The Hopewell Valley Regional School District Mathematics Program

Kindergarten through Grade 12

External Review

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Table of Contents

Executive Summary **Page 3**

Data Sources **Page 5**

Review Framework **Page 7**

Findings and Recommendations **Page 9**

- Curriculum Page 9
- Instruction and Assessment Page 15
- Leadership and Professional Culture Page 21
- Communication and Community Page 25

Action Steps for Consideration **Page 29**

Appendix A **Page 32**
Online Survey of Students, Parents, Teachers and Administrators

Appendix B **Page 38**
Focus Group Participants

Appendix C **Page 40**
Focus Group Questions

Resources **Page 42**

Executive Summary

The 2011 mathematics program review was conducted by Anne N. Catena, Ed.D., Director of Professional Development Initiatives, Program in Teacher Preparation, Princeton University. I thank the faculty, administration and staff for the opportunity to work with the Hopewell Valley Regional School District in the mathematics program review. The gracious welcome and hospitality offered to me embodied the generous spirit of your entire community. I honor the dedication of your faculty and administration to best serve the students in your care. I am confident that the potential for further growth of the Hopewell Valley Regional School District's mathematics program is acknowledged by teachers, administrators and parents.

Mathematics education is charged with meeting the needs of students who will and who will not pursue post secondary study in mathematics (American Educational Research Association 2006). Mathematical concepts and processes are required for personal decision making, participation in civic and cultural affairs, and economic productivity for all students. Mathematical literacy requires a variety of expertise in both processes and mathematical practices. Individuals need to be adept at problem solving, reasoning and proof, communication, representation, and making connections. Mathematical practices include adaptive reasoning, strategic competence, conceptual understanding, procedural fluency, and productive disposition (Common Core State Standards for Mathematics, 2010). In support of the district's mission and goals, I cite research regarding the development of all students' mathematic understanding, skills and interest.

As directed by the Superintendent, Director of Curriculum and Instruction and the Supervisor of Mathematics, I was asked to review the current mathematics program to address stakeholder perceptions of the programs' strengths and to identify shared values for improvement. It is planned that this review will be followed by program planning and curriculum development in 2011-12, implementation and curriculum revision in 2012-2013, curriculum revision in 2013-14 and full implementation in 2014-15.

The current math program is well regarded by most parents, teachers, students and administrators but all stakeholders indicate areas for further development regarding curriculum, instruction and assessment, professional development and communication. Given the range of district initiatives and limited resources and personnel, administrators and the Board of Education will need to assess priorities in the development of the mathematic program. Thoughtful, research-based decisions that are collaboratively pursued by all stakeholders are imperative as the district moves forward with this important work.

Data Sources

Between April and July of 2011, I gathered data regarding the culture, the organizational structures, and the history of the mathematics program. Data collection included an online survey of students, parents, teachers, administrators and alumni, focus groups, selected teacher self evaluation surveys, a review of the district and school professional development plans, a review of the Special Education and Gifted program reports, and brief school visits. In the majority of cases, multiple sources of data were solicited for a given question or topic to provide opportunity for triangulation[1].

Questions included in the online survey of students, parents, teachers, administrators and alumni addressed the goals of the mathematic program review. Areas included curriculum, instruction, culture, and communication. Respondents were asked to record their impression of the current mathematic program and their desired level of importance using a five point Lickert scale. Email notification of the online survey was disseminated to families and educators, and access to the survey was posted on the district website. One hundred and nineteen online responses were received. Please see Appendix A for the survey questions and a summary of responses.

Discussions with 12 middle and high school students, 12 teachers, 6 school principals, and 9 parents in elementary, middle and high school grades were conducted in eight focus groups. Parents volunteered for the focus groups based on their grade level interests and experience. The Supervisor of Mathematics selected parents at random from among the volunteers, and he selected the students and teachers so that all schools and grade levels were represented. These focus groups represent a small sample of the entire student, parent and teacher populations. Principals and/or Vice Principals from every school contributed to that focus group discussion. Please see Appendix B for descriptions of the focus group participants

[1] Triangulation is the process of using three sources of data regarding the same issue or question to help verify findings. In this review, quantitative data from survey responses, and qualitative data from focus groups and school visits, comprise the methodology.

and Appendix C for the focus group questions. Please note that findings and recommendations in this report indicate themes which emerged in data collected from only the sample populations, i.e. focus groups, survey respondents. Themes are constructed by a majority consensus of the program review participants.

Prior to the focus group discussions, teachers and principals were asked to submit written responses to questions regarding curriculum, instruction, communication with the community and mathematic resources. These questions were derived from the district-wide survey responses and the parent and student focus groups responses.

I also visited Hopewell Elementary, Toll Gate Grammar School, Timberlane Middle School and Hopewell Central High School to briefly view the classrooms and school resources.

The district-wide and school specific professional development plans and goals were reviewed in regard to the mathematics program and overall goals. I conferred with the recommendations of the Special Education and Gifted program reviews to identify consensus regarding future improvement areas. The November 2010 Achievement report was consulted to address student achievement in the 2009-10 state and national assessments.

At the recommendation of the Superintendent, Director of Curriculum and Instruction and Supervisor of Mathematics, I did not review curriculum maps, faculty resumes or course materials.

Review Framework

"The important thing is not to stop questioning. Curiosity has its own reason for existing."

Albert Einstein[2]

The goal of the mathematics program review is to identify strengths and concerns about the current program and to identify shared values for improvement. It is my understanding that an extensive mathematic program review and design within the Hopewell Valley Regional School District has not taken place in fifteen years.

Findings and recommendations are meant to inform short and long term mathematics program improvement that will serve the district's efforts to move forward with a five year plan. Opportunities for strategic planning are identified to support the district's mission and goals to "nurture the unique talents of each individual, and to develop confidence and capabilities to face the challenges of a rapidly changing world".

Nationally recognized, research-based standards should guide the five year mathematic program development. The National Council of Teachers of Mathematics publications entitled *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics* and the *Principles and Standards for School Mathematics*[3]are tools used to inform this program review. Likewise, the Common Core State Standards in Mathematics[4], adopted in 2010 by the New Jersey Department of Education, and the 21st Century Life and Career Standards have been consulted regarding program recommendations. In addition, I take into account the summer 2011 revised Standards for Professional Learning. These new standards outline the characteristics of professional learning that lead to effective teaching practices, supportive leadership, and improved student results[5].

[2] http://www.heartquotes.net/Einstein.html
[3] http://www.nctm.org/
[4] http://www.corestandards.org/the-standards/mathematics
[5] The 2011 standards serve as a guide for teaching practice for the nearly 13,000 members in 35 states of Learning Forward, formerly the National Staff Development Council. www.learningforward.org/standards

The design of the mathematics program review is based in part on Ron Pelfrey's protocol found in *The Mathematics Program Improvement Review: A Comprehensive Evaluation Process for K-12 Schools*. In this document Pelfrey calls upon research experience with effective program evaluation methods and his work in more than 300 schools to identify a process for mathematic program review. I consider the ten indicators Pelfrey indentifies for a quality mathematics program: curriculum, instruction, equity and diversity, school climate, usefulness, professional environment, community, organization and leadership, assessment and evaluation, and financial and material resources. With the approval of the district's Supervisor of Mathematics, I have employed components of Pelfrey's tools including the Teacher Self-perception Questionnaires, the Principal's Checklist for the Mathematics Program, and Teacher, Student, Parent and Principal Interview Questions.

Findings and recommendations that follow are formatted in four areas: curriculum, instruction and assessment, leadership and professional culture, and communication and community. This report is structured in such a way that findings and recommendations can be considered across grade levels, and also within the elementary, middle and high schools so that they may serve to inform decisions throughout the district-wide education community. Opportunities for collaboration across elementary schools, the middle school and the high school are stressed to build cohesion and community.

