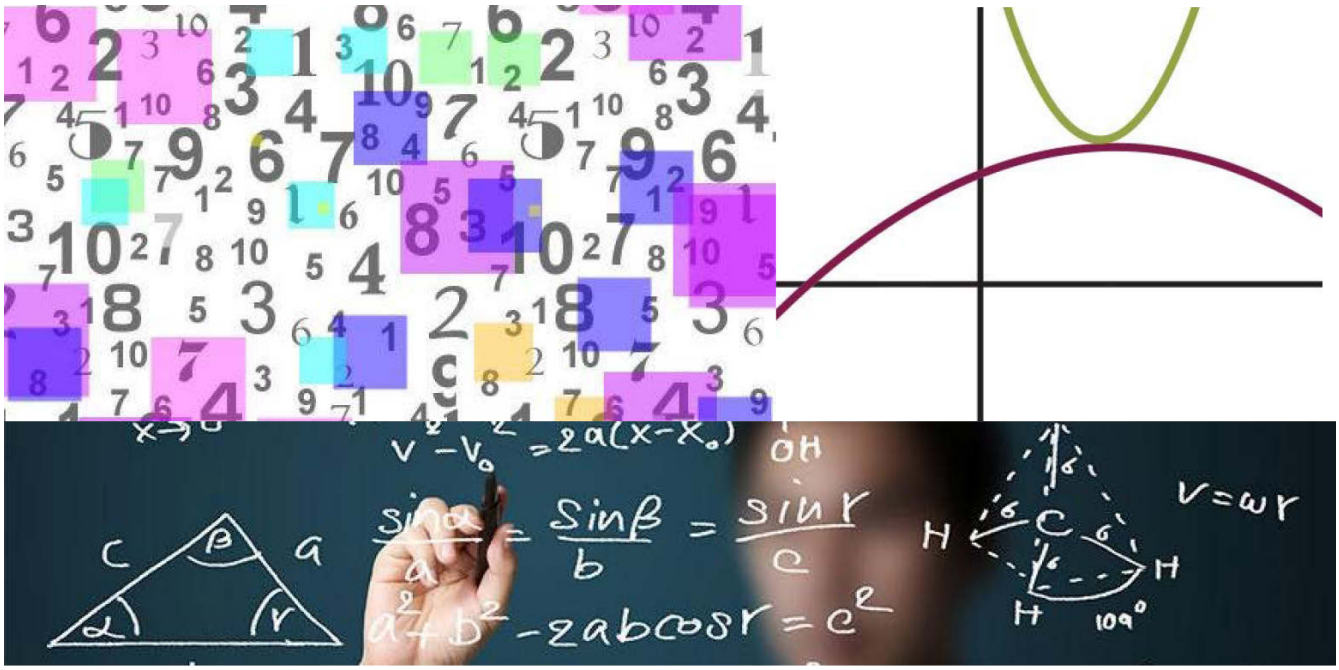

Mathematics Department Program Review

Pine-Richland School District

April 2018

The information contained in this report is provided by the Pine-Richland Mathematics Department for general purposes only. While this report serves as a strategic approach to curriculum planning, recommendations must be considered with respect to all programs provided by Pine-Richland School District.

Mathematics Department Program Review

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Table of Contents

Pine-Richland Board of School Directors 1

Mathematics Department 1

Program Review Report Prepared by: 1

Table of Contents 3

Executive Summary 4

Recommendation Overview 5

In-Depth Program Review Process **Error! Bookmark not defined.**

Continuum of Improvement 9

Emerging Recommendations 10

Works Cited 28

Executive Summary

The mission of the Pine-Richland School District is to *Focus on Learning for Every Student Every Day.* Within the PRSD Strategic Plan, long-term and short-term goals outlined in the Teaching and Learning category form the foundation for continuous improvement. One of the short-term goals for 2016 - 2017 was to design and pilot an in-depth program review. This initial work was conducted in the areas of Science and Health & Physical Education. **For 2017 - 2018, this short-term strategic goal continued with refinements to the process implemented by the Mathematics and Business & Computer Science Departments**. Further information about the purpose and process for this work is outlined in the next section.

The Mathematics Department and Business & Computer Science Departments were identified as areas for further study. This report outlines the process, findings, and recommendations from that work. As an organization, it is understood that the pace of change may be dependent upon the impact of that change on other aspects of the educational program. The committee utilized the action priority matrix to evaluate each recommendation and established an implementation timeline with associated cost estimates.

One element of the in-depth program review was the establishment of a departmental philosophy and vision (Figure 1). For mathematics, the department identified a set of key concepts for consideration ranging from the fundamental skills associated with math facts through the beauty of math that some students find as they progress into more advanced concepts. As a result, the vision is captured through the following image and words:

