BOARD OF EDUCATION, SCHOOL DISTRICT OF CLAYTON

Mathematics Curriculum Review
April 27, 2011

Executive Summary

The Mathematics Curriculum committee members will present their curriculum review document to the Board of Education on April 27, 2011.

In April, 2009, the School District of Clayton launched a Mathematics Curriculum Review, a comprehensive, transparent, and position-neutral study of global best practices in the teaching and learning of K-12 mathematics. The work, which is now nearing completion, has been conducted through a collaborative effort by the District's Mathematics Committee, including additional parent volunteers, and with ongoing guidance provided by the Board of Education. The Mathematics Committee functioned as a learning community with combined expertise and experience to study one primary question:

What is the best mathematics curriculum design and program today, determined from a world class perspective?

On December 15, 2010, the Mathematics Committee presented to the Board of Education interim findings and recommendations. During the April 27, 2011 Board of Education meeting, the Mathematics Committee will present its final recommendations for improvements to curriculum in the content area of mathematics.

The Mathematics Committee's charge was to research what is necessary to ensure a world-class mathematics curriculum/program. The committee's first action was to launch an in depth literature review, including local, national, and international sources. The committee, working both as a whole group and also in subgroups on task specific topics, reviewed over 120 documents (articles, journals, books, etc.) to gain insight into what works in mathematics from a global perspective. Key findings from the research indicated that a globally competitive mathematics program should

- assure a challenging, coherent, and focused preK-12 curriculum that has high expectations for all students
- include instruction and curricula materials that support the balance of conceptual understanding, computational/procedural fluency, and strong mathematical reasoning
- assure highly-qualified, highly-prepared teachers who are knowledgeable and prepared in both the content of mathematics and of teaching mathematics.

Guiding Principles:

As the Mathematics Committee members began to synthesize their research findings and identify themes and common practices across high achieving countries, they also began to draft what

would be called the Guiding Principles which would guide the teaching and learning of mathematics within the School District of Clayton. The committee drafted seven guiding principles and further clarified each with the development of Program Specifications, descriptors detailing the expectations necessary to meet each Guiding Principle. Over the length of the mathematics review process, the Guiding Principles continued to be revisited and refined or additional indicators were determined to be necessary to reflect best practices. The Guiding Principles provided a continuous overarching vision as decisions were made for the various components of the mathematics review, including informing the text adoption process, planning for teacher professional development, and consideration of parent support school to home materials. The seven Guiding Principles are shown below and the complete document can be found in Section VII of the Final Report.

1. High quality mathematics education in Clayton is based on high expectations for all students and opportunities to meet the needs of individual learners.
2. Students will be engaged in meaningful tasks that require them to demonstrate and communicate their learning in a variety of ways.
3. Mathematics instruction will promote mathematical proficiency: conceptual understanding, computational fluency, strategic competence, productive disposition, and problem solving; these proficiencies reinforce one another. (Source: National Resource Council, "Adding It Up")
4. Teachers will be highly qualified with strong content and pedagogical knowledge, while being effective communicators of the mathematics content.
5. The mathematics curriculum will be focused and well articulated across the grades to ensure that all students learn important mathematics.
6. Formative and summative mathematics assessments will enhance student learning by providing meaningful information to teachers, students, and parents.
7. Mathematics curriculum and programming will be clearly and consistently communicated to district community members

Our current realities:

Part of the Mathematics Committee work was to gather information on our current mathematics program. Data collected included input from the community on its perception of the current mathematics program, analysis of the District's standardized assessments in the area of mathematics, and review of the current textbooks with regards to the research from the literature review. The Mathematics Committee engaged Unicom.ARC to conduct an outside professional survey of all stakeholders to provide insight into the community's perceptions of our current mathematics program. Unicom.ARC reported an overall positive opinion from the community at large though there were also areas of concern that affected the work of the Mathematics Committee during the program review. Through the surveys we learned that our current program and curriculum materials do not contain enough support for students and parents, need a stronger focus on the computational/procedural fluency component of the program, need additional resources and communication avenues to help parents support their child's mathematical learning at home, and need additional assessments of mastery to inform instruction at the elementary level. The District also engaged outside statisticians to validate the data analysis work of the Mathematics Committee and conduct additional statistical analysis of our

standardized student achievement data to help clarify our current reality and to inform decisions related to curriculum design and programming.

The standardized assessment data analysis from both the Director of Assessment and Mathematics and the statisticians from Washington University showed similar findings. Both reported similar inequities in learning among our known subgroups. Within our student population, there is a significant achievement gap between African-American students and both White and Asian students; paid lunch students scored significantly higher than students receiving free or reduced lunches. The School District of Clayton also had the opportunity to participate in an international assessment, the 2009 Programme for International Student Achievement (PISA). Results of the PISA indicated that Clayton's 15 year old high school students that participated in the assessment scored well in comparison with the world's leading school systems, outscoring all of the top scoring countries in reading, science, and mathematics, with the exception of Shanghai, China, in mathematics.

