies the teacher as a reflective professional responsible for making decisions about how to best structure instructional experiences for students. “Research on instructional coaching, both in general and in specific content areas such as literacy and mathematics, has found that coaches are associated with significant gains in both teachers’ adoption of reform-based pedagogies, as well as student learning outcomes” (Polly, Mraz, & Algozinne, 2013, p. 306). The Vermont Mathematics Initiative is an example of a mathematics coaching program that supports a corps of mathematics instructional coaches for grades K–8. Research shows that the Vermont Mathematics Initiative (VMI) has had a major impact on teachers, students, and classroom practice. Students in VMI schools outperformed those in control schools, and the achievement gap has narrowed between free- or reduced-lunch eligible students in VMI schools and their non-eligible peers in matched schools (AMTE, 2013).

**Implementation Success Factors:**

- Coaching time: The simplest way to improve the effectiveness of a coaching program is to increase the amount of time coaches are actually coaching. Successful coaching programs value the time of “coaching.” This seems obvious, but the most frequent concern raised by many instructional coaches is that they are asked to complete so many non-instructional tasks they have little time left to work with teachers. Because instructional coaches’ job descriptions are often vague or nonexistent, and because their schedules are more flexible than the schedules of others, they often are asked to do many clerical or non-instructional tasks.

- Professional development for instructional coaches: Professional development for coaches should address at least two subjects. First, coaches should engage in various professional learning activities designed to improve their coaching practices. Second, professional development for coaches should deepen their knowledge about the teaching practices and content they are sharing with teachers. When teachers are provided with opportunities to learn more about the content they teach and how to teach it, there tends to be improved student learning (Darling-Hammond & McLaughlin, 1995).
• School culture and climate: The school should have a common vision and goals within an instructional framework that helps establish a roadmap for teachers. Teachers should have high expectations for students, and the school should support teachers as learners. For an instructional coach to be effective, teachers must be open to feedback and reflection. The school should have a supportive principal who understands and values coaching. “[C]oaches have identified their relationship with the principal as a key factor for success” (Bean & Zigmond, 2006).

Resources
Teacher leadership framework, from the Center for Strengthening the Teaching Profession (CSTP)
Standards for Elementary Mathematics Specialists

References


FAMILY INVOLVEMENT

Family Involvement Outside of School

In a report, Van Voorhis, et al. (2013) summarize research conducted in the last 10 years on parental involvement at home with their children around mathematics activities. This team reviewed 43 studies on mathematics, finding that that when parents engage with their children in math-related activities, it positively affects the mathematics achievement of their children. Specifically, there are positive effects when parents actively support their children’s mathematical development at home. Parents can be supportive by playing math-related games with their children at an early age, providing real-life experiences that involve mathematics (money, shopping, cooking, pointing out the use of numbers in signs, etc.), assisting with homework, and by expressing positive attitudes toward the learning of mathematics.

As with reading, an early positive start in mathematics helps students obtain and maintain grade level understanding of the mathematics taught. For this reason, parent involvement in numeracy activities is critically important in the youngest years. In a meta-analysis of six longitudinal data sets, Duncan, et al. (2007) found that kindergarten entry-level numeracy skills have the greatest predictive power of later mathematics achievement. This would indicate that parental engagement with their pre-school children in numeracy games and activities is significant for their later achievement. In a Canadian study, Skwarchuk (2009) found that engagement by parents with children on more complex mathematics activities were positively related to their children’s Quantitative Concepts scores (Woodcock-Johnson) whereas basic numeracy activities were negatively related to preschooler’s Quantitative Concepts scores. More complex activities would involve thinking about strategies to work with number operations and comparing numbers rather than just learning the counting sequence or counting objects.

Studies show similar support for parent involvement at higher grades. Cai, Moyer & Wang (1997) found that middle school students with the most supportive parents demonstrated higher mathematics achievement and more positive attitudes toward mathematics than those parents who have minimal engagement with supporting mathematics. Particularly with this age group, parents who serve as motivators, resource providers, and monitors occupied roles that were the most important predictors of students' mathematics achievement.

Schools can take an active role in helping to provide strategies for parents to engage in discourse with their child about the mathematics their child is learning and
awareness of activities they can do with their children at home that will promote mathematical understanding and confidence. Epstein’s *Framework of Parent Involvement* addresses learning at home as one of its six types of involvement. Models that schools and districts can use to support parents in these roles and in others can be found on the National Network of Partnership Schools (NNPS) website (http://www.csos.jhu.edu/p2000/Research/index.htm). Joyce Epstein’s extensive research on school, family, and community partnerships is described here. The NNPS uses research-based approaches to help schools and districts establish and strengthen their partnerships with parents and the community. In the *Teacher Involve Parents I Schoolwork (TIPS)* section, teacher moves for working with parents are suggested based on the research citations provided. Providing parents with information about required skills in a subject area, how to monitor and discuss school work at home, and having interactive homework that requires students to discuss classwork with their parents are practices that can be employed to actively involve parents. The National Council of Teachers of Mathematics (NCTM) (http://www.nctm.org/) is another resource that provides specific advice in their book *Success from the Start* that can help teachers develop interactive family mathematics activities. Specific supports for parents are also provided.

**Family Involvement at School**

Family involvement at school has positive outcomes on students’ academic achievement. Other positive outcomes include reduced drop-out rates, reduced absenteeism, improved socio-emotional competence, and a more positive academic self-concept. Family involvement at school also positively impacts student-teacher relationships and teachers’ perceptions of student aptitude (Flamboyan Foundation, 2011b).