Findings and Recommendations

For purposes of clarity, the reader is cautioned that findings and recommendations are based upon only the data collected in this review. If I report that all teachers agree, this is meant to indicate that all teachers with whom I spoke agree, or all teachers who responded to the survey agree. It does not indicate that all teachers within the district agree. Likewise if I state 65% of the middle school students indicate something, I refer only to 65% of the students in the focus group, not 65% of the total student population.

Findings and recommendations that follow are formatted in four areas: curriculum, instruction and assessment, leadership and professional culture, and communication and community.

Curriculum

Everyday Mathematics®, published by Wright Group/McGraw-Hill, is the district's central curriculum resource for students in kindergarten through grade five. Courses in grades six through twelve primarily use texts from the University of Chicago School Mathematics Project (UCSMP) that are approximately 16 years old. Newer editions of the algebra and geometry curriculum are available from the publisher. Courses in pre-calculus and calculus use a combination of UCSMP and Larsen and Hostetler texts, while Statistics classes use "Introduction to the Practice of Statistics", Fifth Edition by Moore and McCabe.

The math curriculum is found to be teacher specific, as all K-12 teachers are reported to enjoy autonomy in the pedagogy and content that is taught. Curriculum is supplemented and the scope and sequence may not be closely followed. This flexibility somewhat influences the mathematics content and skills that students may learn within the same grade level or school. At the direction of district administration, I did not review mathematics curriculum maps regarding articulation across grade levels. As maps are updated with the new Curriculum Framer Understanding by Design program, and as the new Common Core Mathematics Standards are

addressed, vertical articulation of concepts and skills should be verified. Each grade is encouraged to identify an overarching "Big Ideas" or unifying theme to guide the year's course of study and to help make vertical and horizontal connections. As identified by Grant Wiggins' Understanding by Design, by becoming familiar with the concept of "Big Ideas", such as those in the National Council of Teachers of Mathematics (NCTM) Focal Points and Principles and Standards for Math, teachers will deepen students' learning and better address the new Core Content State Standards in mathematics.

Everyday Mathematics was developed in support of the standards recommend by the NCTM. The curriculum's sequencing of how and when math concept are introduced and developed reflects research on student learning. The What Works Clearinghouse found that the first edition of "Everyday Math has potentially positive effects on math achievement[6]" when compared to more traditional math curriculum. This curriculum has several unique features as compared to other elementary math curriculum. Specifically Everyday Math

- uses a spiraling approach to gradually build students' understandings over a two to three year span,
- teaches both alternative algorithms[7] and standard, more traditional, algorithms,
- employs visual models to illustrate concepts and games to facilitate repetition,
- and introduces algebraic thinking in second grade.

Teachers report that spiraling is a good concept as it allows more depth of student understanding in subsequent years or months. Allowing students to move on and then come back to a topic can be a positive or a negative strategy depending on student's developmental levels. Consistent with the April 2010 districts' Special Education program review, I find that the spiral structure of Everyday Math is reported by teachers to be very challenging for their students with disabilities. Some special education students need more time to practice and

[6] http://ies.ed.gov/ncee/wwc/reports/elementary_math/eday_math/

[7] "An algorithm is a specific series of steps that will give you the correct answer every time" downloaded July 21, 2011 from https://www.wrightgroup.com/download/parent_connection/Multiple_Algorithms/EM3HCH_G4-6_028-029.pdf

develop skills than is allotted in the scope and sequence[8]. Many general and special education teachers spend additional time on concepts or revise the order in which concepts are taught as they deem necessary. They also supplement the curriculum with materials to meet students' needs. This is supported by elementary and middle school principals who view, as a necessity, teachers' flexibility within the scope and sequence of lessons, as well as their use of supplemental materials. Middle school special education teachers and math teachers share resources and strategies to best support students' mathematics needs. It is recommended that the elementary and high school teachers do the same as time permits.

The Everyday Math focus on multiple algorithms for student learning and solution strategies is not valued by all K- 5 teachers. Among the teachers interviewed, multiple ways of learning strategies for solutions are considered a strength only when a new concept or skill is first taught. Elementary teachers agree that during the introduction of a new concept or skill, such as multiplication, allowing students to explore a range of solution strategies is helpful since students respond to different approaches. Teachers believe that the multiple strategies should only be taught at the introduction of a topic to solidify the students' understandings of the concept or skill, i.e. the first time that the concept is taught. Many teachers do not teach all the algorithms: based on the teacher's experience and comfort level, s/he chooses which strategies to use and/or teach. In addition, the range of non-traditional algorithms in Everyday Math is not something that elementary school parents have learned or understand. This concerns parents because they cannot assist their children with homework or questions. Approximately 65% of the K-5 parents in the focus group indicate that the multiple ways of learning emphasized in Everyday Math can be stressful for all students. In contrast, middle school students do not report difficulties learning or using the alternative algorithms in elementary grades. Students prefer having a choice of algorithms to use. It is recommended that parents consult both the teacher, and the Everyday Math website, to better acquaint themselves with examples demonstrating the use of a variety of algorithms in the text, see http://everydaymath.uchicago.edu/educators/computation.

[8] Half of the grade 6-12 teachers also indicate that there is not enough time in the curriculum to practice skills, especially for special education students. All respondents to the online survey indicate that they would prefer more opportunity for the development of computational skills.

All teachers in grades K-5 with whom I spoke believe that the Everyday Math alternative solution strategies are "untaught" in middle and/or high school, which confuses students. All middle and high school students concur, indicating approximately 90% of the grade 6-12 math teachers do not allow students to use the various Everyday Math strategies. The majority of 6-12 math teachers also agree that traditional algorithms are taught and expected of their students. All 6-12 parents report similar experiences of "traditional" instruction for their children in middle and high school. It is recommended that if the district values the use of alternative algorithms in student learning and their use in the solution of math problems, clear communication about expectations for math instruction and student's use of a range of solutions strategies in elementary, middle and high school is needed.

Everyday Math includes hands-on games, explorations, and activities which grade K-3 teachers report to be helpful when differentiating assignments and instruction. Conversely, grade 4 & 5 teachers find the games "confusing and the directions too hard for students to understand". Half of the middle school students remember that the math games helped them to learn what was taught during the teacher's direct instruction. Other curriculum features, including math boxes, study link, math message, differentiating suggestions and parent's letter, are reported to be well designed and used by most K-3 teachers. The upper elementary teachers report that Everyday Math includes helpful connections to real applications of math.

The specific vocabulary found in Everyday Math is unfamiliar to K-5 teachers and parents who have not previously used the curriculum. Everyday Math provides an online vocabulary glossary in English and Spanish which should be shared with all stakeholders[9]. Curriculum-specific vocabulary requires time and experience for adults to learn and with which to develop a comfort level. Because some math terms are confusing, parents report difficulties assisting their children with homework. On the other hand, students do not have difficulties with the vocabulary, and indicate that Everyday Math well prepares them in computation and basic math skills for middle and high school courses.

[9] http://www.wrightgroup.com/support_info.html?sid=115

Inquiry focused curriculum such as that used in Everyday Math can result in intellectual exploration which enables conceptual development of math understanding. Research on inquiry learning within the National Council of Teacher of Mathematics has been shown to motivate students' engagement in math. Furthermore, the new Core Content State Standards stress more development of students' cognitive demands such as that experienced through inquiry. The use of inquiry, where questions are generated or investigated, allows children to make sense of their learning and applications in their lives. It must be noted that the middle and high school students, teachers and principals with whom I spoke, do not report a focus on inquiry instruction or learning. Mathematics in grades 6-12 seems to concentrate on the memorization of procedural steps and rules. This is contrary to the new Math Standards, which focus on student understanding and communication rather than memorization and rote problem solving. There are many opportunities to incorporate inquiry problems, thinking critically, and making connections between what students know and how the world works. For example, engineering concepts can be introduced with existing, integrative curriculum that addresses the 21st Century Life and Career Standards. Engineering design process includes students' ability to

- Define the problem and criteria
- Generate solutions and formulate approaches to the problem
- Compare and evaluate alternative approaches
- Implement the optimal design

Teachers in all grades could benefit from more professional development in inquiry-based curriculum.