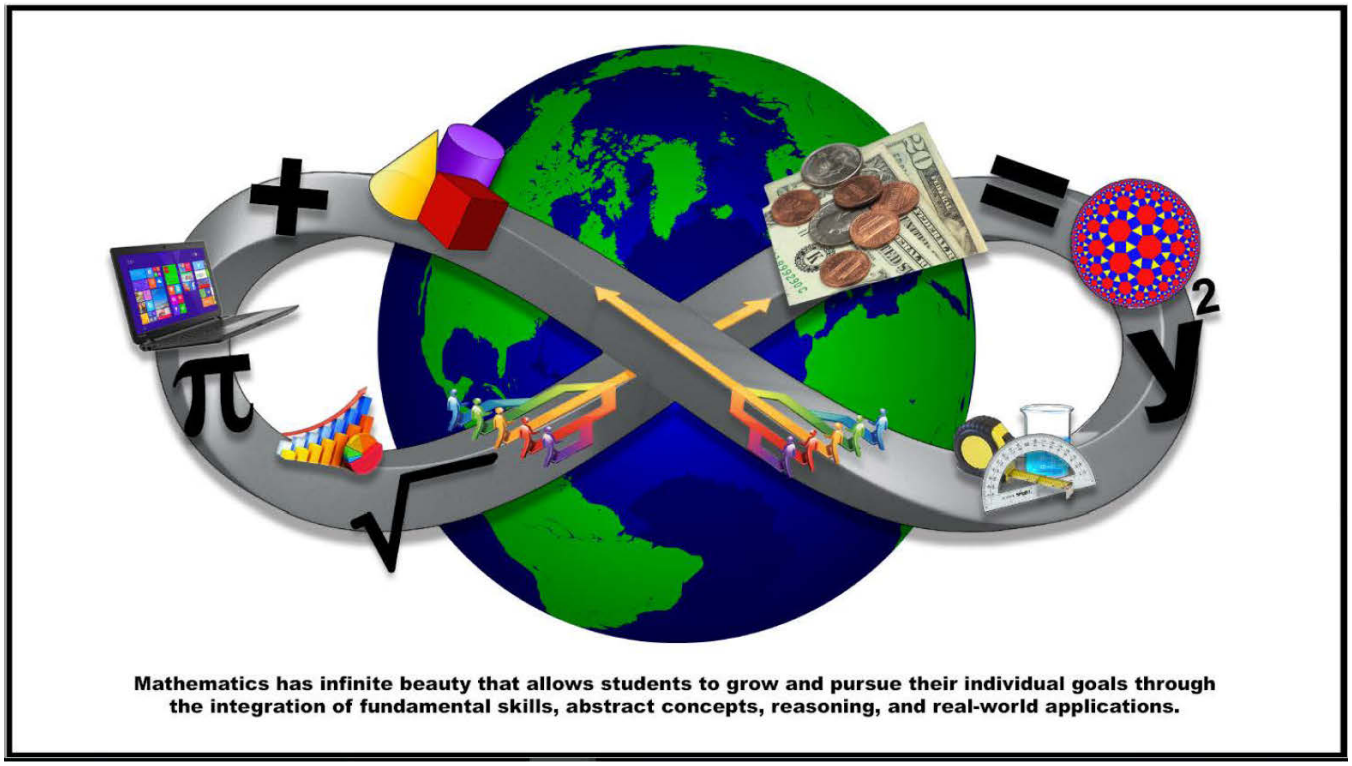


Figure 1

Recommendation Overview

Recommendation #1:
Adopt and widely communicate the Mathematics Department philosophy and vision to internal and external stakeholders while ensuring a practical connection to program design and delivery.

Recommendation #2:
Curriculum:

- Review and revise learning goals and pacing guides within the PRSD curriculum to ensure alignment and integration with PA Core Standards, Assessment Anchors, Eligible Content, standards of math practice, and conceptual understanding.
- Ensure that resources are implemented by PRSD staff with fidelity as outlined in the resource section of the written curriculum.
- Select and implement a systematic and research-based basic math fact fluency program for initial implementation during the 2019-2020 school year.

Recommendation #3:
Instruction:

- Develop students' problem-solving and reasoning skills through the integration of the standards of math practice in all K-12 courses, including developing math-specific communication skills.
- Utilize "Number Talks" in primary grades as a repeated and consistent strategy to think about and discuss mathematics in order to establish number sense and conceptual understanding.
- Embed opportunities for students to consistently connect classroom learning activities to real-world experiences and events.
- Evaluate the time allocated at each level for remediation and enrichment to determine potential changes in structure or approach.

Recommendation #4
Assessments:

- Develop high quality common assessments with questions varying in type and depth of knowledge requirements.
    - Regularly meet to discuss the data to drive future instructional and curricular decisions.
- Evaluate the use of current benchmark and diagnostic assessments (e.g., CDT, ALEKS) in grades 6-11 to determine which provide the most useful data for guiding instructional decisions.
- Develop and communicate an assessment-based guide for determining course acceleration.
- Update the mathematics decision tree to guide teachers in supporting all learners at the Tier 1, 2, and 3 level (e.g., Tier 1 flexible grouping and differentiation, Tier 2 and 3 interventions for support and extension).
- Develop and implement consistent gradebook, grading practices, and syllabi across courses or grade levels.

Recommendation #5

Professional Development

- Identify multiple opportunities within the district in-service calendar to focus specifically on math-related professional development. Design professional development to:
    - Ensure that classroom expectations align to the standards of mathematical practices for all K-12 math classrooms.
    - Build conceptual understanding that includes problem-solving and collaboration.
    - Recognize and choose cognitively-demanding tasks and lead discussions about the task.
    - Incorporate textbook and supplemental resources adopted by the school district (e.g., ALEKS).
- Provide math-specific training for special education staff, gifted education staff, and paraeducators who support students within math classrooms.

Recommendation #6

Equipment/Resources/Technology

- Evaluate math resources for students in courses beyond Algebra I.
- Identify technology resources to support mathematical learning (i.e., hardware and software).
- Identify and utilize intervention and enrichment resources for students in grades K-12 (Tier I, II, and III).
- Identify and select physical and/or virtual manipulatives to deepen students' understanding of abstract and real-world concepts.

Recommendation #7

Community Connections/Partnerships

- Develop partnerships with businesses, universities, and professional organizations to build positive relationships and create learning opportunities for all students.

Recommendation #8

Program of Studies/Course Offerings

- Modify existing courses and/or add new courses to better support students who are not ready for Algebra I by 8th grade and/or may be struggling in Algebra 1.
- Modify the *Concepts of Mathematics* course to better support the diverse needs of the learners in the course.
- Review, collect data, analyze, and formalize the waiver process to ensure students are challenged at the appropriate level and prepared for future courses.

In-Depth Program Review Process

The process for in-depth program review was developed in the 2016 - 2017 school year and refined throughout the 2017 - 2018 school year. To help ensure a clear understanding of the process elements, a process diagram was developed and reviewed on a regular basis. Major elements of this image are further described below:

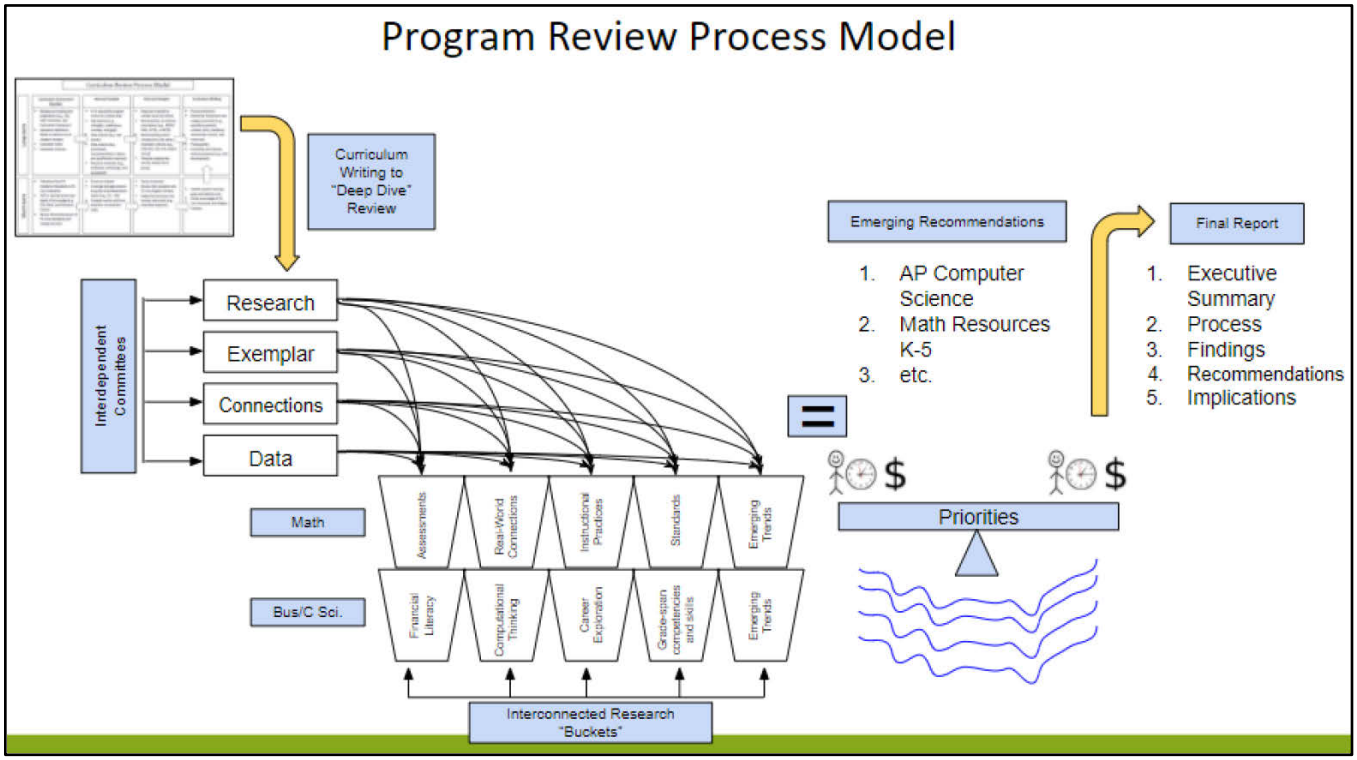


Figure 2

Curriculum Writing to "Deep Dive"