Research supports the notion that family engagement opportunities need to specifically increase family awareness of mathematics learning. Research suggests that a parent’s feelings of efficacy in a particular content area are tied to his or her level of involvement (Hoover-Dempsey, Bassler, & Brissie, 1992). Parents report engaging with their children more often in English language arts than in mathematics due to their sense of efficacy in these subjects (Epstein, 2005). Schools should, therefore, partner with families to support students’ learning of mathematics. Examples of strategies to engage families in mathematics from the Ohio Department of Education (n.d.) include:

- Invite families into classrooms to observe how mathematical ideas, concepts, and skills are taught to support mathematical reasoning and understanding.
- Host interactive mathematics nights that engage students and families in low-floor/high-ceiling mathematical tasks together.
- Host workshops that help families to understand academic content standards and math-related benchmarks appropriate to their child’s age and grade.
- Invite family members to provide support during mathematics instruction in the classroom.
• Invite family members to the school to share with students how mathematics is used in their careers.
• Involve family members as partners in planning math-related activities for students, such as celebrating Pi Day.
• Model positive attitudes about mathematics and creative ways to think about mathematics when meeting with family members.

More traditional forms of family engagement, including volunteering, attending parent-teacher conferences, attending events, and communicating with school staff are also important in predicting student achievement. Researchers posit that these strategies help families feel comfortable interacting with the school and school staff, as well as help them understand, support, and advocate for their child’s education. (Flamboyan Foundation, 2011a, p. 1)

Studies show that most parents strongly value involvement in their child’s learning. However, schools need to be aware of barriers to parents engaging with school staff. Some of these barriers include transportation, neighborhood safety, and language and cultural differences.

Implementation Success Factors
Create a school learning community that:
• Welcomes all families
• Provides parent resources
• Communicates positively about mathematics
• Believes that all students are mathematicians
• Supports families in understanding expectations of the mathematics standards and curriculum

Resources
The Power of Belief--Mindset and Success, Eduardo Briceño, Mindset Works

The way we understand our intelligence and abilities deeply impacts our success. Based on social science research and real life examples, Eduardo Briceño articulates how mindset, or the understanding of intelligence and abilities, is key. When students or adults see their abilities as fixed, whether they think they’re naturals or just not built for a certain domain, they avoid challenge and lose interest when things get hard. Conversely, when they understand that abilities are developed, they more readily adopt learning-oriented behaviors such as deliberate practice and grit that enable them to achieve their goals. But this belief is itself malleable, and there are clear actions we can all take to establish a growth mindset and enable success for our children, our peers and ourselves.

http://ed.ted.com/on/aVMPCOpr
**Growth Mindsets and Motivation**, Carol Dweck, Stanford University

Research in Educational Psychology has illustrated the importance of motivation in relation to achievement. Dr. Carol Dweck from Stanford University has been a pioneer in this field of study. The link below provides a short video about growth mindset and an opportunity to answer and submit self-reflection questions. This can be a resource for parents in considering how Dweck’s ideas can be incorporated in supporting children’s mathematical learning.

[http://ed.ted.com/on/UA77F1Tc](http://ed.ted.com/on/UA77F1Tc)

**Instill a Love of Math** by Laura Lewis Brown

Parents are bombarded with messages to read with their children, but it’s rare to hear about the importance of doing mathematics with them. Here are some helpful tips on why and how to instill a love of mathematics in your children.


**When to Get a Math Tutor for your Child** by Laura Lewis Brown

As parents, we all want to see our children excel in school. Some children are great at motivating themselves, while others need a push to catch up or even a little help to accelerate beyond their current curriculum. When it comes to building mathematics skills, there is no reason to postpone giving your child that push.


**Parent Roadmaps to the Common Core Standards- Mathematics**

The Council of the Great City Schools’ parent roadmaps in mathematics provide guidance to parents about what their children will be learning and how they can support that learning in grades K–8. These parent roadmaps for each grade level also provide three-year snapshots showing how selected standards progress from year to year so that students will be college and career ready upon their graduation from high school.


**Top Ten Questions Parents Ask**

This document is a teacher-authored tool to help teachers answer parents’ questions and address concerns. The topics were chosen by a group of educators based on the questions they hear most frequently in their schools and communities.

This document would be good preparation for back-to-school nights, parent-teacher conferences and other opportunities to introduce the Common Core to parents.

[http://achievethecore.org/page/1028/top-8-questions-parents-ask-teachers](http://achievethecore.org/page/1028/top-8-questions-parents-ask-teachers)

**Mathematics Tips for Parents from PBS**

Resources from National Council of Teachers of Mathematics (NCTM)

NCTM is the public voice of mathematics education, supporting teachers to ensure equitable mathematics learning of the highest quality for all students through vision, professional development, and research.

The following links take you to NCTM’s “family corner” on their website:

**Math Education Today**

Ever think “Why does my child’s math look different?” or “this isn't the math I remember!” read links on this page for ideas about how to foster your child’s success with mathematics in today’s world. Also, read NCTM's position on calculator use in elementary grades, technology in teaching and learning mathematics, what is important in early childhood mathematics, and the role of elementary mathematics specialists.

[http://www.nctm.org/mathedtoday/](http://www.nctm.org/mathedtoday/)

**How to Help Your Child Succeed in Math**

You can make a big difference in your child’s attitude, motivation, and math-ability. Look here for ideas about “What can I do to make sure my child succeeds in math?” and read tips from other parents.


**Homework Help**

Key concepts to make those homework sessions more effective, and more fun! Includes additional resources to use in daily homework sessions, such as: tips for parents, homework support, downloadable resources, and websites


**References**


COMMUNITY PARTNERSHIPS

Up to five percent of a district's LAP allocation may be used for the development of partnerships with community-based organizations, ESDs, and other local agencies to deliver academic and nonacademic supports to students who are significantly at risk of not being successful in school. Programs should reduce barriers to learning, increase student engagement, and enhance students’ readiness to learn. For more information about Readiness to Learn, please visit http://www.k12.wa.us/LAP/ReadinessToLearn/default.aspx. Community-based student mentoring, described below, may be implemented as a community partnership using this allocation.