All grade 6-8 parents who attended the focus group indicate that there is a parent perception that the current grade five curriculum is weak unless students are in Advanced Level Math (ALM). Parents are concerned that this perception results in an "insane push" to accelerate students into ALM when students are not ready developmentally. With the implementation of ALM in grades three and four, it is important that the criteria for selection be clearly communicated to parents and teachers. Furthermore, all stakeholders, including the students, need to fully understand what will be learned in all classes and what implications a given course has for future study in mathematics.

A majority of middle school teachers recommend that the Pre Algebra courses taught across grades seven and eight need updating. Teachers are concerned that the current Pre Algebra Part 1 course in grade seven and Part 2 in grade eight are not effective. Due to the pace of the courses, students only "cover" part of the material that is assessed on the respective grade level ASK tests required of the New Jersey Department of Education. The 2010 district Achievement report indicates that approximately 14% of students who took the grade seven math test scored in the partially proficient range and 12% of the students who took the grade eight math test scored in the partially proficient range. Although the Achievement report does not identify whether those students were in the Part I and Part 2 Pre Algebra courses, it would be helpful to disaggregate the findings to inform decisions for the middle school curriculum. In addition, during 2010 middle or high school students in Algebra I classes took the American Diploma Project End of Course assessment in Algebra 1 and 56% scored proficient or advanced proficient. Please note that the New Jersey Department of Education has curtailed this End of Course Algebra 1 assessment, and there are no future plans to tie this assessment to high school graduation requirements.

Regarding the range of mathematics courses in middle and high school, students indicate that they have no additional requests for new course offerings other than expanding the Applications of Calculus course from a semester to a full year. High school teachers concur that a full year Applications of Calculus course is warranted. Otherwise students report that there is sufficient choice among interesting mathematic course topics from which to choose.

Curriculum findings, as a result of the focus group discussions, online survey and other data collected, reveal a strong program with district-wide commitment for improvement. Recommendations are found in the chapter entitled Actions Steps for Consideration. Priorities, based upon my perceived need and which should be reviewed in the five year plan process, include

1. teachers' and administrators' analysis of the value of non-traditional algorithms taught in grades K-5 and implications for use in grades 6-12,

2. verification of vertical articulation of curriculum maps when alignment of the new Core Content State Standards in Mathematics are complete and maps are updated with the new Curriculum Framer Understanding by Design program
3. teachers' and administrators' analysis of the courses in Advanced Level Math, Pre Algebra parts I and 2, and Applications of Calculus regarding scope and depth of content and skills, and impact on students' learning with appropriate revisions.

Instruction and Assessment

The district employs passionate teachers and principals who aspire to do the best for their students. A large majority of parents whose children have been in the district's elementary schools express appreciation and respect for teachers and their efforts to support students. Many parents in the focus groups comment that their children's elementary experience with teachers has been "caring and wonderful" and they appreciate that "respect, comfort and safety of students" are the teachers' priorities.

Throughout the district, K-12 teachers, students, principals and parents who participated in the focus groups and survey agree that mathematic instruction should include:

- Whole class, small group and individual student-teacher interactions
- Team and individual problem solving
- Multiple strategies "to accommodate different learning styles" and students' needs
- Interactive, real world examples of mathematic applications: "every instructional method that connects to kids should be used"
- Engagement of students in "learning by doing, not by watching"

Teachers express a strong desire to serve the needs of all students: those who are struggling with math, students whose learning is at grade level, as well as those able to move faster or develop deeper understandings. Teachers, students, parents and administrators acknowledge value in using differentiated instruction to meet the wide range of students' needs. I must stress that developing teaching skill in differentiated instruction is the one issue upon

which all participants of the math program review strongly agree. Instruction currently does not include differentiation at the satisfaction of any stakeholder who participated in this review.

Teachers seem eager to learn new differentiated teaching strategies, but they and principals indicate limited opportunities for professional development in mathematics serve as a barrier to improvement. Elementary school principals believe that some current teachers have the expertise to turn-key differentiated instruction pedagogy with their K-5 colleagues. Those individuals could coach or lead small group professional development to build skills school-wide. Principals in the middle and high schools request assistance with differentiated instruction techniques. Creating opportunities for teachers to observe each other's instruction or to work together on differentiated instruction would serve to build the math faculty. Other local school districts are also developing skills in differentiated instruction with protocols found in *Instructional Rounds in Education: A Network Approach to Improving Teaching and Learning*, by City, et al. This book describes how teachers work collaboratively on problems of practice. Together Hopewell teachers can further their understanding of differentiated instruction as it is practiced in the classroom. Any opportunity to turn-key existing expertise within the math department should be explored such that internal capacity is built and sustained. In addition, resources from the University of Chicago School Mathematics Project such as the publication entitled "Advice from Colleagues: Differentiation[10]" could prove valuable. This online text recommends that elementary grade teachers use math centers, games and Math Boxes within the Everyday Math curriculum, project based enrichment for excelling students, and specific strategies for working with special education students in self contained classrooms.

Elementary teachers report that math instruction focuses on students' verbal and written responses to open ended questions, which prepares them well for the ASK test questions. Teachers believe there is a strong emphasis on writing in K-5 math classes that is beneficial. It is recommended that K-12 students also be encouraged to write in math journals about their learning, and pose written questions for investigation. Allowing students the time to put into writing what they have heard, read or observed enables them to reconceptualize information so

[10] http://quliq.com/advice+from+colleagues+differentiation.html

that it is more easily remembered[11]. Journal writing that includes pictures, words and reflection on one's own understanding requires students to process information in more depth than just listening or taking brief notes. It is recommended that the department develop a format for K-12 math notebook entries that helps to formulate students' awareness of their learning process, allows time for construction of understanding and also models how mathematical thought evolves and develops over time.

Middle and high school students report that current math lessons follow a traditional initiation-response-evaluation format: an introduction by the teachers, student response to teacher generated questions, evaluation of practice problems by teachers, homework to practice and reinforce. Grade 6-12 math students indicate that they primarily learn passively by watching, answering questions when asked and practicing the solution steps modeled by the teacher. In addition, the data gathered in this review indicate that students in grades 6-12 are taught one way to solve a problem. This is contrary to the district's Mathematics Department's commitment "to academic excellence through the cultivation of creative, analytical, and independent thinking to assure continual progression of each child in the development of mathematics concepts."[12] In addition, all stakeholders who participated in the online survey indicate a desire to increase students' engagement in problem solving and opportunities for student initiated questions, creativity, discussion and reflection.

When I asked if students develop skills to pose their own questions neither the K-12 teachers, nor students nor principals indicated that this is expected in the math program. Questions are primarily posed by the teacher to assess what the students know by recalling factual information, not to stretch students' thinking. Teacher-to-student questions currently dominate the instruction, with almost no student-to-teacher questions used to develop deeper understandings, nor student-to-student questions that enable debate or further exploration. Research[13] indentifies the following reasons for students to develop their own questions; increases motivation to learn, improves comprehension and retention, encourages creativity and

[11] Halpern and Hakel (2003). *Change*, Vol. 35, p 2-13.
[12] http://www2.hvrsd.org/academics/mathematics/Pages/default.aspx
[13] Richetti and Tregoe (2009)

innovation, teaches how to think and learn, and provides a basis for problem solving and decision making. Across all grade levels, math instruction must develop students' abilities to pose problems or discover solutions. Students' critical thinking, conjecturing or discussing math concepts or problem solving should be a priority. The newly adopted CCSS in mathematics require that students ask questions, as well as discuss and debate evidence that would further their skills to analyze evidence before forming conclusions. The new math standards and upcoming national math assessments will no longer focus on students' factual recall. Rather these standards and tests stress students' ability to synthesize content and ideas from several data sources, apply their understanding of facts and algorithms to solve problems, identify relationships and explain findings.