Given the time and effort invested into curriculum writing at Pine-Richland from 2014 - 2016, it is important to understand the relationship of that work to the in-depth program review process. The two-year curriculum writing process was designed to capture the current content in a consistent format through vertical teams (e.g., units, big ideas, and learning goals). That process allowed the department to identify strengths and opportunities for improvement. Most of the attention was directed internally at a review of our district's current structure and practices.

The **in-depth program review process has a broader focus** on all elements of the department. Importantly, the process was designed to emphasize a balance of internal needs and a review of best practices from external sources. It asks questions, such as, "Are we doing the right things?" or "Do we need to consider more significant changes in program design?" In the image above, the curriculum writing process is like a "springboard" to "dive" more deeply into the content area. The personnel, structure, and work were organized into four major sub-committees.

Committee Composition and Structure

We strongly believe that meaningful and lasting change requires engagement of all key stakeholders. Since the in-depth process was being developed and implemented at the same time, the first organizational decision was the use of a **core team** and an **expanded team**. The core team included several district office administrators, building principals/assistant principals based on vertical team assignment, and a small group of academic leadership council members (i.e., department chairs) and teachers. The core team conducted the planning and thinking

necessary to maximize the efficiency and effectiveness of the expanded team. The expanded team included all core team members and additional teachers to ensure representation by all buildings, levels, and courses. Although this was a larger group, it was still a small representation of the overall mathematics department.

Within the expanded team, members were then organized by **four main subcommittees**: (1) Research; (2) Exemplar K-12 Schools; (3) Connections to Universities, Businesses, and the Community; and (4) Data and Information. While each subcommittee was responsible for specific tasks, two overarching elements were critical. First, the arrows on the left side of the subcommittees indicate that the groups must collaborate and exchange information (i.e., no silos). Second, the arrows on the right side of the subcommittees demonstrate that key findings/learning were captured and organized by major research buckets.

It is important to note that the expanded teams also used a systematic approach to listen to students and parents. Student focus groups were organized at the high school, middle school, and Eden Hall. These groups were representative of the student body and a wide range of academic rigor. In addition, parent and community input was gathered during day and evening town hall sessions. Parents who were unable to attend those face-to-face meetings were able to submit comments electronically.

Research "Buckets"

Within each discipline, five key areas of investigation were identified to guide the work of the subcommittees. **As mathematics information was gathered by subcommittees, it was organized into five key "buckets": (1) Assessments; (2) Real-world Connections; (3) Instructional Practices; (4) Standards; and (5) Emerging Trends.** In the early months of the process, the "buckets" were dynamic, meaning that some initial concepts were removed or combined with other key themes. As the expanded team continued to learn, those titles were then finalized. Importantly, the arrows on the bottom of the buckets also demonstrate the relationship between areas (i.e., no silos). The subcommittees' learning and identification of information for the buckets were interconnected, as information from one area informed others. Based upon the information gathered through the bucket findings, a set of emerging recommendations was developed.

Emerging Recommendations

A systems thinking approach was critical to the in-depth program review process. The transition from "findings" to "emerging recommendations" required skills of synthesis, critical thinking, healthy debate, and communication. The entire expanded team used one set of lenses to review the list of internal strengths and weaknesses. The lenses refer to the four subcommittees. Some emerging recommendations were designed to improve current gaps and weaknesses. Other emerging recommendations were identified in the analysis of exemplary programs, universities, businesses, or in the research literature. The team brainstormed recommendations by identifying recurring themes, ideas, and opportunities for growth. The team then discussed, modified, and edited the recommendations. Emerging recommendations were consolidated into a draft. The expanded team worked with the draft to link the emerging recommendations to data provided by the subcommittees.

Balancing Priorities and Resources

As a system, the "ripple effect" of recommendations was built into the process model. The team then put the emerging recommendations into the action-priority matrix. The action-priority matrix evaluates the impact versus the effort of the emerging recommendations. Examining the use of people, time, and money allows for the identification of which recommendations were quick fixes, major projects, fill-ins, and hard slogs. For example, a hard slog was used to categorize those recommendations that would require much effort but have little impact on student learning. The team then identified the final emerging recommendations.

Action Priority Matrix

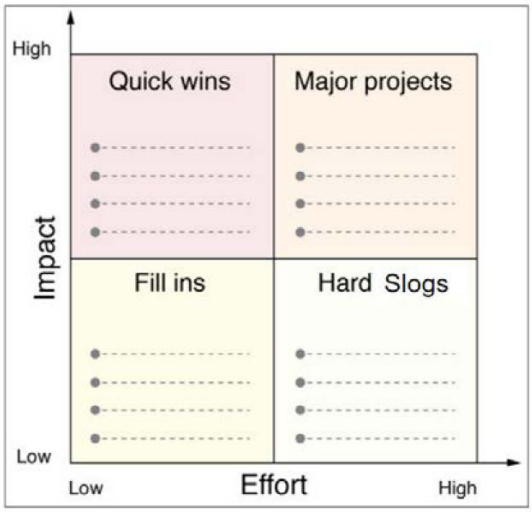


Figure 3: Elmansy, Rafiq. "Time Management Tips for Designers: The Action Priority Matrix."*Designorate,* 14 June 2016, www.designorate.com/time-management-the-action-priority-matrix/. Accessed 14 Mar. 2017.

