

WALLINGFORD-SWARTHMORE SCHOOL DISTRICT
200 South Providence Road, Wallingford, Pennsylvania 19086
The Office of Curriculum & Education



Report of the K-12 Math Vertical Team for Equity, Access, and Excellence
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Wallingford-Swarthmore School District

Math Vertical Team for Equity, Access and Excellence in Math

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Introduction

This report of the Wallingford-Swarthmore School District's Math Vertical Team for Equity, Access and Excellence is part of an ongoing framework for curriculum review aligned with the vision and goals of the district. The monitoring process is a critical part of the curriculum cycle that ensures continuous improvement and renewal of goals and strategies to support implementation of a high quality instructional program. Review, development, and monitoring of curriculum takes place through the active participation and leadership of a select group of teachers, administrators, and department chairs that form a K-12 vertical team, representative of math education across the district.

In monitoring years, vertical teams (cross-grade), horizontal teams (within a grade), both formal and informal, and instructional leaders, evaluate the implementation of the current curriculum and evaluate its effectiveness in raising student achievement. Feedback across system layers guides development of supporting resources and ongoing training as part of continuous improvement. The team develops key questions for monitoring, which include informal/formal discussions with instructors/instructional leaders, assessment scores, and in some cases, outside evaluations and site visits. In addition, research-based practices are investigated, which may include off-site visitation to outside districts that show consistent evidence of successful student achievement or implementation. Using the evidence, teams determine how, and whether or not to restructure, revise or refine the current practices. The goal of curriculum cycle work is to develop ongoing practices to support continuous system improvement.

This report reflects unique work as part of the curriculum and instruction monitoring cycle. The team focused on the improvement of instructional alignment to the approach of the *Math in Focus* program, which, when implemented with fidelity, is a research-based program for students across the learning continuum. *Math in Focus* is a rich comprehensive math program that supports development of mathematical problem-solving. *Math in Focus* is the United States edition of Singapore Math, a highly effective curriculum that integrates best practices in math instruction and centers on problem-solving as the focus of mathematical learning. The approach and program resources are based on the more than twenty years of success experienced by Singapore as a world leader in math. There is positive district-wide feedback about the level of challenge and engagement our students experience in math.

Background About the District Core Math Program K-8:

Traits of the *Math in Focus* approach include:

- Building understanding of concepts with a Concrete-Pictorial-Abstract learning progression (C-P-A)
- Encouraging all learners with built-in differentiation support.
 - Math in Focus materials and lesson design include resources and adaptations for on-level, advanced and struggling students as well as English Learners.
 - Materials also include a range of assessments, from formative (informal checks for understanding/mastery) to summative (formal mastery) to assist in identifying appropriate levels of challenge.
- Bringing the instructional practices foundational to Singapore Math's high achievement to U.S. students (Singapore consistently ranks at the top in math achievement on international measures (TIMMS, 1994-2015)). These practices include:
 - Visualization: Concrete-pictorial-abstract learning progression, use of consistent visual models to support foundational and extended learning.
 - Gradual release model: student-focused instruction, guided learning, independent practice with release to tackle routine and non-routine problems and deepen understanding.

- Scaffolded content: Instruction is adapted for needs of individual learners (with differentiated sequence and prompts).

Program outcomes are described as follows:

- To build conceptual understanding (through Concrete-Pictorial-Abstract (CPA) approaches)
- To develop critical thinking skills (by applying math concepts in different ways, creating alternative solutions to problems)
- To advance problem-solving proficiency (applying different strategies, considering best strategies for routine and non-routine problems)
- To build positive attitudes (learning to approach problem-solving with interest, enthusiasm, and confidence to persevere).

(Houghton Mifflin Harcourt, 2018)

At the time of the district selection of the math program, the standards for math instruction were changing to the new PA Core Standards. The Math Vertical Team considered the increasing demands of the new standards and recognized the profound shift in focus from content coverage and algorithmic/rote mastery to what the standards refer to as “*Habits of Mind of a Productive Mathematical Thinker*” (PDE, 2014). These practices relate to student reasoning and communication of reasoning, modeling and using tools, seeing structure and generalizing. Successful mastery of grade level content standards requires synchronous development of math habits of mind. Team members report one of the greatest shifts with the new standards and the core program is the requirement to explain reasoning and engage in mathematical discourse to analyze approaches, relationships and ideas. Student talk about math has become a new and highly important element of math instruction and student learning and enrichment. Algorithmic mastery is not sufficient as the sole or primary indicator of mathematical understanding.