The current math program seems to stress that grade 6-12 students will master specific mathematic procedures but does not necessarily expect that they will be able to apply those concepts and skills in meaningful ways. Students and math teachers in the focus groups report that math instruction infrequently makes connections between math and the real world, addresses the usefulness of math in other subject areas, or relates math to students' interests. This finding is most apparent in the high school responses to questions in the online survey regarding making connections with math and other disciplines. Grade 6-12 teachers and students report that the application of math skills and knowledge is referenced in other academic courses such as science, social studies or language arts, but it is not specifically addressed in math classes. This appears to be counter-intuitive. It is recommend that a model of math instruction be considered that engages students in making meaning of math applications in real world problems and which culminates in the application of math concepts and skills to new situations. For example, technology could be leveraged to promote problem solving, and development of student thinking in concepts including pattern recognition, modeling and data analysis. Within the current curricula, young students should be encouraged to design, construct, test and modify mathematical solutions. Middle and Upper school students can be engaged in technology resourced lessons that require them to define a problem, generate ideas, gather information, analyze solutions, test conclusions and possibly engineer prototypes or applications. When I asked about the use of technology in mathematics, middle school students only indicated that they do not find Study Island engaging or useful.

Teachers, students and parents are concerned about meeting the needs of struggling students. In support of students in language arts, the district is developing a Response to Intervention (RTI) initiative at the elementary level. The effectiveness and efficiency of the program should be evaluated in the context of math instruction as well. If RTI is initiated in mathematics in the future, the principals indicate a need for more personnel to successfully support students' learning and success.

Data collected in this program review indicate that grades 6-12 students are responsible to take the initiative to pursue extra help with teachers before, after or during school. Currently during class instruction, other than reviews before a unit test, grade 6-12 math students find little opportunity for individual instruction and are hesitant to ask for help. Finding time before and/or after school to work with teachers is also reported to be problematic for some students because of sports or club commitments, and transportation. Research by the National Council of Teachers of Mathematics entitled *Effective Strategies for Teaching Students with Difficulties in Mathematics* finds that for low achieving students "the use of structured peer-assisted learning activities, with systematic and explicit instructions and formative data furnished both to the teachers and to the students appears to be the most important" (p.2). The NCTM research indicates that working in isolation with struggling students before, after or in free time during school is not as effective as working within peer-assisted groups. In addition, for special education students, the NCTM research finds "explicit, systematic instruction that involves extensive use of visual representations appears to be crucial" (p.2).

Homework is currently under study in a district-wide effort. To further inform that work, data was collected regarding the purpose and frequency of math homework. I find that math homework is assigned primarily to reinforce what is taught during class. Teachers indicate that homework is a formative assessment tool which is assigned to "solidify what is covered in class". Homework is considered independent practice so that students "try different versions of problems introduced in class work". Teachers check homework for completion only, not for understanding. If homework is truly a formative assessment, then it is recommended that

students' work be reviewed to identify areas of strength and areas that require future study. This would inform teachers' instruction and make better use of students' time for learning.

Regarding homework assignments, students within a given class are usually given the same math homework regardless of their level of understanding or skill. Special education students might be given a reduced number of problems from among those assigned to the rest of the class. This is a lost opportunity for differentiated instruction and assessment. The Association for Supervision and Curriculum Development recommends that math homework be differentiated to better serve students' learning. Douglas Reeves's *From Differentiated Instruction to Differentiated Assessment*[14], indicates to better engage students in math and develop their understandings, homework assignments should include student choice from among problems that allow practice, and problems that provide opportunities to master challenges by applying the content and/or skills with real-world problems. District high school students indicate they seldom bother to do math homework because it is not useful in subsequent class periods or counted in their grade. These same students admit that they do complete homework in other academic classes, such as social studies or science, because they know the assignment will be used or needed in future work. From the students' comments, I believe if math homework in middle and high school had more relevance and students perceived value, it is more likely that they would complete the assignment.

The National Council of Teachers of Mathematics[15] has conducted a review of research regarding the impact of homework on students' learning. Cautioning that most studies are somewhat flawed, "with only rare exceptions, the relationship between the amount of homework students do and their achievement was found to be positive" (p. 2). The research indicates that a positive effect of homework on achievement for young students may be limited and only serve to improve scores on subsequent unit tests. Data collected in this math program review finds that elementary students are assigned between 5 and 15 minutes of math homework each night. Middle school teachers acknowledge that the amount of homework "increases significantly"

[14] http://www.ascd.org/ascd-express/vol6/620-reeves.aspx
[15] http://www.nctm.org/news/content.aspx?id=13814&itemid=13814&linkidentifier=id

between grade 6 and 7. Middle and high teachers assign students between 15 and 45 minutes of math homework daily.

In an effort to support all stakeholders' interests in supporting the students' mathematic understandings and further developing their skills, the following priorities are recommended for consideration in the five year plan regarding math instruction:

1. district-wide use of differentiated instruction techniques to meet the needs of all students
2. focus on inquiry, including student generated discussions, questions and metacognition
3. more student focused learning in grades 6-12 with intentional integration of math content and skills across all academic courses and application to real world problems.

Leadership and Professional Culture

All schools were represented when I spoke with the principals or vice principals in this program review. They, and the Math Supervisor, indicate that the math program is well regarded. In the past three years the district priority has been to maintain the implementation of the current mathematics program and there has been little focus on new initiatives or training in the area of mathematics. Given the range of district initiatives and limited resources and personnel, administrators and the Board of Education will need to assess the urgency of developing the mathematic program and come to consensus on priorities.

An overview of the 2010 state mandated math tests indicates that the children's scores are consistently higher than the state average scores: 85-90% of the grade 3-8 students' math scores are in the proficient or advanced proficient ranges. In addition, 90% of the High School Proficiency Assessment math scores are in the proficient to advanced proficient ranges. A review of the professional development plans for the district and individual schools reveals that mathematics is mentioned primarily regarding the subgroups struggling to make adequate yearly progress in the state assessments. Professional development plans for the district and individual

school could include specific math content and skills that all teachers are to develop and the corresponding district support in that effort.

New grade K-5 programs in handwriting, literacy and Response to Intervention for language arts have dominated professional development in the elementary schools during the past three years. Teachers' professional learning communities (PLC) K-5 have focused only on language arts. Elementary teachers rarely have opportunities to study math curriculum, instruction, assessment or resources at grade level, with colleagues in other grades, or with special education teachers. In addition the elementary grade teachers want time to learn together and direction from the district leadership, regarding the math program.

Advantages of teachers working together to improve student learning is well documented in the research, and is something that Hopewell supports within PLCs. The National Council on Teaching and America's Future in collaboration with West End have issued a review of research regarding the impact of PLCs on science, technology, engineering and mathematics teaching and learning in K-12 education. The synthesis of findings indicates the following essential supports enable PLCs to be more effective: knowledge, process and focus facilitators, an inquiry stance, engaging teacher choice in the area of study, effective use of data and aligning resources to bring coherence to the activity of the PLC.

Currently PLCs for middle and high school math teachers focus on common assessments at the direction of the school principals and district administrators. Principals report that the five year plan for the work of the PLCs on common math assessments will ultimately facilitate differentiated instruction. Teachers express a need to study more than common assessment questions now. PLC work generated from math teachers' own needs and interests would be more beneficial in improving instruction and student learning. For purposes of vertical articulation and district-wide consistency, the work of the math PLCs needs to be better informed and facilitated. Currently the district Supervisor of Mathematics meets with elementary teachers informally and upon request. Mr. James sometimes joins in the grade 6-12 PLC math meetings and does receive minutes from all meetings. Periodic meetings with the Supervisor and math teachers during the school-year, as well as before the start of school and after the end of the

school year, seem to be warranted and are requested. Professional interaction might help build collegiality and result in more vertical integration between the elementary, middle and high school curriculum[16] and instruction. In addition, math PLCs in the elementary schools would provide faculty with the opportunity to develop a professional culture including a shared vision and goals. Regular meetings would provide time to discuss instruction and assessment methods and curriculum. In general math teachers need more time together within and across grade levels, during the school year and/or during the summer.