Continuum of Improvement

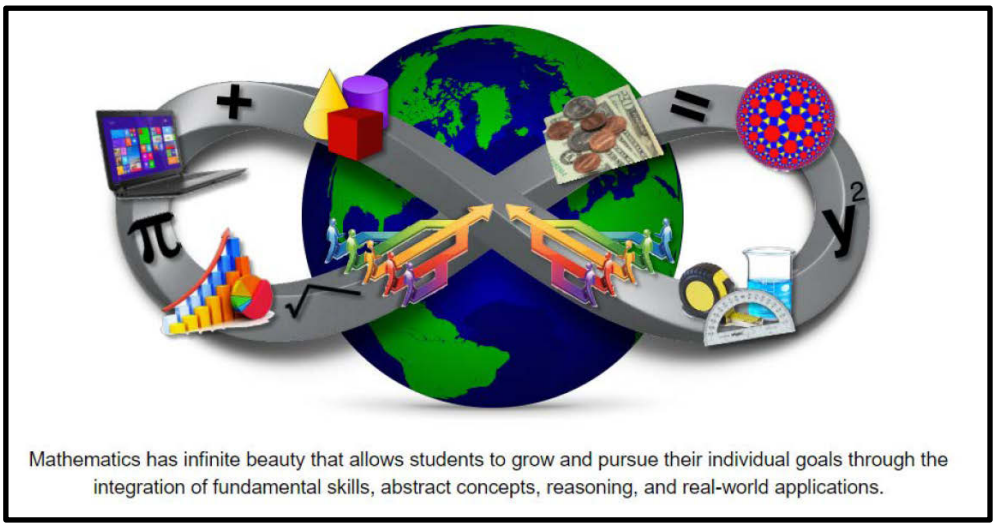
Throughout the in-depth program review process, it was important to maintain perspective on the nature of program improvements. Especially when considering effective elements of exemplary schools or programs, the desire to move from the current program ("Point A") to an ideal future ("Point Z") is natural. However, it is more realistic to recognize that meaningful program improvement within an organizational system will often result from a series of smaller steps ("Points B, C, D, etc."). Although depicted as a straight line in the image below (figure 4), the in-depth program review committee recognizes that continuous improvement is not always a linear process.



Figure 4

Emerging Recommendations

Recommendation #1:
Adopt and widely communicate the Mathematics Department philosophy and vision to internal and external stakeholders while ensuring a practical connection to program design and delivery.



Mathematics has infinite beauty that allows students to grow and pursue their individual goals through the integration of fundamental skills, abstract concepts, reasoning, and real-world applications.

FINDINGS:

Internal Analysis

1. There is no formal, articulated, and shared philosophy or vision statement for the Mathematics Department (PRSD Vertical Team, 2018).
2. The Math Pathways have been shared with internal and external stakeholders through the High School Program of Studies and elementary math pathways overview presentations, but the pathways are only part of the Mathematics Department program (PRSD Vertical Team, 2018).
3. Problem solving and real-world applications need to be embedded through open-ended resources (PRSD Vertical Team, 2018).
4. During Town Hall Meetings, parents indicated that school topics that "make it to the dinner table" are heavily based in real-world problems/projects (PRSD Parent/Community Focus Group, 2018).

External Analysis

1. Foundational skills formed in the elementary years lead to success at the middle and secondary level (Mt. Lebanon SD, 2018).
2. Fact fluency is needed to enhance computation to assist real-world problem solving (Central Bucks SD, 2018).
3. Core team of math teachers employ techniques to help connect real world themes (New Hope-Solebury SD, 2018).
4. Application and real-world problems should be part of the majority of lessons (Slippery Rock University, 2018).
5. The PA Core Standards define the knowledge and skills students will need to be prepared for the careers of tomorrow, including the ability to communicate effectively, work in groups, apply math in real-world

situations, read and analyze both literature and informational text, construct viable arguments and critique the reasoning of others, and persevere in solving problems. These standards offer "a foundation for the development of more rigorous, focused, and coherent mathematics curricula, instruction, and assessments that promote conceptual understanding and reasoning as well as skill fluency" (Pennsylvania Department of Education, 2017).

6. "There is real-life application of almost every form of mathematics. It does not mean that every student will use every piece of mathematics that they learn, but it does mean we can show them how we can use that bit of mathematics to understand and explain something around us." (Kitchen, 2016).
7. There is concern with the increasing proportion of students arriving as freshmen (college) with weak foundational math skills (more specifically Algebraic skills). It was suggested that students are accelerating through Algebra courses to higher level courses at the expense of developing sound fundamental skills (University of Pittsburgh, 2018).
8. "Effective teaching practices provide experiences that help students to connect procedures with the underlying concepts and provide students with opportunities to rehearse or practice strategies and to justify their procedures." (National Council of Teachers of Mathematics, 2017).

Implementation Timeline (Anticipated Start/Finish): 5/1/18 - 9/30/18

Key Personnel: Mathematics Core Team Members and Director of Communications

Major Action Steps: (1) Finalize words and image; (2) Disseminate to all members of the K-12 mathematics department; (3) Publish on district website; (4) Discuss with students and parents at the start of the 2018 - 2019 school year via syllabus and open house/curriculum nights; (5) Incorporate into published mathematics curriculum documents; and (6) Incorporate into programs of studies.

Estimated Budget/Resources: There is a limited cost associated with producing posters. No other costs are anticipated.

Potential Implications (Short-Term and Long Term): The development, understanding, and communication of a clearly articulated mathematics department vision/philosophy should strengthen program delivery for all stakeholders (i.e., staff, students, and parents). It provides a perspective that can be reinforced and considered when making future program decisions.

Recommendation #2:

Curriculum:

- Review and revise learning goals and pacing guides within the PRSD curriculum to ensure alignment and integration with PA Core Standards, Assessment Anchors, Eligible Content, standards of math practice, and conceptual understanding.
- Ensure that resources are implemented by PRSD staff with fidelity as outlined in the resource section of the written curriculum.
- Select and implement a systematic and research-based basic math fact fluency program for initial implementation during the 2019-2020 school year.

FINDINGS:

Internal Analysis

1. There is an imbalance between developing computational fluency and conceptual understanding (PRSD Vertical Team, 2018).
2. PA Core Standards and eligible content need to be appropriately integrated into all courses (PRSD Vertical Team, 2014).
3. Given existing textbook resources at the elementary level and alignment of those resources to PA Core Standards, teachers have heavily supplemented district materials with resources found through individual research (PRSD Vertical Team, 2018).
4. The resources section of the PRSD curriculum maps vary by grade level and/or course due to the lack of alignment of resources to PA Core Standards (PRSD Vertical Team, 2018).
5. A consistent and systematic approach to math facts does not currently exist (PRSD Vertical Team, 2018).
6. There is a need for consistent math fact mastery at each grade level (PRSD Vertical Team, 2014).
7. As part of the textbook review and evaluation process, the representative committee of PRSD teachers and administrators specifically evaluated the resources for alignment with PA Core Standards (PRSD Vertical Team, 2018).

External Analysis

1. The PA Core Standards define the knowledge and skills students will need to be prepared for the careers of tomorrow, including the ability to communicate effectively, work in groups, apply math in real-world situations, read and analyze both literature and informational text, construct viable arguments and critique the reasoning of others, and persevere in solving problems. These standards offer "a foundation for the development of more rigorous, focused, and coherent mathematics curricula, instruction, and assessments that promote conceptual understanding and reasoning as well as skill fluency" (Pennsylvania Department of Education, 2017).
2. "Standards cannot be viewed or addressed in isolation, as each standard depends upon or may lead into multiple standards across grades; thus, it is imperative that educators are familiar with both the standards that come before and those that follow a particular grade level. These revised standards reflect instructional shifts that cannot occur without the integrated emphasis on content and practice" (Pennsylvania Department of Education, 2017).
3. Exemplar schools design common assessments aligned to PA Core standards (Upper St. Clair SD, Central Bucks SD, and Hampton Township SD, 2018).