The standards for mathematical practices are listed below:

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.

By middle school and high school, the state standards “set a rigorous definition of college and career readiness by demanding that students develop a depth of understanding and ability to apply mathematics to novel situations, as college students and employees regularly do” (PDE, 2014). Secondary grade level student success in higher level mathematics will depend on a strong elementary foundation with deep conceptual understanding as well as procedural knowledge. The *Math in Focus* program includes a progression of problem-solving, novel problems and application that match the increased demands of the new standards.

In addition to aligning to the rigorous instructional and learning practices of the new standards, *Math in Focus* aligns to the standards and principles of the National Council of Teachers of Mathematics (NCTM), which reinforce the idea of developing depth of understanding along with procedural fluency (HMH, 2018; NCTM, 2018). During the 2011-2012 program review, the Math Vertical Team developed a program mission and

identified specific areas of student focus to support the development of strong habits that develop mathematical practices. The program mission and student focus areas are listed below.

WSSD Mathematics Program Mission

The mission of the Wallingford/Swarthmore School District mathematics program is to:

1. Inspire intellectual curiosity and aesthetic appreciation of mathematics as a body of knowledge
2. Promote critical thinking and problem solving skills to solve real world problems
3. Develop computational fluency and understanding of mathematical algorithms in order to apply known facts to unknown situations
4. Encourage students to be active participants in a life-long learning process as independent thinkers

WSSD Mathematics Student Focus

In order to accomplish our mathematics mission, the WSSD mathematics program should encourage students to:

1. Understand that mathematical thinking is as much about the questions as it is about creatively uncovering patterns that lead to answers
2. Take ownership of learning and develop skills needed for self-evaluation
3. Discover concepts through experience before executing algorithms
4. Use multiple approaches to problem solving
5. Understand developmentally appropriate mathematical ideas and apply this knowledge to solve problems
6. Enjoy mathematics while celebrating the disequilibrium that is a natural part of the learning process
7. Work collaboratively and cooperatively to solve problems, using mathematical language to explain thought processes

The work of this team also served as a response to the longitudinal data shared with the board and staff related to district equity goals. In addition to specific improvements in math instruction to align with best practices, the work of this committee focused on the district goal to increase access to challenge for every child across the learning continuum and to explore potential institutional barriers to equity and excellence. The 2017-18 math team responded to formal and informal feedback related to the new ability grouping practices in math.

Methodology

This group was convened as a culminating initiative after multi-year monitoring efforts suggested a need for focused work on specific topics of ability grouping, access, equity and excellence. The multi-year monitoring process involved examination of key district curriculum related documents, assessments, review of best practices, site visitations, observation of classroom instruction, planning and development, as well as needs assessment for long-term professional development and resource development. The Wallingford-Swarthmore School District administration and Math Vertical Team identified specific questions determined to be integral to the implementation monitoring process. It is through these questions that the monitoring was conducted.

Members of the Math Vertical Team were oriented to the specific goals of the group in Fall 2017. Many core members were also included in the outside consultations that occurred in previous years, specifically Spring 2016, December 2016, and February 2018. Many returning team members were also part of the original program review in 2013. However, the team membership was expanded during the 2017-18 work to increase secondary and special education representation. The teachers of gifted education also participated in consultation.

Data Sources

Documents

These sources included written implementation requirements, existing curriculum, assessments, student performance indicators, standards and guidelines from academic organizations such as NCTM, ASCD, Next Generation Science Standards, and other documents related to the focus of the group.

Classroom Observations

Outside consultation and informal observations were conducted over the 2016-2017 school year, and the findings and recommendations of prior year monitoring were included for review, analysis and response by this team during the 2017-2018 process.

Drivers for Consideration of Existing Practices

- Best practice recommendations
- Curriculum Review Cycle: Continuous improvement of Monitoring phase
- Annual Math in Focus implementation challenges
- Vertical (K-12) concerns regarding long-term tracking
- Longitudinal equity data
- High School compression of levels
- K-8 Math in Focus monitoring visit confirmed concerns in both enriched and emerging skills groupings
- Elementary teachers observed increase in passive learner behaviors
- Gifted teachers expressed concerns about risk-taking/flexibility of thinking among advanced students
- Social/emotional concerns about long term stress of advanced students
- Districtwide focus on development of growth mindset
- District Equity and Excellence goals: How can we increase enrichment and challenge for all?