According to the Ohio Department of Education, the “definition of a community partnership includes every formal arrangement a school can make with an individual, association, private sector organization or public institution to provide a program, service or resource that will help support student achievement” (n.d., p. 2). Effective involvement includes collaborating with the community and integrating resources and services available into students’ experiences to strengthen the school program. In a study conducted by Sheldon et al. (2010) of math–related family and community practices, 20 or more schools reported that family mathematics night, volunteer math-aides, and mathematics projects involving family or community partners were most effective in promoting involvement. Community support of students could include awards programs, student incentives, scholarships, trips, tutors, or mentors (Sanders, 2003).

Student Mentoring by Community Partners

Mentoring is defined as a positive relationship between a non-parental adult or older youth to a younger child or youth (Gordon et al., 2009). Mentoring programs may be broadly categorized as school-based or community-based. In school-based mentoring, mentors typically meet with mentees one-on-one during or after the school day and engage in both academic and non-academic activities. Community-based mentoring occurs outside of the school context. Community-based mentoring sessions are typically longer than school-based mentoring activities and community-based mentor-mentee relationships often are longer in duration than school-based matches (Herrera et al., 2011).

The school-based mentoring (SBM) relationship can provide students with a more positive experience and outlook on school. Studies show that participation in school-based activities increases students’ sense of school belonging and liking (Eccles & Barber, 1999; Grossman et al., 2002). This experience may, in turn, lead to improved attendance and academic performance. Studies have found positive associations between SBM and academic performance (Diversi & Mecham, 2005; Hansen, 2001, 2002), self-perceptions of academic abilities (Bernstein, Dun Rappaport, Olsho, Hunt, & Levin, 2009), and attitudes toward school (Karcher, Davis, & Powell, 2002; King, Vidourek, Davis, & McClellan, 2002; Portwood & Ayers, 2005).

Both school-based and community-based mentoring have been found to have a positive effect on student academic outcomes. In a study of middle school African American students, researchers found an Afrocentric mentoring program to be effective in fostering academic
achievement and success in the participating mentees (Gordon et al., 2009). In a five-month Big Brothers Big Sisters school-based mentoring program, mentees experienced modest short-term academic gains (Herrera et al., 2011).

Implementation Success Factors

- “Mentors and mentees need opportunities to meet and participate in shared activities on a regular basis over an extended period of time” (Ryan et al., 2002, p. 134).
- Mentoring programs should carefully screen mentors, thoughtfully match mentors and mentees, and provide training for the mentors (Ryan et al., 2002).
- Mentor programs should utilize a paid mentor coordinator who coordinates activities, communicates with families, and recruits/trains/supports mentors (Ryan et al., 2002).

Resources

The ABCs of School-Based Mentoring: Effective Strategies for Providing Quality Youth Mentoring in Schools and Communities from Education Northwest

References


SERVICES UNDER RCW 28A.320.190—EXTENDED LEARNING OPPORTUNITIES PROGRAM

Services under RCW 28A.320.190 generally fall within the broad category of extended learning opportunities. The law was created for eligible 11th and 12th-grade students who are not on track to meet local or state graduation requirements, as well as 8th-grade students who need additional assistance in order to have the opportunity for a successful entry into high school. LAP funds can be used for services outlined under the law, including, but not limited to:

1. Individual or small group instruction
2. Instruction in ELA and/or mathematics that eligible students need to pass all or part of the Washington state assessment
3. Attendance in public high school or public alternative school classes or at a skill center
4. Inclusion in remediation programs, including summer school
5. Language development instruction for ELLs
6. Online curriculum and instructional support, including programs for credit retrieval and Washington State assessment preparatory classes

The following practices of credit retrieval and transition to high school are examples of services under RCW 28A.320.190—Extended Learning Opportunities Program:

Credit Retrieval
Credit retrieval, or credit recovery, refers to a course that is retaken after a student has completed the course without earning credit for the course on the initial attempt. Reasons for a student not earning credit for a course may include unsatisfactory grades and/or insufficient attendance. Credit retrieval programs are often used to keep students in school and on track for graduation (Watson and Gemin, 2008). Credit recovery courses may be offered at an alternate time, such as after school or during the summer (D’Agustino, 2013). Credit retrieval programs may also be offered in a variety of formats such as online, face-to-face, and through a blended-learning approach.

Online credit retrieval programs may pose challenges for some learners, although the experience of online learning can be valuable. As Franco and Patel (2011) note, “[k]ey features of success for high school students in virtual learning programs are the development of self-regulative strategies and the ability to guide their own learning. Unfortunately, many of the students engaged in online programs have not sufficiently developed these attributes, making it more difficult for them to be successful” (p. 18). Online components of credit retrieval programs, however, can offer benefits to struggling students, as Watson and Gemin (2008) suggest: “[t]he blended approach is important because it provides expanded student support and face-to-face contact. The online component—whether fully online or blended—provides 21st century skills to a group of students who often have less than average exposure to computers and technology” (p. 15).
Implementation Success Factors

- Program planning should include early identification of students who may be at risk of not graduating (Archambault et al., 2010).
- Program should allow for rolling enrollment in credit retrieval courses (Archambault et al., 2010).
- Counseling services should be offered for students in credit retrieval courses (Franco & Patel, 2011).
- Curriculum must be rigorous and program should ensure that students are learning the material and not simply meeting seat-time requirements (Watson and Gemin, 2008).
- Diagnostic testing should allow students to demonstrate mastery of the elements of a subject that they learned in their previous attempt to pass the course, and to move on to the parts of the course that they need to master (Watson and Gemin, 2008).
- A strong technological infrastructure is critical for online and blended-learning programs (D’Agustino, 2013).
- Students in credit retrieval courses often do not have the self-regulation strategies necessary for success in an online program.