4. "Over the last quarter-century, high school mathematics education has been documented to be an essential element in advancing students' overall academic achievement, college readiness, and postsecondary success" (American Secondary Education, 2011).
5. Some systematic approaches to vertical team meetings and/or coordination through teacher-leaders (chairs, supervisors, etc.) are used to improve consistency (New Hope-Solebury SD, 2018).
6. Everyday math computational skills are imperative for programs at Beattie and the careers that are aligned with those programs (A. W. Beattie, 2018).
7. Exemplar schools focus on math fact fluency at the primary level (Peters Township SD, New Hope SD, Central Bucks SD, and Hampton Township SD, 2018).
8. Concrete and hands-on materials help all students, especially struggling learners (Slippery Rock University, 2018).
9. One teacher at each building serves as a curriculum leader and works an additional 20 days (Upper St. Clair SD, 2018).
10. Curriculum is reviewed on a five-year cycle and connected through Performance Tracker (New Hope-Solebury SD, 2018).
11. Semi-annual formal curriculum meetings are held to discuss small curriculum changes (Upper St. Clair SD, 2018).
12. Understanding by Design is used as the approach for designing curriculum (Mt. Lebanon SD, Peters Township SD, and Hampton Township SD, 2018).
13. Fact fluency is needed to enhance computation to assist real-world problem solving (Central Bucks SD, 2018).
14. Upper St. Clair and Central Bucks School Districts consistently monitor vertical alignment of curriculum over time through established mechanisms (Upper St. Clair SD and Central Bucks SD, 2018).

Elementary Curriculum Revision

Implementation Timeline (Anticipated Start/Finish): K-5 curriculum revision will begin 6/1/2018 and continue through first step implementation for the 2018 - 2019 school year. For other grade levels and/or courses, work on the curriculum recommendation is ongoing.

Key Personnel: K-5 Math Teachers, Math Department Chairs, Administrative Liaisons, and Assistant Superintendents

Major Action Steps: (1) Finalize purchase and adoption of K-5 math resources. (2) Conduct professional development and training on new resources. (3) Revise pacing guide and curriculum maps. (4) Continually meet at grade level/subject areas to review and revise learning goals and pacing guide within the PRSD curriculum. (5) Monitor the use of newly purchased resources for consistency across courses, such as lesson plans, monthly department meetings, walk-throughs, and observations. (6) Reflect after the 2018 - 2019 school year to clarify revisions in pacing guide and use of resources after gaining the experience of the first year implementation.

Estimated Budget/Resources: Curriculum revision costs are based on ancillary rate and/or substitutes for writing team members. Given the connection between mathematics learning goals and textbook resources, the adoption of new resources is linked to this recommendation. The district supports an annual budget for textbook and resource replacement. Priorities for textbooks are evaluated across all departments and grade levels. For example, text resources for grades 6 - 8 and Algebra 1 were purchased for use in the 2017 - 2018 school year. Purchasing of text resources for K - 5 will occur for use in the 2018 - 2019 school year. Geometry and other high level courses will be determined for future years.

Potential Implications (Short-Term and Long-Term): The PRSD Model for Teaching and Learning describes the overlap and integration of curriculum, instruction, and assessment. Curriculum identifies the big ideas and learning goals associated with specific units and courses. Work conducted in this area will impact the daily mathematics program for all students.

Math Facts Program
Implementation Timeline (Anticipated Start/Finish): 4/30/2018 - 8/30/2018

Key Personnel: K-5 Math Teachers, Math Department Chairs, Administrative Liaisons to the Department, and Assistant Superintendents

Major Action Steps: (1) Develop a committee to research, identify, choose, and purchase a math fact fluency program. (2) Conduct professional development and training on new resource. (3) Monitor use of newly purchased program for consistency through lesson plans, monthly department meetings, walk-throughs, and observations.

Estimated Budget/Resources: Costs finalized after program selection.

Potential Implications (Short-Term and Long-Term): Given the importance of basic math fact fluency, a consistent approach to mastery and automaticity allows most students to focus attention on concepts and problem solving. For a smaller group of students, the use of additional tools can be used to support a deficit in basic facts that also allow a similar transition to problem solving (e.g., calculators).

Recommendation #3:

Instruction:

- Develop students' problem-solving and reasoning skills through the integration of the standards of math practice in all K-12 courses, including developing math-specific communication skills.
- Utilize "Number Talks" in primary grades as a repeated and consistent strategy to think about and discuss mathematics in order to establish number sense and conceptual understanding.
- Embed opportunities for students to consistently connect classroom learning activities to real-world experiences and events.
- Evaluate the time allocated at each level for remediation and enrichment to determine potential changes in structure or approach.

FINDINGS:

Internal Analysis

1. Community members expressed that "collaboration, communication, critical thinking, and problem-solving are important skills" (PRSD Parent/Community Focus Group, 2018).
2. Students appreciate an "anchor" problem to help them see the connections between the learning in class to a real-world application (PRSD Student Focus Groups, 2018).
3. Students indicated that it is beneficial to implement peer collaboration and explanation to enhance their understanding (PRSD Student Focus Groups, 2018).
4. Constructed responses and math specific communication skills continue to be an area of weakness for students (PRSD Academic Achievement and Growth Report, 2017).

External Analysis

1. Engage students in the Standards of Math Practice (Allegheny Intermediate Unit, Slippery Rock University, 2018).
2. Math communication skills are imperative; students need more face-to-face and verbal communication practice (A. W. Beattie, First Commonwealth Bank, 2018).
3. Number Talks should be incorporated to encourage students' ability to explain their logic and strategy to make their thinking visible to the teacher and others (National Council of Teachers of Mathematics, 2017; McGraw Hill Resource Review, 2018; Quaker Valley Site Visit, 2018).
4. Using evidence, students need to support an argument and summarize their findings (University of Pittsburgh, 2018).
5. "Number Talks are a great way to teach in a student-centric manner as they help students learn to think and behave like a mathematician. Students share their ideas on how and why they solved the expression the way they did and the teacher records the student's thinking in a non-evaluative manner, probing for clarification if specific steps or decisions are unclear" (National Council of Teachers of Mathematics, 2017).
6. "Research clearly suggests that problem solving should not be taught as a separate topic in the mathematics curriculum. In fact, research tells us that teaching students to use general problem-solving strategies has little effect on their success as problem solvers" (National Council of Teachers of Mathematics, 2010).
7. Upper St. Clair School District embeds a written component on all math assessments. (Upper St. Clair SD, 2018).

8. Students participate in competitions and STEM activities when invited or identified by the enrichment teacher. (Poff Elementary, 2018).
9. Learning activities need to be relevant to students: not necessarily real-world, but "real to the child's world" (Allegheny Intermediate Unit, 2018).
10. Authentic problems help students grasp concepts and think systematically (A.W. Beattie, 2018).
11. "Mathematics needs to be taught within situated, problem-based curricula that narrow the gap between abstract mathematics and its uses in the world. There also needs to be more emphasis on visualizing, orienting, plotting, locating, and reasoning." (Mathematical Association of America, 2006).
12. "There is real-life application of almost every form of mathematics. It does not mean that every student will use every piece of mathematics that they learn, but it does mean we can show them how we can use that bit of mathematics to understand and explain something around us." (Kitchen, 2016).
13. Time devoted to mathematics in exemplar schools is consistent with the approach at PRSD (Central Bucks SD, Quaker Valley SD, and New Hope-Solebury SD, 2018).
14. Fact fluency is needed to enhance computation to assist real-world problem solving (Central Bucks SD, 2018).
15. Monthly instruction practice meetings are held to review specific best practices among staff (Upper St. Clair SD, 2018).