Focus of the Evaluation

Core questions that the team examines during all stages of the curriculum cycle are listed below.

- **Instruction**
 - *To what extent are best practices being used to ensure appropriately rigorous instruction in K-12 math?*
- **Assessment**
 - *In what ways are assessments (formal and informal; formative and summative) being used to evaluate student achievement and drive instruction?*
- **Resources/Technology**
 - *How well do the current materials, resources, and technology meet the needs of effective math instruction?*

Additional questions related to the district goals of equity and excellence emerged through the process:

- Does the proposal increase use of best practices?
- Does the proposal increase student sense of self-efficacy?
- Does the proposal have any chance of limiting students' sense of self-efficacy? (intended/unintended)
- Does the proposal include options for students with demonstrated need for acceleration?
- Does the proposal lead to any fixed groupings?
- Does the proposal impose limiting labels on students? (Formal/informal? Intended/unintended?)
- Does the proposal impose any obstacles to equity/access?
 - Formal/informal? Intended/unintended? Short term/Long-term?

Outcome: The team drafted a list of conclusions and recommendations throughout the process, which are integrated in this report. The Math Vertical Team for Equity, Access and Excellence has determined strengths and needs of program implementation, and they have developed recommendations for program improvement and sustainability of the improvement cycle. What follows is a summary of overall findings and recommendations categorized by grade level, professional development or resource development.

Team Conclusions

- Developing self-efficacy is critical.
- Schools should be doing more of what has positive impact with a strong effect size. (See Hattie’s effect size list) (Hattie, Fisher, & Frey, 2017; Hattie, 2008)
- Acceleration does have a high effect size.
- Not labeling students has a high effect size.
- Long term ability grouping can be an institutional obstacle to equity/access.
- Fixed ability grouping does not have enough positive impact on achievement to outweigh the negative impacts for students placed in “lower” ability groups.
- Advanced students need access to high levels of challenge/enrichment.

Middle School/High School Findings and Recommendations

Concerns identified:

- While flexibility exists in the system, student placements do not alter greatly from early placements in particular levels.
- By the high school level, there is a disproportionate number of poor and minority students in lower tracks.
- We have many strong students who could benefit from greater opportunity in higher level classes. The consensus of the group is to increase “leveling up” for increased challenge for all students. The grade level standards-aligned math instruction should be the default curriculum for math students from K-12
- There is strong focus on differentiation to provide greater challenge across all levels.
- There is consensus on the moral imperative to reduce the negative effects of tracking, but there is also consensus there should continue to be exploration of 6th to 12th math intervention opportunities beyond the core math block.

Actions for 2018-2019 and beyond

- Following an estimated two-year timeline, eliminate foundations/transitions classes.
- To determine pace of change, consider de-leveling as rising heterogeneous groups advance. In the interim, teams should continue to look case by case to determine greatest level of challenge possible for individual students and reduce number of sections of transitions/foundations classes.
- Maintain focus on differentiation to provide greater access to challenge across all levels.
- Maintain/increase individualized placements during scheduling to ensure supports by special educators/instructional assistants across sections.
- Students moving up a level must be distributed across classes rather than clustered. This will ensure a concentration of like students does not result in a new homogeneous ability group. This will support commitment to maintaining appropriate levels of rigor for leveled classes.
- Identify strongest enriched students to consider appropriateness of accelerated options.
- As levels are compressed, consider instituting an opportunity/requirement for students to participate in math remediation/support (similar to Keystone preparation requirement) outside the core math block as a supplemental course/support.

- As students transition to secondary from more heterogeneous elementary math experiences, consider aligning intervention programs/blocks/resources to offer remedial support outside of the core math block.
- Maintain continued professional development in differentiating instruction.
- Consider development of tiered assessments to define levels of achievement from proficiency to higher levels of challenge and mastery within courses. This will maintain commitment to existing levels of rigor as students are moved up for access to greater challenge.