Transition to High School

High school transition opportunities refer to courses that intend to support the transition from 8th-grade mathematics to successful completion of algebra I in high school. As a general practice, the panel discourages student placement in algebra prior to 9th grade. Research shows that accelerating algebra into middle school produces significantly lower algebra test score outcomes and a negative impact on the likelihood of passing geometry (Clotfelter, Ladd, & Vigdor, 2015). Also according to Clotfelter, Ladd, and Vigdor (2015), students at all prior achievement levels have a far greater risk of repeating algebra if their first attempt at the course occurs prior to high school. “We find substantial evidence that introducing algebra in middle school, rather than serving to equalize student outcomes, exacerbates inequality” (Clotfelter, Ladd, & Vigdor, 2015).

Students identified for a transition-to-high-school program might lack one or more of the following: motivation, self-efficacy, and mathematics skills, and conceptual mathematical understanding. A transitional program, therefore, needs to be able to engage all students in productive ways with meaningful mathematics. Traditional remedial classes are not effective in supporting successful transitions; instead, transition interventions that effectively prepare students for high school operate on a model of accelerated learning (Herlihy, 2007).

A strong transitional program would address student motivation to pursue academic goals with conceptual understanding and skill-building in mathematics. These transition programs should include: 1) student engagement, 2) student participation and discourse, 3) positive motivation and 4) academic risk-taking.
Implementation Success Factors

- Experienced and qualified teachers should lead transition interventions (Herlihy, 2007). The same teacher teaching algebra at the high school should be integral to the intervention program.
- Practices that address non-cognitive factors and support development of the “habits of mind” possessed by successful students should be incorporated into transition programs.

References


CONCLUSION

This work is significant because it has the potential to improve student outcomes across the state. Historically, even with similar funding levels, student outcomes by district have been uneven. The Legislature, with ESSB 5946, directs districts to use proven mathematics practices to help struggling students. Even with proven practices, it is critically important to ensure they are implemented with fidelity because the best practices and strategies, when implemented poorly, can fail to raise student outcomes.

This menu of best practices and strategies will be refreshed annually, no later than July 1 each calendar year. Interested stakeholders are invited to submit recommendations for intervention practices, along with related research references, for consideration by the expert panel and possible inclusion in subsequent menus. It is important to note that if new research emerges that disproves the effectiveness of a practice that has historically been included in this report, the practice may be removed and no longer be allowed under LAP guidelines. Public comment forms are available on the project web page on the OSPI website, at http://www.k12.wa.us/LAP/MathPanel.aspx.

Next Steps

The Mathematics Panel of Experts recognizes that there are a number of next steps to ensure that the Menu of Best Practices and Strategies for Mathematics are implemented across the state. Following are a list of activities that will be carried out in the 2015–16 school year:

1. OSPI will offer training and technical assistance on the Mathematics Menu of Best practices in a variety of formats:
   a. Online resources and supports
      - Mathematics Menu Implementation Guide
      - One-pagers on core components of each mathematics practice on the menu
      - Newsletters
      - Webinars
   b. Targeted technical assistance
      - Mathematics Menu 101 – provides an overview of what the menu is, what it includes, how it is organized, and other high-level information to the broadest audience
      - Targeted training – e.g., spring regional Title 1/LAP director meetings to include Teaching and Learning counterparts to look at the menu and how it supports the Washington State Standards
   c. Extended training
• District team trainings/practitioner workshops – understanding menu strategies and practices and how they work at the building/classroom level. To include Title 1/LAP directors, curriculum directors, principals, K–12 teachers, intervention specialists. Trainings will lead district personnel through:
  o self-assessment of current practices
  o needs assessment/gap analysis
  o review of menu to meet needs/fill gaps
  o development of practice profiles
  o development of fidelity assessments

2. The Mathematics Panel will continue their work which includes the following:
   a. Examine proposed best practices and strategies that the committee chose to table for future consideration for placement on the updated July 1, 2016 Mathematics Menu of Best Practices and Strategies.
   b. Address public comments that suggest additional practices and strategies for inclusion in the July 1, 2016 Mathematics Menu of Best Practices and Strategies.
   c. Vet potential best practices and strategies for mathematics recommended by districts and others.

3. Prepare and distribute data collection instruments that districts will be required to submit to meet the reporting requirements of ESSB 5946.

4. Analyze data from the LAP Student Data end-of-year report in a summary report to the legislature.

5. Use information collected from the LAP student data end-of-year report to determine where LAP programs are having the greatest positive effects and establish a network for districts to learn from each other and to consult in implementing LAP services. Newsletters may be used as a way to connect districts to other districts and to highlight stories of success from the field.
APPENDIX A: LEARNING ASSISTANCE PROGRAM (LAP)

The Learning Assistance Program (LAP) is a supplemental services program that assists underachieving students in reading, writing, and mathematics, as well as the readiness skills needed to successfully learn these core content areas. LAP also serves students who need behavioral support in order to reduce disruptive behavior in the classroom. Additionally, school districts may use up to five percent of LAP funds for “Readiness to Learn” services, which include the development of partnerships with external organizations to provide academic and non-academic supports for students and their families. These supports are intended to reduce barriers to learning, increase student engagement, and improve readiness to learn. The Learning Assistance Program was created by the Legislature in 1987 and, over the past 25 years, LAP has grown to reach 12.0 percent of the statewide, K–12 population (126,627 students).

Table 1 shows LAP enrollment by grade level and subject area for the 2013-14 school year. As you can see, over 60,000 students in Washington State received LAP services in mathematics in 2013-14.