Implementation Timeline (Anticipated Start/Finish): 5/1/2018 - 6/1/2020

Key Personnel: K-12 Mathematics Teachers, Mathematics Department Chairs, Keystone Remediation Administrator, PRSD Principals, and Assistant Superintendents

Major Action Steps: (1) Identify and provide professional development for staff related to the standards of math practice; (2) Identify number talk resources and integrate those learning activities into elementary mathematics classes; (3) Research and identify remediation and enrichment interventions for mathematics; (4) Develop and implement an early intervention experience for students based on score projections; (5) Communicate the need for early intervention courses to applicable students and their parents annually; (6) Review current supplemental instruction model and identify opportunities for improvement; and (7) Analyze the impact of new supplemental instruction and proactive remediation courses on students' Keystone success rates.

Estimated Budget/Resources: Potential costs are associated with the intervention programs. Number talk resources may need to be developed or purchased. Our current remediation model for Algebra I Keystone exam supplemental instruction includes the following resources: USA Test Prep or every other day direct instruction.

Potential Implications (Short-Term and Long-Term): Increasing instruction related to problem solving and number talks will likely improve students' computational thinking skills. Ongoing professional development and modeling will be needed for staff. As a result of these changes, students should be better prepared to demonstrate their mastery levels through the Keystone assessments and be equipped with the necessary knowledge and skills to be successful after graduation. If we are utilizing the Pennsylvania Value Added Assessment System (PVAAS) projected scores, we should be able to remediate students with needs, prior to them taking an assessment and needing to enroll in supplemental instruction as a result of a non-passing score.

Recommendation #4

Assessments:

- Develop high quality common assessments with questions varying in type and depth of knowledge requirements.

    - Regularly meet to discuss the data to drive future instructional and curricular decisions.
- Evaluate the use of current benchmark and diagnostic assessments (e.g., CDT, ALEKS) in grades 6-11 to determine which provide the most useful data for guiding instructional decisions.
- Develop and communicate an assessment-based guide for determining course acceleration.
- Update the mathematics decision tree to guide teachers in supporting all learners at the Tier 1, 2, and 3 level (e.g., Tier 1 flexible grouping and differentiation, Tier 2 and 3 interventions for support and extension).
- Develop and implement consistent gradebook, grading practices, and syllabi across courses or grade levels.

FINDINGS:

Internal Analysis

1. ALEKS is helpful in guiding us to areas of strength and weakness (PRSD Student Focus Groups, 2018).
2. There is a need for ensuring the concept and skill mastery of students who take courses outside of Pine-Richland in order to accelerate appropriately through our program (PRSD Vertical Team, 2014).
3. During town hall meetings, parents indicated that school topics that "make it to the dinner table" are heavily based in real-world applications or projects (PRSD Parent/Community Focus Group, 2018).
4. Students value an "anchor" problem to help them see the connection connect the learning in class to the real-world (PRSD Student Focus Groups, 2018).
5. Constructed responses continue to be an area of weakness for students (PRSD Academic Achievement and Growth Report, 2017)
6. Opportunities exist to narrow the range of readiness levels in math classrooms in grades 3-8 (PRSD Vertical Team, 2014).

External Analysis

1. “An excellent mathematics program ensures that assessment is an integral part of instruction, provides evidence of proficiency with important mathematics content and practices, includes a variety of strategies and data sources, and informs feedback to students, instructional decisions, and program improvement” (National Council of Teachers of Mathematics, 2014).
2. Academic equity is promoted through locally designed common assessments that are aligned to PA Core standards. (Upper St. Clair SD and Central Bucks SD, 2018).
3. Developing and using common assessments to determine whether students have learned the agreed-on content and related practices is a best practice (National Council of Teachers of Mathematics, 2017).
4. “Multiple-choice testing vs. constructive-response testing are only two means of assessment, which sit at opposite ends of the assessment continuum. Constructed response assessments take longer, yet are recommended as teachers can better assess what students know” (National Council of Teachers of Mathematics, 2017).
5. It is recommended that teachers, “continually monitor and respond to their students’ progress through formal and informal means, including - but not limited to - effective questioning and classroom discussion, conducting interviews with individual students, having students respond to prompts in math journals, answering real-time questions through the use of clickers or mobile devices, or responding to a prompt on an exit slip” (National Council of Teachers of Mathematics, 2017).

6. "To determine the instructional direction, a teacher needs to know how students in the classroom vary in their mathematical developmental level. The data derived from prior assessment should drive how instruction is differentiated" (Small & Lin, 2010).
7. Upper St. Clair administers pre-test and post-test assessments to measure growth and utilize flexible grouping. (Upper St. Clair SD, 2018).
8. Several external organizations cautioned against skipping grades/levels in math (Allegheny Intermediate Unit, University of Pittsburgh, Quaker Valley Site Visit for Mathematics Resources, 2018).
9. There is concern with the increasing proportion of students arriving as freshmen (college) with weak foundational math skills (more specifically Algebraic skills). It was suggested that students are accelerating through Algebra courses to higher level courses at the expense of developing sound fundamental skills (University of Pittsburgh, 2018).
10. Some exemplar schools prefer "doubling up" math courses as opposed to accelerating. (Upper St. Clair SD, New Hope-Solebury SD, Mt. Lebanon SD, 2018).
11. Summer acceleration is permitted but is limited by a district policy of 80% on all unit tests and final exams (Upper St. Clair SD, 2018).
12. Teachers are encouraged to think like assessors to evaluate the evidence necessary to substantiate that learning has occurred at the appropriate level of rigor and to design instruction to ensure students' mastery of these benchmarks (Wiggins & McTighe, 2005).
13. Assessments are not designed to simply generate grades, but should be viewed through an integrated lens linking the results to necessary adjustments to instruction and curriculum (Wiggins & McTighe, 2005).
14. Simply assessing a student, without providing meaningful, formative feedback, will not lead to increased learning. It is only through ongoing, clear feedback and encouragement towards growth tied to learning goals that students might improve (Marzano, 2006).
15. Teachers of similar courses and grade levels are encouraged to meet regularly to review student work and check for understanding. This process involves the team using common assessment results to alter their instructional approach and reflect on the curiculum, after sharing best practices backed by evidence in student performance (Fisher & Frey, 2007).
16. Reviewing assessment data to inform instructional and curricular decisions is cyclical and continuous. Reviewing the results frequently and formatively can provide opportunities or differentiation and interventions for learners across the spectrum, ensuring that they master the content and skills in a manner that transfers to real world scenarios (Fisher & Frey, 2007).