Professional development regarding the specific content, pedagogy and resources used with Everyday Mathematics was last taught in 2007 by an elementary teacher through the Professional Development Academy Committee. Since the vocabulary and algorithms used in this curriculum are unique and not familiar to teachers, especially those newly hired by the district, elementary teachers request specific help learning the curriculum in more depth. Elementary teachers also need to better understand how students progress in math into middle school to prepare students for middle and high school math. Those in our focus group also indicate that they specifically need guidance regarding the district policy on pre and post assessments. Teachers use a variety of pre and post assessments, some provided from the curriculum and some from other sources. They request clarification in the use of those assessments in the formation of students' grades. In addition teachers indicate that the use of instructional technology in math is currently teacher specific. They are concerned that, depending on the instructor, a student might have no exposure to technology for the entire year in all subjects taught by a given teacher. They request policy clarification regarding the use of assessments and technology that is enforced throughout the district.

As was previously addressed in the section on Instruction, all teachers, K-12 with whom I spoke indicate a need and a desire to learn about and develop their skills in differentiated instruction. Professional development focusing on pedagogies for mathematic instruction should be ongoing, useful and collaborative so as to further expand upon internal capacity. Teachers

[16] As math curriculum maps are updated with the new Curriculum Framer Understanding by Design program, and the new Common Core Mathematics Standards are addressed, vertical articulation of concepts and skills must be verified.

need skills and resources that enable them to address the range of learners in their care, develop students' critical thinking, engage with math concepts, and expand verbal and written communication skills. This recommendation corroborates findings of the district's Special Education Program review and the Gifted Program review regarding differentiated instruction for district improvement, not only in mathematics. If possible teachers could be videotaped while teaching so that they can evaluate their own methods, or time could be made available for teachers to observe each other and work as a professional learning community in mathematics. This would enable teachers to analyze their ability to address all students' needs as well as their inquiry, questioning methods. All teachers ask for small group (5 or 6 people) professional development with multiple follow-up sessions to reinforce and reflect on what they've learned or tried. Professional development relevant to math courses and lead by teachers who also teach that content and skill set would be preferred by the teachers with whom I spoke.

It is recommended that the Supervisor of Mathematics, with teachers from each grade, develop and implement a plan to enhance the learning of students who are struggling and excelling in mathematics. Some students require academic support that allows them to learn successfully within their class or to move out of low-track classes. Others students who are succeeding within their current tracked course, rather than wait while peers receive instructional support in class, should have the opportunity to challenge their understandings with new applications and to explore their own questions.

This math program review also collected data on math resources. In grades K-5 teachers indicate that the one hour per day allocated for math instruction is sufficient. They also express satisfaction with the math resources and equipment available and teachers' option for discretionary spending. In a walk through Hopewell Elementary School and Tollgate Grammar School, each classroom had a library of math books, manipulatives, posters and games for children's use. It is recommended that an inventory of elementary math resources be submitted to the Supervisor of Mathematics by each teacher so that a central record is maintained to inform needs and budgets. In contrast to the wealth of K-5 math supplies and curriculum, most grade 6-12 teachers indicate dissatisfaction with math resources, specifically the texts. Grade 6 have only student resource books and repeated funding requests for math text have been cut from the

budget. Teachers are concerned that the sixteen year old high school books are "falling apart" and the 1990 dates and statistics quoted are not relevant.

In addition, the middle and high school teachers request that the district leadership address the criteria by which students are selected for courses. All grade 6-12 teachers indicate that there are too many students taking out of district classes in the summer so that they can move into a more advanced course in the subsequent school year. Teachers report that the placement criteria have "too many loopholes" regarding test scores which result in blurring of qualification criteria. This data is consistent with the Gifted program review report, which found that the criteria to indentify high school students for honors classes are under question and often circumvented by parents. The high school students with whom I spoke disagree with this perspective. They believe test cut off scores are too tightly held and that students should have the opportunity to take higher level courses if they are willing to try and do the work. Students report that there is more opportunity to take less challenging courses than there is opportunity to enroll in the more demanding classes. It appears that the entrance criteria for mathematics courses are perceived differently by teachers, parents and students. This necessitates clarification and improved communication.

In support of the districts' mission and in preparation of the five year plan, the following priorities are recommended regarding leadership and professional culture:

1. assess the urgency of developing the mathematic program and come to consensus on priorities.
2. enact professional development plans that focus on alternative pedagogies and inquiry to enhance the learning of students who are struggling, succeeding and excelling in mathematics.
3. inventory math resources in all grade levels to inform needs and budget decisions.

Communication and Community

Responses to both the online survey and focus group discussions stress the benefits of clear and timely communication between the school system and the Hopewell community. All stakeholders are committed to working toward common goals and value collaborative relationships. We discussed communication channels and topics that support communication from the school system to the community and from the community to the school district. I also collected data regarding the level of mathematics presence in the schools and throughout the district.

All K- 12 teachers with whom I spoke use email to communicate announcements and concerns to parents. All parents agree that email works well and is their primary mode of communication with the school district. Parents will sometimes telephone teachers with their concerns. All grade 6-12 teachers indicate that they use Infinite Campus to post assignments and grades. Parents confirm that they consult Infinite Campus and find it valuable. Parents with whom I spoke do not want curriculum maps online. or individual teacher websites or newsletters.

Only in grades 2-6 do parents want more informational math meetings. They speak highly of the informational meeting the Supervisor of Mathematics holds for grade five parents and would like something similar offered for every grade level. Parents request one meeting in each grade level, specifically to help parents better understand math concepts, algorithms and vocabulary that student will be learning each year with Everyday Math. Parents believe that annual, grade level meetings will serve to alleviate some of the parental confusion with this unique curriculum. They also request that an overview of students' course choices and placements be discussed at the yearly meetings so that parents fully understand the intent of the Advanced Level Math classes and implications for future study in middle school. It is recommended that meetings be supplemented with emails and website postings that include periodic announcements as well as specific information regarding how students are chosen for class placements.

To further address parental concern about student placement in courses through high school, it is recommended that the Supervisor of Mathematics disseminate several flow charts that clearly communicate the options available. Illustrative pathways should indicate the range of placement options available for students to move into courses, the grade level range and/or timing of placement consideration and the criteria for placement decisions. These flow charts should be available on the Math Department website, in periodic emails and at parent, grade level meetings.

Brief visits to Hopewell Elementary School, Tollgate Grammar School, Timberlane Middle School and Hopewell Central High School were conducted with the Supervisor of Mathematics to learn more about the mathematics culture. I appreciate the opportunity to visit some elementary classrooms and the openness with which the teachers accepted our visit. The elementary classrooms I visited are spacious and well equipped. Student desks and furniture afford flexible seating arrangements, and desks are grouped to support collaborative work. In contrast, students in middle and high school classrooms sit in rows facing the front of the room. This classroom layout contrast seems to reflect a student centered culture in grades K-5, and a teacher driven instruction model in middle and high school. A student centered culture better supports inquiry based instruction, collaborative work and student discussions as identified by research.

Most classrooms visited at Hopewell Elementary and Tollgate Schools display posters, math information and charts, and student work within the classroom or in the nearby hallway. Showcasing student work, projects and questions is most prevalent in the elementary schools and a few middle school classrooms. The hallway in the high school infrequently displays student mathematical work or awards. Whenever possible, students' work, questions and accomplishments should be celebrated. Efforts in the classrooms and in the libraries to honor contributions of varied cultures to mathematics and scientific discoveries, inventions, understandings and collaborations would increase mathematics presence. Displays of mathematic accomplishments could help students think about the importance of discoveries and inventions in America as well other cultures regarding the potential impact math could have on improving societies globally.