Table 1: LAP Enrollment by Grade Level and Subject Area in 2013-14

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Reading</th>
<th>Math</th>
<th>Language Arts</th>
<th>Readiness</th>
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<tr>
<td>Full-Day K</td>
<td>5,880</td>
<td>1,413</td>
<td>313</td>
<td>1,332</td>
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<tr>
<td>Half-Day K</td>
<td>4,131</td>
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<td>1st</td>
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<td>2nd</td>
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<td>3,584</td>
<td>506</td>
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<tr>
<td>3rd</td>
<td>8,623</td>
<td>4,445</td>
<td>552</td>
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<tr>
<td>4th</td>
<td>7,285</td>
<td>4,694</td>
<td>418</td>
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<tr>
<td>5th</td>
<td>4,851</td>
<td>4,412</td>
<td>407</td>
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<tr>
<td>6th</td>
<td>5,303</td>
<td>6,581</td>
<td>735</td>
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<tr>
<td>7th</td>
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<td>1,314</td>
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<tr>
<td>8th</td>
<td>4,831</td>
<td>6,563</td>
<td>1,110</td>
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<tr>
<td>9th</td>
<td>3,224</td>
<td>7,646</td>
<td>1,567</td>
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<tr>
<td>10th</td>
<td>2,024</td>
<td>4,202</td>
<td>1,344</td>
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<tr>
<td>11th</td>
<td>1,235</td>
<td>2,975</td>
<td>1,092</td>
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<tr>
<td>12th</td>
<td>1,073</td>
<td>2,630</td>
<td>1,335</td>
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<tr>
<td>Total</td>
<td>76,691</td>
<td>60,221</td>
<td>11,595</td>
<td>3,266</td>
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</table>

Columns left blank had an n < 30

A Read as “5,880 full day kindergarteners received services in LAP reading.”
B Read as “1,413 full day kindergarteners received services in LAP math.”
C Read as “313 full day kindergarteners received services in LAP language arts.”
D Read as “1,332 full day kindergarteners received services in LAP readiness.”

LAP funds are distributed at the district level and are allocated based on the district-wide percentage of students in grades K–12 who were eligible for free- or reduced-price meals.
(FRPL) in the prior school year. A student is eligible to participate in LAP if they are in kindergarten through 12th grade, and are below standard in reading, writing, or mathematics. Districts determine which students are eligible by using multiple measures of performance. Performance measures may include the state assessment, other standardized assessments, classroom- or district-developed assessments, teacher observation, and credits earned/GPA.

**LAP Allowable Services**

Beginning in the 2015-16 school year, expenditure of funds for the Learning Assistance Program must be consistent with the provisions of [RCW 28A.655.235](https://laws.wa.gov/). Beginning in the 2016-17 school year, school districts must use a practice or strategy in accordance with the Mathematics Menu of Best Practices and Strategies for LAP services for mathematics per [RCW 28A.165.035](https://laws.wa.gov/). Beginning in the 2016-17 school year, school districts may use a practice or strategy that is not on a Mathematics Menu of Best Practices and Strategies if the district is able to demonstrate improved outcomes for participating students.

The following are categories of services and activities that may be supported by the Learning Assistance Program, per [RCW 28A.165.035](https://laws.wa.gov/), and shown in Figure 1 below:

1. Extended learning time occurring:
   a. Before or after the regular school day
   b. On Saturdays, and
   c. Beyond the regular school year

2. Services under [RCW 28A.320.190](https://laws.wa.gov/), which include:
   a. The extended learning opportunities program, which was created for eligible 11th and 12th-grade students who are not on track to meet local or state graduation requirements, and for 8th-grade students who need additional assistance to have a successful entry into high school.
   b. Under the extended learning opportunities program, instructional services for eligible students can occur during the regular school day, evenings, weekends, or at a time and location deemed appropriate by the school district (i.e., the educational service district). Instructional services can include the following:
      i. Individual or small group instruction
      ii. Instruction in English language arts and/or mathematics to pass all or part of the Washington assessment of student learning
      iii. Attendance at a public alternative school or a skill center for specific courses
      iv. Inclusion in remediation program;
      v. Language development instruction for English language learners

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1 Washington State summative assessments
vi. Online curriculum and instructional support, including programs for credit retrieval or preparatory classes for Washington assessments, and

vii. Reading improvement specialists to serve 8th, 11th, and 12th-grade educators through professional development (in accordance with RCW 28A.415.350). The reading improvement specialist may also provide direct services to eligible students, which includes students enrolled in a fifth year of high school who are still struggling with basic reading skills.

3. Professional development for certificated and classified staff that focuses on:
   a. The needs of a diverse student population
   b. Specific literacy and mathematics content and instructional strategies, and
   c. The use of student work to guide effective instruction and appropriate assistance.

4. Consultant teachers to assist in implementing effective instructional practices

5. Tutoring support for participating students

6. Outreach activities and supports for parents of participating students. This could potentially include employing the parent or the employment of a family engagement coordinator.

7. Finally, up to five percent of a district's LAP funding allocation may be used for the development of partnerships with community-based organizations, educational service districts, or other local agencies. The purpose of these partnerships is to deliver academic and nonacademic supports to participating students who are at risk of not being successful in school. The goals of these partnerships are to reduce barriers to learning, increase student engagement, and enhance students' readiness to learn. The Office of Superintendent of Public Instruction (OSPI) must approve any community-based organization or local agency before LAP funds may be expended.
Figure 1: LAP Allowable Services

Learning Assistance Program

- Professional Development focusing on:
  - Needs of diverse students
  - Content and instructional strategies
  - Use of student work
- Extended Learning Time
- Before/after school
- Saturday
- Beyond regular school year
- Tutoring
- Individual/group instruction
- Exit exam assistance
- Credit retrieval
- Reading improvement specialists
- Attendance at alt. HS/SC Center
- Remediation programs
- Language development ELLs

Consultant Teachers

Family Involvement

Community Partnerships for academic and nonacademic supports

Community-based organizations

ESDs

Local agencies

Special Assistance for 8th/11th/12th Graders (RCW 28A.320.190)
APPENDIX B: MATHEMATICS PANEL OF EXPERTS
Panel members were appointed by the State Superintendent of Public Instruction, Randy Dorn. Panel candidates were solicited through several professional channels. Candidates were nominated from OSPI, Educational Services Districts, school districts, and state educational associations. OSPI sought leaders nationally and within Washington possessing expertise and experience with multi-tiered systems of support frameworks (such as Response to Intervention), Washington State K–12 Learning Standards for Mathematics (Common Core State Standards for Mathematics), and broad assessment systems that use data to make instructional decisions.