Elementary Findings and Recommendations

Concerns identified

- While flexibility exists in the system, student placements do not alter greatly from early placements in particular levels. There is concern this could begin long-term tracking and become an institutional barrier to equity and excellence.
- There are many strong students who could benefit from greater opportunity in higher level classes. The consensus of the group is to increase “leveling up” for increased challenge for all students. The grade level standards-aligned math instruction should be the default curriculum for math students from K-12.
- There is consensus on the moral imperative to reduce the negative effects of tracking, but there is also consensus there should continue to be commitment to strong math intervention opportunities beyond the core math block. This will maintain the rigor of the core.
- Heterogeneous grouping recognizes the great variability in readiness and maturity in elementary age students. The core program design includes varied options for lessons, activities, assignments, and assessments. The program design intends heterogeneous grouping, social learning and differentiated elements.
 - The decision to move to cross-class ability grouping preceded the selection/implementation of the new math program by one year. The long-term cross-class ability grouping was counter to the approach of the program and affected alignment and implementation of the approach across classes.
 - Teachers encountered obstacles throughout implementation that connected to the practice of cross-class long-term ability grouping. Primary grade teachers (K-2) where heterogeneous grouping exists, demonstrate the closest alignment to the design of the program. Where long-term ability grouping takes place (3-5), there is the greatest variability in alignment to the approach.
 - Multiple outside consultants have advised the district to reconsider the practice to increase instructional alignment, which will lead to increased achievement for all students.

Actions for 2018-2019

- Grades K-3 will remain as currently configured in heterogeneous classes with differentiation. In Grade 4, all classes will maintain heterogeneous grouping for math starting in 2018-2019.
 - Increase alignment with the approach of the core program:
 - Promote social learning and self-efficacy
 - Implement the program lesson design which includes differentiation options
 - Develop additional differentiated resources to support and extend continued enrichment beyond the core.
 - Maintain supplemental intervention instruction beyond the core math block to support students and ensure remediation needs do not interfere with the rigor of the core instructional block.
 - Continue to involve gifted coordinators in evaluating needs for acceleration and supporting classroom teachers with individualized enrichment to meet the needs of all advanced students (GIEP/non-GIEP).

- Increase opportunities for advanced students to experience deeper real world problem-solving.
- Grade 5 will maintain two levels starting in 2018-19, an enriched level and a heterogeneous on-level group. Factors considered include increased content complexity in grade five and the transition to middle school.
 - Increase alignment with the approach of the core program:
 - Promote social learning and self-efficacy
 - Implement the program lesson design which includes differentiation options for all levels
 - Develop additional differentiated resources to support and extend continued enrichment beyond the core.
 - Maintain supplemental intervention instruction beyond the core math block to support students and ensure remediation needs do not interfere with the rigor of the core instructional block.
 - Continue to involve gifted coordinators in evaluating needs for acceleration and supporting classroom teachers with individualized enrichment to meet needs of all advanced students (GIEP/non-GIEP)
 - Increase opportunities for advanced students to experience deeper real world problem-solving.

Resource Development Recommendations

1. Differentiated question bank and anchor tasks/props by unit
2. Grade level goals for developing social learning/accountable talk/mathematical argumentation in math (with scaffolds and frames to support and provide models for students)
3. Formative assessment bank by unit
4. Anchor charts (a framework for developing the anchor chart; method for sharing)
5. Identify grade level focus areas for mastery/development of both spiral and enriched experience.
 - Define levels of proficiency/mastery from minimum to advanced
 - Articulate a math skills continuum (aligned to both content standards and to standards for mathematical practice)
 - Improved tie-in between skills assessed and report card/progress reporting (not percentage-based and increased communication of skills toward standards for mathematical practice)
 - Clear student-friendly learning objectives with success criteria to increase student self-efficacy, personal goal-setting and metacognition. Develop aligned resources for student reflection/metacognition and goal-setting.

Professional Development Recommendations

- Continued training in in-class flexible groups/ differentiated instruction/ math talk/ effective questioning/formative assessment/standards-based assessment using *Math in Focus* /math coaching
- Continue work to increase awareness of development of STEM mindset, or design thinking focused on identifying and posing the problems or questions to be solved. Long-term mathematical goals for students include developing ability to pose the problems that should be solved, to design multiple approaches to the solution, to engage in mathematical argumentation and reasoning, to explore and defend the most efficient course to the solution, and to develop awareness and ownership of their own development as mathematical thinkers. Continue professional development to ensure teachers of all grades have an understanding of the development of a continuum of problem-solving and problem-posing skills.