To further develop a math presence in the district, more students should have opportunities to participate in the district's current extracurricular activities. Math Olympiad is only available to students during the Advanced Level Math classes and as part of the grade six math club. Approximately 15 children in grade six participate in an afterschool math club. In high school approximately 10 students compete in the New Jersey Math League The Supervisor of Mathematics would like to expand upon these offerings, and suggests considering Odyssey of the Mind, Future Problem Solving Club and High Tops. Critical thinking and problem solving are emphasized in these organizations. Furthermore they provide social interaction and opportunities for personal growth that expand upon the districts' extensive athletic, artistic and musical options. Competitive math teams' accomplishments, awards and struggles can be communicated publically to students, teachers and the larger community to increase awareness of the relevance, application and beauty of mathematics.

In support of all students' learning in mathematics and the five year plan regarding communication and community, I assess the following priority recommendations:

1. initiate annual elementary grade level meetings with parents to address the specific Everyday Math vocabulary and algorithms and to explain students' course choices, placements and implications for future study in mathematics
2. continue use of emails for announcements and periodic math program updates and Infinite Campus for assignments and grades
3. further develop a math presence in the district, through extracurricular clubs and competitions, and public celebration of student work, awards and interest.

Action Steps for Consideration

Administrators and the Board of Education of the Hopewell Valley Regional School District have many decisions and choices to consider as a strategic plan for the mathematics program is formulated and enacted. The action steps recommended for consideration as a result of this program review are based upon data collected from a sample of the school and community populations. Consensus building and priority considerations are critical as this important work continues.

Potential Short Term Action Steps

→ assess the urgency of developing the mathematic program and come to consensus on priorities.

→ develop a format for math notebook entries and integrate as part of the K-12 instructional practice to formulate students' awareness of their learning process, to allow time for construction of understanding and also to model how mathematical thoughts evolves and develops over time.

→ to better acquaint themselves with examples demonstrating the use of a variety of algorithms in Everyday Math, parents should be made aware of the website, http://everydaymath.uchicago.edu/educators/computation/.

→ share Everyday Math online vocabulary glossary in English and Spanish with all stakeholders.

→ with the implementation of Advanced Level Mathematics in grades 3, criteria for selection and what implications a given course has for future study in mathematics should be clearly communicated to parents and teachers.

→ analyze the use of Study Island, and courses in Advanced Level Math, Pre Algebra Parts I and 2, and Applications of Calculus regarding scope and depth of content and skills, and impact on students' learning with appropriate revisions.

→ inventory math resources in all grade levels to inform needs and budget decisions.

⟶ support more student focused learning in grades 6-12 with intentional integration of math content and skills across academic courses and application to real world problems.

⟶ schedule time for special education teachers, elementary teachers and math teachers to share resources and strategies to best support students' mathematics needs.

⟶ initiate professional learning communities among math faculty K-12, within grades and across schools that reflect best practices.

⟶ consider professional development plans for the district and individual school that include specific math content and skills all teachers are to demonstrate in the classroom.

⟶ initiate annual elementary grade level meetings with parents to address the specific Everyday Math vocabulary and algorithms and to explain students' course choices and placements and implications for future study in middle and high school.

⟶ create and disseminate flow charts that depict the range of placement options available to students as they move into courses, the grade level range and/or timing of placement consideration and the criteria for placement decisions.

⟶ continue use of emails for announcements and periodic math program updates and Infinite Campus for assignments and grades.

⟶ further develop a math presence in the district, through extracurricular clubs and competitions, and public celebration of student work, awards and interest.

⟶ efforts should be made in the curriculum, classrooms and in the libraries to honor contributions of varied cultures to mathematic discoveries, understandings and collaborations.

Potential Long Term Action Steps

→ design and implement professional development in the district-wide use of differentiated instruction techniques to better meet the needs of all students.

→ analyze the value of non-traditional algorithms taught in grades K-5 and implications for use in grades 6-12. If the district values the use of alternative algorithms present in the Everyday Math curriculum, there needs to be clear communication about expectations for instruction and student's use of a range of solution strategies in elementary, middle and high school.

→ verify vertical articulation of K-12 curriculum maps when alignment of the new Core Content State Standards in math are complete and maps are updated with the new Curriculum Framer Understanding by Design program. Each grade is encouraged to identify an overarching "Big idea" or unifying theme to guide the year's course of study and help to make both vertical and horizontal connections.

→ focus on inquiry based instruction, including student generated discussions, questions and metacognition.

→ verify vertical articulation of K-12 instruction and professional development.

→ discuss entrance criteria for the mathematics courses and how to approach the differences between what teachers perceive and what students and parents feel.

→ integrate engineering concepts and skills into the existing math curriculum.

Appendix A

Online Survey of Students, Parents, Teachers and Administrators

District Wide Survey Responses
N=119 **April/May 2011** **Scale of 1-5** **Scale of 1-5**

Question 4: The mathematics curriculum provides	Group # of responses	Q. 4 Current	Q. 4 Desired Level	
opportunities for students to develop proficiency with computational algorithms (basic math skills).	K-5 parents 27	3.074	4.308	
	6-8 parents 18	4.000	4.688	
	9-12 parents 16	3.063	4.563	
none=1	post CHS parent 17	3.824	4.412	
some=3	no child parent 1	5.000	5.000	
many=5	k-5 teacher 16	3.667	4.813	
	6-8 teacher 7	3.667	4.714	
	9-12 Teacher 8	3.875	4.500	
	9-12 Student 9	3.778	4.778	Difference
		3.556	4.560	1.005

Question 5: The mathematics curriculum provides	Group # of responses	Q 5: Current	Q 5: Desired Level	
students the opportunity to be actively engaged in problem solving / creating solutions based upon sound reasons.	K-5 parents 27	3.222	4.333	
	6-8 parents 18	3.444	4.778	
	9-12 parents 16	3.333	4.438	
	post CHS parent 17	4.176	4.471	
none=1	no child parent 1	5.000	5.000	
some=3	k-5 teacher 16	4.188	4.600	
many=5	6-8 teacher 7	4.571	4.857	
	9-12 Teacher 8	3.125	4.250	
	9-12 Student 9	3.111	4.778	Difference
		3.619	4.534	0.915

Question 6: Lessons provide opportunities for	Group # of responses	Q 6: Current	Q 6: Desired Level	
student-initiated questions and discussion.				
	K-5 parents 27	3.192	4.000	
	6-8 parents 18	3.167	4.500	
	9-12 parents 16	2.667	4.000	
none=1	post CHS parent 17	3.941	4.250	
some=3	no child parent 1	5.000	5.000	
many=5	k-5 teacher 16	3.938	4.313	
	6-8 teacher 7	3.857	4.571	
	9-12 Teacher 8	3.250	4.500	
	9-12 Student 9	3.222	4.667	Difference
		3.393	4.287	0.894

Question 7: Students reflect upon the	Group # of responses	Q 7: Current	Q 7: Desired Level	
mathematics they have learned and write about or discuss their understanding.				
	K-5 parents 27	2.593	3.741	
	6-8 parents 18	2.111	3.333	
	9-12 parents 16	2.400	3.600	
never=1	post CHS parent 17	3.000	3.500	
sometimes=3	no child parent 1	4.000	4.000	
daily=5	k-5 teacher 16	3.500	4.125	
	6-8 teacher 7	2.857	4.000	
	9-12 Teacher 8	2.750	4.250	
	9-12 Student 9	2.125	4.000	Difference
		2.684	3.750	1.066

Question 8: Manipulatives and technology are used	Group # of responses	Q 8: Current	Q 8: Desired Level	
to facilitate the application of skills, development of concepts, problem solving, and verification.				
	K-5 parents 27	3.296	3.667	
	6-8 parents 18	3.000	3.833	
	9-12 parents 16	3.231	3.714	
	post CHS parent 17	3.471	3.933	
never=1	no child parent 1	4.000	4.000	
sometimes=3	k-5 teacher 16	3.938	4.188	
daily=5	6-8 teacher 7	3.714	4.000	
	9-12 Teacher 8	3.500	4.125	
	9-12 Student 9	4.000	4.625	Difference
		3.452	3.930	0.478