Candidates were nominated and selected based on evidence of their expertise in one or more of the following areas:

- Mathematics classroom and/or district leadership experience
- Classroom and system expertise in supporting struggling students in grades K–12
- Educational research expertise
- Experience in implementing best practices
- Knowledge of research-based best practices and strategies in working with diverse student populations
- Representatives from high-poverty school districts that range in size from urban to rural with large populations of struggling students

Nominations were collected and reviewed by OSPI’s Strengthening Student Educational Outcomes team. After a review of all candidates, OSPI’s team recommended panel candidates to the State Superintendent for his consideration. The cross-disciplinary panel reflects a wide range of experience and professional expertise within the K–20 environment. See below for a list of panel member biographies.

Development of the Menu of Best Practices and Strategies for Mathematics

Work Plan
There were six work sessions held over the course of the 2014–15 school year. The first session was an interactive orientation webinar lasting approximately two hours. The remaining five meetings were face-to-face sessions held in the SeaTac area. Significant research, writing, and collaboration happened outside the formal panel meetings. OSPI provided a project SharePoint site to help facilitate collaboration and access to information.

Figure 2 below outlines the work of the expert panel over the six scheduled sessions. The work sessions were organized around the framework of the currently allowed LAP service categories, with one key addition of identifying emerging or promising practices that may or may not fit into the currently allowed categories.
Panelists were asked to review selected research literature in advance of each session. Panelists then worked in small groups to review the body of peer-reviewed research on each of the proposed practices. Panelists provided written descriptions of the practices, citing evidence of effectiveness and considerations for implementation.

During the sixth and final session, panelists reviewed all of the completed menu entries and voted on each practice for inclusion in the menu. Panelists voted based on the strength of the body of research and their expert opinion on the effects of the practice in positively impacting student achievement. Panel votes are represented in Table 1: Menu of Best Practices and Strategies. Practices that did not garner support from at least 50 percent of the panelists were not included in the menu.
APPENDIX C: EXPERT PANEL MEMBER BIOGRAPHIES

Sue Bluestein, Teacher in Washington State for 18 years, the first 3 years were as a LAP remedial mathematics teacher for elementary students. Since leaving the classroom Sue has worked for ESD 112 for 13 years providing teacher professional development under many initiatives including Math Helping Corps, No Limit Math and Technology and recently as a Regional Mathematics Coordinator. Through her position as Coordinator she provides mathematics instructional services to 30 school districts in Southwest Washington. She has extensive experience, starting in 2004, supporting teacher instructional changes through 5 State MSP grants (Math and Science Partnership). She also facilitates a current College Spark grant working with Middle School mathematics teachers to improve student understanding of mathematics.

Greta Bornemann, Ed.D., is currently the Director of Mathematics at the Puget Sound Educational Service District. She has eighteen years of classroom teaching experience at the middle, high and post-secondary levels. Greta served as an instructional coach before spending 5 1/2 years as Director of Mathematics for the Superintendent of Public Instruction. Greta is a National Board Certified Teacher in Mathematics and recently received her doctorate in Educational Leadership. She is focused on building regional leadership to support mathematics improvement efforts.

Catherine Carroll, Senior Research Associate and Project Director at WestEd, specializes in mathematics education and mathematics teacher education. She serves as co-PI for Linear Functions for Teaching–An Efficacy Study of Learning and Teaching Linear Functions and directs several professional development projects. Ms. Carroll is co-author of Learning to Lead Mathematics Professional Development and Making Mathematics Accessible to English Learners. Ms. Carroll served as Director of the Mathematics Renaissance Leadership Alliance, an initiative funded by the California Department of Education to develop teacher and administrator leadership for quality mathematics programs. Previously, she served as Associate Director for the Mathematics Renaissance K-12 and Regional Director for the Middle Grades Mathematics Renaissance. Ms. Carroll also has nearly twenty years of experience teaching middle school mathematics.

Douglas H. Clements, Ph.D., is Kennedy Endowed Chair in Early Childhood Learning and Professor at the University of Denver. Previously a kindergarten teacher for five years and a preschool teacher for one year, he has conducted research and published widely in the areas of the learning and teaching of early mathematics and computer applications in mathematics education. His most recent interests are in creating, using, and evaluating a research-based curriculum and in taking successful curricula to scale using technologies and learning trajectories. He has published over 125 refereed research studies, 18 books, 80 chapters, and 300 additional publications. His latest books detail research-based learning trajectories in early mathematics education: Early childhood mathematics education research: Learning trajectories for young children and a companion book, Learning and teaching early math: The
learning trajectories approach (Routledge). Dr. Clements has directed over 25 funded projects, including those funded by the National Science Foundation (NSF) and the U.S. Dept. of Education’s Institute of Education Sciences (IES). Currently, Dr. Clements is Principal Investigator on two large-scale randomized cluster trial projects in early mathematics (IES). Two recent research projects funded by the NSF include Using Rule Space and Poset-based Adaptive Testing Methodologies to Identify Ability Patterns in Early Mathematics and Create a Comprehensive Mathematics Ability Test, which will develop a computer-adaptive assessment for early mathematics and Early Childhood Education in the Context of Mathematics, Science, and Literacy, developing an interdisciplinary preschool curriculum. Dr. Clements was a member of President Bush’s National Math Advisory Panel, convened to advise the administration on the best use of scientifically based research to advance the teaching and learning of mathematics and coauthor of the Panel’s report. He was also a member of the National Research Council’s Committee on Early Mathematics and co-author of their report. He is presently serving on the Common Core State Standards committee of the National Governor’s Association and the Council of Chief State School Officers, helping to write national academic standards and the learning trajectories that underlie them. He is one of the authors of NCTM’s Principles and Standards in School Mathematics and Curriculum Focal Points. Additional information can be found at http://du.academia.edu/DouglasClements, http://www.researchgate.net/profile/Douglas_Clements/, and http://portfolio.du.edu/dclemen9