Parent Education Recommendations

- Conduct parent education/parent math nights and develop increased parent information resources to increase understanding of:
 - The *Math in Focus*/Singapore Math approach
 - Changes in math standards and practices
 - The connection of deep foundational understanding, math discourse/reasoning and flexibility of thinking to 21st century skills, science and engineering skills and Next Generation Science Standards (NGSS) focused on students as real world problem-solvers.
 - Increased enrichment opportunities for all students
- Increase parent education about the K to 12 sequencing of math instruction to ensure elementary and middle school parent awareness of the increased opportunities for students to reach advanced terminal levels of math in high school.
- Continue work to increase awareness of development of STEM mindset, or design thinking focused on identifying and posing the problems or questions to be solved. Long-term mathematical goals for students include developing ability to pose the problems that should be solved, to design multiple approaches to the solution, to engage in mathematical argumentation and reasoning, to explore and defend the most efficient course to the solution, and to develop awareness and ownership of their own development as mathematical thinkers.

References

- Achieve. (Accessed 2018). Next generation science standards (NGSS). <https://www.achieve.org/our-initiatives>
- Boaler, J. (2016) *Mathematical Mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching*. San Francisco, CA: Jossey-Bass
- Burns, M. (2014). *Uncovering the math curriculum*. Education Leadership, October, p.64-68.
- Clark, A. (2017). Does Singapore pedagogy work in the United States? (Results of Educational Research Institute of America (ERIA) study). <https://www.hmhco.com/programs/math-in-focus>
- Dweck, C. (2006). *Mindset: The new psychology of success*. New York: Random House.
- Dweck, C. (2008). *Mindsets and math/science achievement*. Institute for Advanced Study Commission on Mathematics and Science Education: The Opportunity Equation
- Dweck, C., Walton, G., & Cohen, G. (2014). Academic tenacity mindsets and skills that promote long-term learning. The Bill and Melinda Gates Foundation. <https://files.eric.ed.gov/fulltext/ED576649.pdf>
- Dweck, C. (2010). Even geniuses work hard. *Education Leadership*. 68: 1, 16-20.
- Hattie, J. (2008). *Visible learning: A synthesis of over 800 meta-analyses related to achievement*. New York: Routledge.
- Hattie, J., Fisher, D., & Frey, N. (2017). *Visible learning for mathematics: What works best to optimize student learning*. Thousand Oaks, CA: Corwin.
- Houghton Mifflin Harcourt (Retrieved 2018). *Math in focus Singapore math: Overview*. <https://www.hmhco.com/programs/math-in-focus>
- Kheong, F. H. (N.D.) *Math in Focus: Singapore math by Marshall Cavendish: The underpinning concept*. <https://www.hmhco.com/programs/math-in-focus>
- National Council of Teachers of Mathematics (N.D. Accessed 2018). *Executive summary: Principles to action: Ensuring mathematical success for all*.
- National Council of Teachers of Mathematics (NCTM). (April 26, 2018). *NCTM calls for major changes to high school: Mathematics group calls for end to student and teacher tracking*. <https://www.nctm.org>
- National Council of Teachers of Mathematics (NCTM). (2012). *Closing the opportunity gap in mathematics education: A position of the national council of teachers of mathematics*. <https://www.nctm.org>
- National Council of Teachers of Mathematics. (NCTM). (2014). *Access and equity in mathematics education: A position of the national council of teachers of mathematics*. <https://www.nctm.org>
- National Council of Teachers of Mathematics (NCTM). (N.D. Accessed 2018) *Building STEM education on a sound mathematical foundation: A joint position statement on STEM from the national council of supervisors of mathematics and the national council of teachers of mathematics*. <https://www.nctm.org>
- Institute of Education Sciences National Center for Education Statistics (IES-NCES). (Accessed 2018). *Trends in international mathematics and science study (TIMSS)*. <https://nces.ed.gov/timss/>
- Pennsylvania Department of Education (PDE). (2014). *Academic standards for mathematics: Grades pre-k - high school*. <https://www.pdesas.org/>