Question 9: High expectations are set for all students.	Group # of responses	Q 9: Current	Q 9: Desired Level	
too low=1 **appropriate=3** **too high=5**	K-5 parents 27	2.400	3.577	
	6-8 parents 18	2.833	3.444	
	9-12 parents 16	2.800	3.267	
	post CHS parent 17	2.875	3.333	
	no child parent 1	3.000	3.000	
	k-5 teacher 16	3.813	3.188	
	6-8 teacher 7	3.143	3.143	
	9-12 Teacher 8	2.625	3.750	
	9-12 Student 9	2.750	3.375	Difference
		2.877	3.395	0.518

Question 10: Students perceive the classroom	Group # of responses	Q 10: Current	Q 10: Desired Level	
to be a risk-free environment, where they feel comfortable asking questions of the teacher or others. **never=1** **sometimes=3** **always=5**	K-5 parents 27	3.889	4.519	
	6-8 parents 18	3.167	4.722	
	9-12 parents 16	2.867	4.467	
	post CHS parent 17	3.625	4.333	
	no child parent 1	4.000	4.000	
	k-5 teacher 16	4.375	4.688	
	6-8 teacher 7	4.143	5.000	
	9-12 Teacher 8	3.625	4.375	
	9-12 Student 9	3.375	4.875	Difference
		3.638	4.583	0.945

Question 11: Connections are made between	Group # of responses	Q 11: Current Impression of the program	Q 11: Desired Level	
mathematics and other disciplines. **none=1** **some=3** **many=5**	K-5 parents 27	2.852	4.148	
	6-8 parents 18	3.111	4.556	
	9-12 parents 16	3.133	4.267	
	post CHS parent 17	3.125	4.133	
	no child parent 1	5.000	5.000	
	k-5 teacher 16	3.500	4.250	
	6-8 teacher 7	3.714	4.571	
	9-12 Teacher 8	2.750	4.125	
	9-12 Student 9	2.375	3.625	Difference
		3.086	4.235	1.149

Question 12: Opportunities exist in the mathematics	Group # of responses	Q12: Current	Q 12: Desired Level	
program for students to learn how to learn, explore their own curiosities, collaborate with others, and develop a sense of creativity.	K-5 parents 27	2.538	3.808	
	6-8 parents 18	2.278	4.222	
	9-12 parents 16	2.667	3.800	
	post CHS parent 17	3.375	4.000	
none=1	no child parent 1	5.000	5.000	
some=3	k-5 teacher 16	3.800	4.286	
many=5	6-8 teacher 7	3.333	4.143	
	9-12 Teacher 8	2.500	4.250	
	9-12 Student 9	2.500	4.286	Difference
		2.858	4.054	1.196

Question 13: The district mathematics program	Group # of responses	Q13: Current	Q 13: Desired Level	
has clear learning goals for students developed by teachers and supported by a research based mathematics program.	K-5 parents 27	2.923	4.500	
	6-8 parents 18	3.500	4.667	
	9-12 parents 16	3.333	4.533	
	post CHS parent 17	3.750	4.333	
none=1	no child parent 1	5.000	5.000	
unclear=3	k-5 teacher 16	4.125	4.813	
clear=5	6-8 teacher 7	4.857	5.000	
	9-12 Teacher 8	3.750	4.000	
	9-12 Student 9	3.500	4.625	Difference
		3.583	4.561	0.979

Question 14: The mathematics program is clearly	Group # of responses	Q14: Current	Q 14: Desired Level	
communicated to the community and provides means for feedback.	K-5 parents 27	2.370	4.407	
	6-8 parents 18	2.833	4.611	
	9-12 parents 16	2.667	4.267	
none=1	post CHS parent 17	2.933	4.214	
unclear=3	no child parent 1	3.000	3.000	
clear=5	k-5 teacher 16	3.938	4.800	
	6-8 teacher 7	4.143	5.000	
	9-12 Teacher 8	3.375	4.125	
	9-12 Student 9	2.500	4.375	Difference
		2.965	4.451	1.486

Question 15: How would you weigh	Group # of responses	Q 15: Student Performance in Class
student inclass performance in measuring the success of the mathematics program?	K-5 parents 27	4.333
	6-8 parents 18	4.600
	9-12 parents 16	4.133
	post CHS parent 17	3.933
not important=1	no child parent 1	5.000
important=3	k-5 teacher 16	4.563
very important=5	6-8 teacher 7	4.571
	9-12 Teacher 8	4.250
	9-12 Student 9	3.000
		4.241

Question 16: How would you weigh results from	Group # of responses	Q 16: NJ ASK & HSPA
state assessments in measuring the success of the mathematics program?	K-5 parents 27	3.519
	6-8 parents 18	2.556
	9-12 parents 16	3.600
	post CHS parent 17	3.125
not important=1	no child parent 1	3.000
important=3	k-5 teacher 16	3.688
very important=5	6-8 teacher 7	3.286
	9-12 Teacher 8	2.875
	9-12 Student 9	1.750
		3.164

Question 17: How would you weigh national	Group # of responses	Q 17: SAT, ACT, AP, etc.
assessment results in measuring the success		
of the mathematics program?	K-5 parents 27	4.074
	6-8 parents 18	3.444
	9-12 parents 16	3.933
	post CHS parent 17	3.500
not important=1	no child parent 1	2.000
important=3	k-5 teacher 16	4.067
very important=5	6-8 teacher 7	3.286
	9-12 Teacher 8	3.250
	9-12 Student 9	2.000
		3.609

Question 18: How would you weigh a student's	Group # of responses	Q 18: College / Work Placement
college or work placement in measuring the		
success of the mathematics program?	K-5 parents 27	3.741
	6-8 parents 18	4.111
	9-12 parents 16	3.733
	post CHS parent 17	3.875
not important=1	no child parent 1	3.000
important=3	k-5 teacher 16	3.875
very important=5	6-8 teacher 7	3.429
	9-12 Teacher 8	4.500
	9-12 Student 9	2.750
		3.793

Appendix B

Focus Group Participants

Parent focus group participants

K-5 parents of students who have attended all elementary schools in the district.

- A female parent who is a teacher working in another district, with a male child in grade 3 and a female child in grade 5.
- A male parent who was formerly active in the township education foundation, with a female child in grade 8 and two male children who graduated in the class of 2005 and 2010 .
- A female parent who is active in the PTO, with a female student in grade 2 and two children not yet in school.

6-8 : all parents have students in Pre Algebra who attended two different elementary schools

- A male parent with two female and two male students in grades 6, and 4, and two students in grade 1.
- A male parent with one male student in grade 6.
- A female parent with two female students in grades 3 and 6.

9-12

- Female parent with a female student in first grade and a male student in third grade. This parent volunteered to speak in any focus group and felt qualified to speak on the high school curriculum because of experience teaching at the college level and she has a Ph.D. in statistics.
- Male parent with a male child graduated in the class of 2005, female child graduated in the class of 2009 and a female child in grade 9.
- The third parent did not arrive and responded to questions by email.

Student focus group participants

6-8 with all grade levels represented. No representative from Tollgate Elementary School

- 3 students, graduated from Hopewell Elementary, in 6th, 7th and 8th grades
- 2 students, graduated from Bear Tavern, in grades 6 & 7
    - 4 students have been in Hopewell K-current
    - 2 students began in grade 3 in Hopewell system
    - 2 students have parents who were former teachers in the district but not current teachers.