Francis (Skip) Fennell, Ph.D., is the L. Stanley Bowlsbey professor of education and Graduate and Professional Studies at McDaniel College in Maryland, where he directs the Brookhill Institute of Mathematics supported Elementary Mathematics Specialists and Teacher Leaders Project. A mathematics educator who has experience as a classroom teacher, principal, and supervisor of instruction, he is a past president of the Association of Mathematics Teacher Educators (AMTE), the Research Council for Mathematics Learning (RCML), and the National Council of Teachers of Mathematics (NCTM).

Widely published in professional journals and textbooks related to PreK-8 mathematics education, Dr. Fennell has also played key leadership roles for the Mathematical Sciences Education Board, National Science Foundation, and the U.S. National Commission on Mathematics Instruction. He served as a writer for the Principles and Standards for School Mathematics (NCTM, 2000), the Curriculum Focal Points (NCTM, 2006) and for the Common Core State Standards (CCSSO, 2010). He also served on the National Mathematics Advisory Panel (2006-2008). Dr. Fennell served as a member of the Council for the Accreditation of Educator Preparation (CAEP) Commission (2012-2013) and currently serves on the CAEP Board of Directors. He is also currently serving as the mathematics advisor for both Peg + CAT (which recently received three Emmy Awards) and the soon to be released (November, 2014) Odd Squad. Both are PBS television shows for children that also include a website, games and an app.

Dr. Fennell has received numerous honors and awards, including Maryland’s Outstanding Mathematics Educator, McDaniel College’s Professor of the Year, the Glenn Gilbert National
Leadership Award from the National Council of Supervisors of Mathematics, the CASE - Carnegie Foundation Professor of the Year - Maryland, the Association of Mathematics Teacher Educators’ Distinguished Outstanding Teacher Educator, and, more recently, the 2012 Lifetime Achievement Award from the National Council of Teachers of Mathematics.

**Connie Hachtel**, M.Ed., Instructional Coach at Housel Middle School, Prosser School District. Connie Hachtel has worked for the Prosser School District since 1979 both as a teacher and an instructional coach. She received her Bachelor of Arts in elementary education from Washington State University and a MA in Professional Development in Education from Heritage University. As a mathematics educator, she has experience as a classroom teacher and a mathematics instructional coach. She has been involved with Mathematic Helping Corp, was selected as part of the State Math Coach Cadre for five years, and is currently a Washington State Mathematics Fellow. She has begun the mathematics intervention program within her own school to help all students become successful. She has also been a professional developer for secondary mathematics within her own district working with middle and high school teachers. She is a member of Learning Forward and Washington State Mathematics Council. In 2013, she was honored with the Golden Apple Award from the state of Washington.

**Allison Hintz**, Ph.D., is an assistant professor in the School of Educational Studies at the University of Washington, Bothell. Her research and teaching interests are in the areas of elementary mathematics, classroom discourse, and professional learning. As a former classroom teacher in Washington State, she continues to work alongside pre-service and practicing teachers in elementary classrooms as she studies teaching practices that support all children in lively, robust mathematics learning. Her research has been published in educational journals such as Mathematical Thinking and Learning and Teaching Children Mathematics. She is co-author of the book Intentional Talk: How to Structure and Lead Productive Mathematical Discussions.

**Matt Lemon** conducts applied policy research for the state Legislature with a focus in education. His work in K-12 policy includes studies of innovative schools in Washington and the Learning Assistance Program, which provides academic support to struggling students. His work in higher education has examined a scholarship program for foster youth (Passport to College Promise) and the Washington State Need Grant for low-income undergraduate students. In addition to his research, Matt is a member of the K-12 Data Governance group that oversees the development and implementation of an education data system in Washington State. Matt graduated magna cum laude from Western Washington University with a BA in political science and received a M.P.A. from The Evergreen State College.

**Lesley Maxfield** currently serves Spokane Public Schools as both a K-6 Mathematics Instructional Coach and as a Title 1/LAP Elementary Mathematics Facilitator. She taught 5th and 6th grade for 12 years at Roosevelt Elementary before taking on the Mathematics Coach role there. Her work with students translated into a role as Mathematics Lab teacher and
facilitator. She also has provided district professional development for a variety of curriculums, including Connected Math and Engage NY. Lesley’s certifications include MC/Gen National Board Certification and Math Recovery© Intervention Specialist, Leader and Champion. She currently oversees the Math Recovery© training for Spokane Public Schools, which provides on-going professional development for classroom and consultant teachers to improve elementary numeracy instruction.

Alice Murner, M.Ed., Principal of Neah Bay Elementary School, Cape Flattery School District. Alice Murner has worked for the Cape Flattery School District since 1997 both as a teacher and principal. She received her Bachelor of Arts in elementary education from Western Washington University with an emphasis in K-12 special education and her Master’s Degree in P-12 administration from City University. Alice has been highly successful as a teacher and administrator on the Neah Bay Campus. Neah Bay Elementary has the distinct opportunity to serve a 95 percent Native American population. Under Alice’s leadership not only have the academic scores reached the state average and above, but she has also been instrumental in working with the community to bring formal Makah Language and cultural classes into the school. The Neah Bay Elementary has a long list of accomplishments under Alice’s leadership including but not limited to: State and National Title I Awards, three School of Distinction Awards, and most recently the 2013 Golden Apple Award.