Implementation Timeline (Anticipated Start/Finish): 5/1/18 - 6/1/2020

Key Personnel: K-12 Mathematics Teachers, Learning Support Teachers, Mathematics Department Chairs, PRSD Principals, and Assistant Superintendents

Major Action Steps: (1) Establish the frequency with which common assessments will take place and create a schedule for their administration annually; (2) Develop common assessments utilizing a variety of knowledge depths and types; (3) Create a shared folder of common assessments and scoring guidelines; (4) Create a database for entering scores from common assessments for analysis; (5) Train teachers in the use and scoring of common assessments and ensure interrater reliability; (6) Schedule departmental time to analyze and report on scores from common assessments; (7) Build a cycle of continued review, analysis, reporting, and implementation of subsequent, responsive curricular and instructional actions; (8) Modify the mid-term and final exams across courses. Scheduling of exams will need to be adjusted based upon course vs. period;

(9) Review current assessments if grades 6-11 for time, stretch, and utility; (10) Revise the mathematics decision tree based upon the recommendations from this review; and (11) Create an assessment/grading team to identify the most effective practices related to feedback and grading.

Estimated Budget/Resources: If this writing occurs during the school year on non-in-service days, the cost of substitutes and/or ancillary pay could be incurred.

Potential Implications (Short-Term and Long-Term): Within the model for teaching and learning, instruction and curriculum will be better aligned with the assessments as a common benchmark. Teachers will be able to utilize the data gleaned from common assessments to adjust their own instruction to be responsive to learners. Additionally, changes to the curriculum and/or instructional strategies could be explored and documented for the department to utilize when helping students successfully master and employ the concepts and skills intended through the written curriculum. Discussions related to consistency in gradebook development, grading, and syllabi design along with written curriculum and high-quality resources should further tighten the learning experiences for students.

Recommendation #5

Professional Development

- Identify multiple opportunities within the district in-service calendar to focus specifically on math-related professional development. Design professional development to:
    - Ensure that classroom expectations align to the standards of mathematical practices for all K-12 math classrooms (e.g. number talk instructional strategies).
    - Build conceptual understanding that includes problem-solving and collaboration.
    - Recognize and choose cognitively-demanding tasks and lead discussions about the task.
    - Incorporate textbook and supplemental resources adopted by the school district (e.g., ALEKS, Red Bird).
- Provide math-specific training for special education staff, gifted education staff, and paraeducators who support students within math classrooms.

FINDINGS:

Internal Analysis:

1. Various practices are utilized in scoring and recording graded assignments across courses and content areas (SWOT or PRSD Mathematics In-Depth Program Review, 2014 or 2018).
2. Limited supports and lack of consistent resources exist for students in need of remediation or enrichment on our MTSS Decision Trees (PRSD Mathematics In-Depth Program Review Committee, 2018).

External Analysis:

1. "At the heart of the challenge associated with student-centered practice is the need to strike an appropriate balance between giving students authority over their mathematical work and ensuring that this work is held accountable to the discipline" (Stein, et al, 2008).
2. Professional development sessions are a combination of classroom experiences and on the job experiences (First Commonwealth Bank, 2018).
3. "Mathematical tasks with which students become engaged determine not only what substance they learn but also how they come to think about, develop, use, and make sense of mathematics" (459). "When employing the construct of the mathematical task...one needs to be constantly vigilant about the possibility about the tasks with which students actually engage may or may not be the same task that the teacher announced at the outset" (Stein, et al, 1996).
4. "Tasks that ask students to perform a memorized procedure in a routine manner lead to one level of thinking; tasks that ask students to think conceptually lead to a very different set of thinking processes" (Smith and Stein, 1998).
5. "Effective teaching practices provide experiences that help students to connect procedures with the underlying concepts and provide students with opportunities to rehearse or practice strategies and to justify their procedures" (National Council of Teachers of Mathematics, 2017).
6. "Programs in teacher education and professional development must continually support practitioners in their development of knowledge of technology and its application to support learning" (National Council of Teachers of Mathematics, 2017).
7. "To determine the instructional direction, a teacher needs to know how students in the classroom vary in their mathematical developmental level. The data derived from prior assessment should drive how instruction is differentiated" (Small & Lin, 2010).

8. Professional learning community meetings are held to review assessment data and to revise assessments (Upper St. Clair SD, 2018).
9. Eight days of professional development are used for vertical K-12 team collaboration (New Hope-Solebury SD, 2018).
10. Strategies include student-centered learning activities where the instruction moves from the whole group to each individual student (The Flipped Classroom: An Avenue for Student Centered Learning, 2015).

Implementation Timeline (Anticipated Start/Finish): 5/1/2018 - Ongoing

Key Personnel: Professional Development Committee, Mathematics Department Chair, and Assistant Superintendents

Major Action Steps: (1) Identify prioritized needs for both general and grade-specific professional development across the K-12 mathematics teachers and staff who support students in mathematics classrooms; (2) Allot departmental and/or grade level in-service time for identified training needs when outlining the professional development calendar; (3) Create professional learning networks among teachers to collaborate regarding instructional approaches and resources; and (4) Demonstrate results based upon changes in teaching and learning resulting from the professional development sessions to advocate for and guide future trainings.

Estimated Budget/Resources: Outside providers or guest speakers might have fees associated with their workshops or presentations. Utilizing a train-the-trainer model would allow us to send a staff member to a conference or professional development session for the cost of one person with the understanding that they will share their learning with their colleagues. Allegheny Intermediate Unit's math and science collaborative will serve as a resource.

Potential Implications (Short-Term and Long-Term): Connecting the professional development sessions to results and setting expectations for implementation will ensure an instructional benefit for students and teachers alike. Establishing professional learning networks and ingraining collaboration among teachers will assist in the refinement of teaching and learning opportunities and result in the sharing of best practices.

Recommendation #6

Equipment/Resources/Technology

- Evaluate math resources for students in courses beyond Algebra I.
- Identify technology resources to support mathematical learning (i.e., hardware and software).
- Identify and utilize intervention and enrichment resources for students in grades K-12 (Tier I, II, and III).
- Identify and select hands-on and/or virtual manipulatives to deepen students' understanding of abstract and real-world concepts.

FINDINGS:

Internal Analysis

1. There is a need for access to technology to support learning goals (e.g., laptops, tablets) (PRSD Vertical Team, 2014).
2. Teachers in the district currently use Blackboard and Google Classroom as online communication tools (PRSD Vertical Team, 2018).
3. Explore using Carnegie Learning's Cognitive Tutor for struggling Algebra 1 students (PRSD Parent/Community Focus Group, 2018).
4. Students should become proficient in using a variety of technological platforms. (PRSD Vertical Team, 2018).
5. Identify and embed both hands-on physical and virtual manipulatives to move concepts from abstract to concrete (PRSD Vertical Team, 2018).
6. The current Tier 3 intervention resource, Connecting Math Concepts, aligns to grades 3-5 math standards. However, students take grade-level state assessments. There is a lack of consistency in intervention programs and the grade levels in which they are utilized (PRSD Vertical Team, 2018).