Student focus group participants (continued)

9-12

- Grade 12 in Applications of Calculus
- Grade 12 in Advanced Algebra
- Grade 11 in Pre-Calculus
- Grade 11 in Functions, Statistics and Trigonometry
- Grade 9 in Applied Algebra
- Grade 9 in Advanced Algebra Honors
    - 5 students have been in Hopewell since kindergarten or first grade
    - 1 student in Hopewell for grades K-5, who went to private middle school, and then returned for grades 9-11

Teacher focus group participants

K-5 teachers

- Tollgate Kindergarten with 2 years teaching in Hopewell
- Hopewell Elementary in grades 1 and 2, with 3 years teaching in Hopewell
- Bear Tavern in grade 3, with 19 years teaching in Hopewell
- Stonybrook in grade 4, with 10 years teaching in Hopewell
- Hopewell Elementary in grades 4 and 5 special education, with 5 years teaching in Hopewell
- Tollgate in grade 4 and 5 Gifted and Talented, with 11 years teaching in Hopewell

6-12 teachers

- 6-8 all grades, with 3 years in Hopewell and teaching
- Grade 7, with 13 years in Hopewell and 20 yrs total teaching
- 7th grade, with 20 years in Hopewell and 22 years total teaching
- Grade 9-12 with 15 years in Hopewell and teaching.
- Grade 9-12, Functions, Statistics and Trigonometry, Advanced Algebra and Foundations of Algebra. 6 years teaching in Hopewell and 12 years total teaching
- 9-12 special education, resources, Applied 2 and FIA with 13 years in Hopewell, 15 yrs total teaching

Principal focus group participants

All elementary school principals were present

Tollgate Middle school principal was present

The Hopewell Valley Central High School principal was unable to attend and in his place the Vice Principal participated in the focus group.

Appendix C

Focus Group Questions

Parent Focus Groups, Grades K-12

How would you define a successful math program regarding classroom instruction?
(e.g. text book vs. hands-on, homework, accommodating each child's needs, use of calculators/technology)

How would you define a successful math program regarding classroom environment?
(e.g. willing to take risks, equity, respect)

How would you define a successful math program regarding the K-12 curriculum?
(e.g. basic skills, real-life applications, problem solving, range of courses offered)

What would you recommend to clarify communication between parents and the school district and/or teachers regarding the math goals, instruction, curriculum options, etc.?
(e.g. What information do you need? How should information be disseminated/gathered?)

Student Focus Groups, Grades 6-12

What do you see as the major strengths of the math program?

What do you see as the areas in most need of improvement?

In what ways were you prepared for middle/high school math?

In what ways were you not prepared for middle/high school math?

Do you use the varied strategies you learned K-5 to multiply or solve equations in middle/high school?

Do teachers make connections between math and the real world, the usefulness of math in other content areas, and/or to student interests?

What do teachers do to challenge students who excel in math?

What adaptations do teachers make to meet the needs of struggling students?

What is the purpose of homework? How often and what type of homework do you get? How much time do you spend doing homework at home?

Do you have enough flexibility to change math courses or math classes?

Teacher Focus Groups, Grades K-12

What do you see as the major strengths of the math program?

What do you see as the areas in most need of improvement?

How do you demonstrate connections between math and the real world, the usefulness of math in other content areas, and/or to student interests?

What do you do to challenge students who excel in math?

What adaptations do you make to meet the needs of lower-achieving/special needs students?

How do you help students to develop their ability to pose problems and/or to discover solutions?

What is the purpose of homework? How often and what type of homework do you assign? How much time do you expect students to spend doing homework at home?

Who coaches you on effective instructional practices that help you to teach math? What experiences have helped you to teach math? What resources do you use to plan what and how you will teach?

How do you inform parents of the purpose, focus, expectations of the math program?

Principal Focus Group, K-12

What do you see as the priorities in math for the next 3 years?

What do you think is effective math instruction?

What resources are needed to improve/sustain the math program?

Below are themes which have emerged from the parent, teacher, students focus groups. What is your reaction to these findings?

- The Chicago Math elementary focus on multiple ways of learning/ strategies for solutions is not valued by all teachers.

- Differentiated instruction is needed to support all students' learning, but skills will need to be developed.

- There is limited opportunity for math colleague collaboration

Resources

In Support of Mathematics Curriculum

21st Century Life and Career Standards of the New Jersey Department of Education. https://www13.state.nj.us/NJCCCS/ContentAreaTableView_21st.aspx

Atlas of Scientific Literacy, Vol. 1 and 2 by the American Association of the Advancement of Science, Oxford University Press, 2001/2007 and mathematic curriculum maps http://www.project2061.org/publications/atlas/default.htm

Computer Science Teachers Association, ACM K-12 CS Model Curriculum, 2nd Edition www.csta.acm.org.

National Council of Teachers of Mathematics. *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics*. http://www.nctm.org/standards/content.aspx?id=270

National Council of Teachers of Mathematics. *Principles and Standards for School Mathematics.* http://www.nctm.org/standards/content.aspx?id=16909

The Common Core State Standards in Mathematics. http://www.corestandards.org/the-standards/mathematics

What Works Clearinghouse (2007). *Elementary School Math*. Downloaded May 2011 from http://ies.ed.gov/ncee/wwc/reports/elementary_math/eday_math/

In Support of Mathematics Instruction and Assessment

City, Elizabeth A., Elmore, Richard F., Fiarman, Saraj E. and Teitel, Lee (2010). *Instructional Rounds in Education: A Network Approach to Improving Teaching and Learning*, Harvard Education Press.

Fogarty, R., & Pete, B. M. (2010). *Supporting differentiated instruction: A professional learning communities approach*. Bloomington, IN: Solution Tree.

Halpern and Hakel. (2003) *Change.* Volume 35, p. 2-13.

Keeping Learning on Track, formative assessment curricula by the Educational Testing Service http://www.ets.org/Media/Campaign/12652/index.html.

Marzano, Robert (2000). *Transforming Classroom Grading*, Association for Supervision and Curriculum Development.

National Council on Teaching and America's Future and West Ed. (2010) *STEM Teachers in Professional Learning Communities: A Knowledge of Synthesis*. National Science Foundation.

National Council of Teachers of Mathematics. *Effective Strategies of Teaching Students with Difficulties in Mathematics. Downloaded July 22, 2011 from http://www.nctm.org/news/content.aspx?id=8452*

National Council of Teachers of Mathematics. *Homework: What the Research Says. Downloaded June 15, 2011 from http://www.nctm.org/news/content.aspx?id=13814&itemid=13814&linkidentifier=id*

Reeves, Douglas. *From Differentiated Instruction to Differentiated Assessment.* Association for Supervision and Curriculum Development. Downloaded July 9, 2011from http://www.ascd.org/ascd-express/vol6/620-reeves.aspx.

Richetti, Cynthia T. and Tregoe, Benjamin B. (2009). *Analytic Processes for School Leaders.* Association for Supervision and Curriculum Development. Downloaded June 20, 2011 from http://www.ascd.org/publications/books/101017/chapters/Thining_About_Questions.aspx.

Tomlinson, Carol Ann and McTighe, Jay. (2006). *Integrating Differentiated Instruction and Understanding by Design: Connecting Content and Kids.* Association of Supervision and Curriculum Development.

University of Chicago School Mathematics Project. *Everyday Math, Advice from Colleagues: Differentiation.* Downloaded July 6, 2011 from http://quliq.com/advice+from+colleagues+differentiation.html

Wiggins, Grant and McTighe, Jay. (2005). *Understanding by Design (Expanded 2nd Edition)* Association for Supervision and Curriculum Development.

In Support of Leadership and Mathematics Strategic Planning

American Educational Research Association. (2006). *Do the math: Cognitive demands makes a difference.*

Donovan and Bransford (2005) *How Students Learn: Mathematics in the Classroom.* National Research Council.

Learning Forward, formerly the National Staff Development Council (2011). *Standards for Professional Learning.* Downloaded July 15, 2011 from www.learningforward.org/standards.

Loucks-Horsley, Susan et. al. (2003). *Designing Professional Development for Teachers of Science and Mathematics*, 2nd Edition, Corwin Press.

Pelfrey, Ron (2006) *The Mathematics Program Improvement Review: A Comprehensive Evaluation Process for K-12 Schools.* Association for Supervision and Curriculum Development.