Annie Pennucci has conducted applied policy research for the state Legislature for over 12 years, specializing in education (spanning early childhood, K–12, and higher education topics). In her K–12 studies, she has examined educational services for students who are deaf and hard of hearing, English Language Learners, recent immigrants, and in foster care; the Learning Assistance Program; academic assessments; education finance; and innovative schools in Washington State. She has experience as a fiscal analyst for the K–12 capital budget in the state House of Representatives and as an evaluator for a nonprofit that provides social services to adults. Annie holds a certificate from the Senior Executives in State and Local Government program at Harvard’s Kennedy School of Government and an M.P.A. from New Mexico State University.

Tamara Smith, M.Ed., is the Mathematics Education Coordinator at the Olympic ESD in Bremerton. She has worked for 10 years with teachers focusing on creating student centered classrooms and supporting mathematical discourse. Tamara works with OSPI and other Regional Mathematics Coordinators to develop a statewide vision of high quality mathematics instruction and implementation of the Washington State Learning Standards (CCSS). Tamara received a bachelor’s degree from Cornell University and her Master of Education degree from SUNY at Buffalo in New York. She is currently pursuing a Master of Education in Administration at the University of Washington.

John Woodward, Ph.D., Dean of School of Education at University of Puget Sound Dr. Woodward is a professor and researcher in the field of education and a former special education teacher. His areas of interest include mathematics education, computer-based
instruction, curriculum theory, professional development, and comparative education. He has been involved in 20 research projects totaling $10.6 million funded by the U.S. Department of Education, Office of Special Education Programs. Two curricular projects have emerged from this research funded by the U.S. Department of Education, Office of Special Education Programs. The first project is Tools for Understanding. It involves the use of common application tools like spreadsheets and word processing programs in middle school math classes. Students learn how to model mathematical concepts using spreadsheets and produce brief reports. The second project is much more extensive in scope. Transitional Mathematics is a comprehensive, 3 year curriculum for middle school students who struggle with mathematics. The curricula is based on the NCTM Standards, and it moves students from a conceptual understanding of basic operations through rational numbers to algebraic equations. Other topics such as measurement, geometry, working with data, basic statistics, and ratios and proportions are covered in the 3 levels of the program. Transitional Mathematics also includes a companion program, Fact Fluency and More! This program is designed to teach basic facts to elementary and middle school students. Students are taught strategies for learning facts, and the program also develops number sense by stressing the relationship between facts and extended facts. Dr. Woodward also has over 60 publications in professional journals and edited books that focus on a range of issues related to mathematics education and the needs of remedial students and those with learning disabilities.

Sharon Young, Ph.D., Professor, Department of Mathematics, Seattle Pacific University

Dr. Young’s areas of interest include elementary school mathematics curriculum, mathematics in children's literature, and teaching preservice elementary teachers. Dr. Young is a former elementary school teacher and has taught methods and content courses at the university level for elementary school mathematics. Dr. Young has contributed to the development of instructional and assessment items for a project funded by the National Science Foundation and has authored books, basal textbook series, and instructional resources. She also has over 20 publications in professional journals and edited books and has written over 50 children’s books with mathematics themes.
APPENDIX D: ACKNOWLEDGEMENTS

OSPI is indebted to the volunteers and staff who thoughtfully assisted in conducting the 2014-2014 review of Menu of Best Practices and Strategies for Mathematics. The panel members strove to find proven practices that were research and/or evidence based that were shown to improve student outcomes. The panel members and support staff were committed to providing a quality resource to school districts looking for guidance. They devoted many hours out of their busy schedules to do this work. We are grateful for their efforts.

Members of the Mathematics Expert Panel

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Title</th>
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<td>Bluestein, Sue</td>
<td>ESD 112</td>
<td>Regional Mathematics Coordinator</td>
<td>Expert Panel Member</td>
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<tr>
<td>Bornemann, Greta</td>
<td>Puget Sound ESD</td>
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<td>Clements, Doug</td>
<td>University of Denver</td>
<td>Professor, Executive Director of the Marsico Institute of Early Learning and Literacy</td>
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<td>Deputy Superintendent</td>
<td>Project Lead</td>
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<td>Assistant Superintendent, Special Programs and Federal Accountability</td>
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<td>Ward, Caryn</td>
<td>NIRN/SISEP</td>
<td>Senior Implementation Specialist</td>
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<td>Zombo, Janet</td>
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<td>Instructional Success Coach - Mathematics</td>
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## APPENDIX E: GLOSSARY AND LIST OF ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tbody>
<tr>
<td>CCSS-M</td>
<td><em>Common Core State Standards for Mathematics</em></td>
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<tr>
<td>ELA</td>
<td>English Language Arts</td>
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<td>ELL</td>
<td>English Language Learner</td>
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<tr>
<td>ESD</td>
<td>Educational Service District</td>
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<tr>
<td>ESSB</td>
<td>Engrossed Substitute Senate Bill</td>
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<td>LAP</td>
<td>Learning Assistance Program</td>
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<td>MTSS</td>
<td>Multi-Tiered System of Support Framework</td>
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<td>NIRN</td>
<td>National Implementation Science Network</td>
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<td>OSPI</td>
<td>Office of Superintendent of Public Instruction</td>
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<tr>
<td>PLC</td>
<td>Professional Learning Community</td>
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<tr>
<td>SISEP</td>
<td>The State Implementation and Scaling-up of Evidence-Based Practices Center</td>
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<td>WSIPP</td>
<td>Washington State Institute for Public Policy</td>
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APPENDIX F: BIBLIOGRAPHY


Center for Prevention Research and Development. (2009). *Background research: Tutoring programs*. Champaign, IL: Center for Prevention Research and Development, Institute of Government and Public Affairs, University of Illinois.


Hord, S. (1997). *Professional learning communities: What they are and why they are important?* Austin, TX: Southwest Educational Development Library.