External Analysis

1. Technology continues to change how we do banking; the business will look radically different in five years (First Commonwealth Bank, 2018).
2. Microsoft Excel is important for students to know and understand (First Commonwealth Bank, Highmark, 2018).
3. Python is an important Computer Science language for all students going into a math or science field (University of Pittsburgh, 2018).
4. Students should be proficient in using technology and should be able to adapt easily (Slippery Rock University, 2018).
5. Variation exists in the use of intervention resources (e.g., TransMath, Think Through Math, Coach Books, Dibels, IXL, Reflex Math, Study Island, Xtra Math, ALEKS, Mind Math) (Lewisburg Area SD, Central Bucks SD, Mt. Lebanon SD, New Hope-Solebury SD, Peters Township SD, Hampton Township SD, and Upper St. Clair SD, 2018).

Implementation Timeline (Anticipated Start/Finish): 5/1/2018 - Ongoing

Key Personnel: Principals, Technology Department, Math Resource Committee, and Assistant Superintendents

Major Action Steps: (1) Identify companies offering math intervention and enrichment resources; (2) Select committee members and schedule meetings to learn about and review resources; (3) Conduct site visits to see

resources being implemented in other districts; (4) Narrow down and present top choices to school board and community; (5) Select final resource(s); (6) Provide professional development for staff members utilizing the new resource(s); and (7) Provide ongoing training and follow-up to ensure fidelity and consistency of implementation.

Estimated Budget/Resources: Costs may include those associated with the purchase of new resource(s) for select subgroups of students, as well as training on the new resource(s) and the cost of substitute teachers.

Potential Implications (Short-Term and Long-Term): As a result of these changes, students should be better prepared to demonstrate mastery and growth. Students in need of remediation as well as enrichment will benefit from these changes. Incorporating these changes will allow teachers to differentiate instruction.

Recommendation #7

Community Connections/Partnerships

- Develop partnerships with businesses, universities, and professional organizations to build positive relationships and create learning opportunities for all students.

FINDINGS:

Internal Analysis:

1. There is a need for science supporting mathematics and vice versa (PRSD Vertical Team, 2014).
2. Pine-Richland School District's vision statement references learning occurs both inside and outside of the classroom (PRSD Strategic Plan, 2015-2019).
3. One of the long-term goals embedded in the Pine-Richland Strategic Plan reads: *Use real-world strategies to engage students in solving problems, using their hands, and seeing connections between content areas that include career connections and play/creativity/risk* (PRSD Strategic Plan, 2015-2019).
4. Financial literacy and real-world application is important for all students (PRSD Parent/Community Focus Group, 2018).

External Analysis:

1. Schools need to teach financial literacy and business math (A.W. Beattie Career Center, 2018).
2. The math/science collaborative is a potential resource for our staff and students (Allegheny Intermediate Unit, 2018).
3. PPG has an interest in working with schools (Allegheny Intermediate Unit, 2018).
4. Application and real-world problems should be part of the majority of lessons (Slippery Rock University, 2018).
5. Students should be linking classroom mathematics and statistics to real-world problems through modeling (CCSSM, 2010)

Implementation Timeline (Anticipated Start/Finish): 6/1/2018 - 6/1/2020

Key Personnel: K-12 Mathematics Teachers, Special Education and Gifted Education Teachers, School Counselors, and Building/Central Office Administrators

Major Action Steps: (1) Identify curricular areas to be enhanced by guest speakers, partnerships, and connections to mathematics in action; (2) Examine current partnerships and resources and determine if additional connections with these same partners can be established; (3) Explore new partnerships with organizations offering beneficial connections and learning opportunities for our students and establish these opportunities as assured experiences across grade levels and/or courses; and (4) Communicate and promote a desire to establish partnership opportunities within the community through both seeking and reporting on these types of experiences in our classrooms.

Estimated Budget/Resources: Parent Teacher Organizations (PTOs) might represent a supplemental funding source for these types of experiences and can be approached as opportunities arise. Additionally, some partners and organizations might prefer to donate their resources and time to the schools. Costs could be associated with field trips or guest speakers.

Potential Implications (Short-Term and Long-Term): Students may gain an appreciation for and

understanding of the integration of mathematics outside of the classroom through seeing first hand how math principles are applied in various fields. These experiences may assist in the development of their problem-solving and decision-making skills. Challenges may exist with scheduling these experiences during the school day. Teachers may expand their knowledge of how mathematics is used in the community which will help them create real-world learning opportunities within their classrooms.

Recommendation #8

Program of Studies/Course Offerings

- Modify existing courses and/or add new courses to better support students who are not ready for Algebra I by 8th grade and/or may be struggling in Algebra I.

- Modify the *Concepts of Mathematics* course to better support the diverse needs of the learners in the course.
- Review, collect data, analyze, and formalize the waiver process to ensure students are challenged at the appropriate level and prepared for future courses.

FINDINGS:

Internal Analysis

1. There is a need for consistent, content-specific support for students in grades 7-12 (PRSD Vertical Team, 2014).
2. There is a need to explore course pathways and content priorities for our most struggling learners in grades 9-12 (e.g., Concepts, Algebra 1 Keystone Module 1, and Algebra 1 Keystone Module 2) (PRSD Vertical Team, 2014, 2018).
3. There is a need to explore the intervention programs of mid-performing schools with high PVAAS scores (PRSD Vertical Team, 2018).
4. Currently, Pine-Richland School District does not have a formalized process for collecting data related to students waiving into courses, specifically, the rate of success in the waived course and subsequent courses (PRSD Vertical Team, 2018).
5. Majority of Pine-Richland students take Algebra I in eighth grade. (PRSD Course Request Document, 2018).

External Analysis

1. Foundational skills, especially Algebra 1, are essential for all students (University of Pittsburgh, 2018).
2. Schools need to instruct financial literacy and business math (A.W. Beattie Career Center, 2018).
3. There is a need to instruct financial literacy (Slippery Rock University, 2018).
4. Some exemplar schools require a half credit class for non-proficient scores on the Keystone exam. (New Hope-Solebury SD, Upper St. Clair SD, and Peters Township SD, 2018).
5. Exemplar schools have a waiver process for acceleration. (Upper St. Clair SD, New Hope-Solebury SD, Mt. Lebanon SD, Lewisburg Area SD, Central Bucks SD, and Peters Township SD, 2018).

Implementation Timeline (Anticipated Start/Finish): 6/1/2018 - 6/1/2019

Key Personnel: Pine-Richland Mathematics Teachers; Building and Central Office Administrators

Major Action Steps: (1) Review the curriculum design for Fundamental of Mathematics (grade 7-8), Concepts of Mathematics, and Algebra I; (2) Identify unit design changes or course options to better support the students enrolled in these courses; (3) Modify the program of studies to clearly communicate design changes to parents and students; (4) Understand the waiver process as it currently exists in all schools; (5) Develop a process for requesting and approving waivers that is consistent across all schools; (6) Document waiver agreements in PerformancePlus as a resource to analyze students' experiences as they progress through the math pathways.

Estimated Budget/Resources: Costs associated with course design and development such as substitute coverage for teachers to update curriculum may be needed. Alternative or additional resources for the course Concepts of Mathematics may be needed.

Potential Implications (Short-Term and Long-Term): Addition/deletion of courses may occur based upon the

research and work. The waiver process improvements may decrease the number of add/drop requests. The waiver data collection process may guide the departments in determining where students who request waivers find success or struggle. The ability to monitor waiver trends will guide the department to review/revise curriculum and instruction in those courses where waiver requests are high.

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