Concurrently, while the Mathematics Committee was launching and working through the various stages of the mathematics review, a national educational reform effort was also taking place with the development and release of the Common Core State Standards (CCSS). The Common Core State Standards are considered to be a set of internationally benchmarked standards that will be used by the greater majority of states across the country to standardize and improve the standards to which states are held accountable. The movement toward common standards is expected to raise the bar considerably across the country so that all states have internationally benchmarked comparable expectations for student learning and comparable student accountability. The CCSS work has been developing concurrently with the Clayton mathematics review, which has provided insight into future state level expectations in the area of mathematics as well as guidelines for textbook selection so that our classroom texts are, at a minimum, aligned to what will be coming forth as Missouri grade level expectations. Analysis by the Director of Assessment and Mathematics of the Common Core State Standards continues, and while the CCSS will be considered a "floor" level of expectations for our District, they will still continue to be monitored for insight into Missouri expectations for students preK-12. In coming years, the CCSS assessments will provide opportunities for additional comparisons with other high achieving states as we continue to benchmark Clayton students for success in mathematics.

Because of the continual monitoring of the development of the Common Core State Standards, the Assistant Superintendent for Teaching and Learning and the Director of Assessment and Mathematics made a connection with a nationally respected consultant to the work of the Common Core, Dr. Andrew Chen. See below for his bio:

> Dr. Chen is currently a principal research scientist at the Massachusetts Institute of Technology. He frequently consults with education research institutions including the Institute for Education Science at the U.S. Department of Education, and Achieve, Inc. Dr. Chen is on the Common Core State Standards Initiative K-12 Standards Development Team in Mathematics. He is on the Advisory Board of the National Council on Teacher Quality. Locally he is on the Mathematics and Science Advisory Council for the Massachusetts Board of Education.

Since our mathematics review research was informing the Mathematics Committee of the importance of a well balanced curriculum and quality professional development for teachers of mathematics, we invited Dr. Chen to partnership with Clayton as part of our professional development work with Clayton's teachers of mathematics on content development. Dr. Chen visited Clayton in January, 2011, and through an intensive three day focus on mathematics, engaged our secondary mathematics teachers, both high school and middle school, and our elementary mathematics specialists in high level professional development in mathematics content. Dr. Chen will continue his work with Clayton in May, 2011, as he provides similar professional development in mathematics for our elementary teachers, and will continue to visit and consult with Clayton's teachers of mathematics as part of our ongoing professional development as we launch our new mathematics program.

In addition to the work Dr. Chen engaged in with our teachers, we were fortunate to have Dr. Chen engage our community as well in a conversation on international benchmarking in the area of mathematics. Dr. Chen's presentation to the community helped bring our stakeholders together in agreement on best practices in mathematics and the importance of a well balanced approached to teaching and learning of mathematics. His message of the "three legged stool" (skills, content, and problem solving) helped inform the development of the rubric measurement tool that would be used as we progressed into text selections. His message of the importance of deep content knowledge for teachers will continue to help us as we design and provide high quality professional development in mathematics content for our preK-12 teachers.

Reflection upon the research, stakeholder surveys, student achievement data, Common Core State Standards, and work of Dr. Chen, helped the Mathematics Committee to draw some conclusions about our current mathematics program. While we identified areas of strength that need to be maintained and refined, we also identified areas of weakness that need to be addressed as we move forward in our goal to assure a world class mathematics program. Global competency in comparison with the world's leading performers in mathematics requires focused, high quality, balanced curriculum across the preK-12 spectrum. The world's best performers in mathematics also have far less discrepancy in student achievement scores across the various subgroups of students, resulting in less achievement gaps and more equitable learning outcomes for all students. We also found that countries scoring the highest on both the TIMSS and PISA have more and longer opportunities for teachers to train in mathematics instruction and also work in collaboration with peers to study student work.

From the collective inquiry and data analysis process we came to the following conclusions:

- When the committee analyzed the current textbooks with regards to a balanced curriculum (conceptual understanding, computational fluency, and mathematical reasoning) there were concerns at all three levels (elementary level, middle school level, and high school level).

- Everyday Mathematics (elementary text), Connected Mathematics (middle school text), and Core-Plus Mathematics (high school text for Integrated Mathematics sequence) were all weak in the area of computational and procedural fluency.

In order to evaluate potential textbooks for use across the District, the Mathematics Committee reviewed texts used at comparison high achieving school districts across the country, particularly focusing on selections used by our Project Blueprint comparison schools as well as those used at the top ten school districts in the State of Massachusetts, commonly acknowledged as the highest achieving state in the country in the area of mathematics. At least ten top selections for each grade level span, elementary, middle, and high school, were requested from publishers for review. Text samples received from various publishers were reviewed by members of the Mathematics Committee to narrow the selection to a top four, which were then made available for review to the teachers at appropriate grade spans across the District and parents and community members.

For the initial evaluation of texts by the Mathematics Committee, a comprehensive rubric was generated to help review the texts for components identified as key through the literature review and also known to be integral in high achieving districts globally. A rubric that had been used by the Bridgewater Raritan School District in New Jersey was recommended by a member of the Board of Education and was then modified for use by the School District of Clayton. Using the Board approved comprehensive rubric, we found the following:

- Connected Mathematics did not score as high as other potential middle school texts when reviewed and thus did not move forward as an option for use at the middle school.

- Everyday Mathematics, though weak in computational fluency, scored similarly on the rubric when compared to other high scoring texts that were reviewed.

- Core-Plus Mathematic text was not reviewed. The Core-Plus text had been removed from the high school as stated in a previous report from the Assistant Superintendent and the Director of Assessment and Mathematics.

Recommendations:

After synthesizing the comprehensive body of research and work of the Mathematics Committee and review of the top books and presentations from vendors, the Mathematics Committee is recommending the purchase of textbooks at the middle school level for grades 6, 7, and 8. As stated in the Mathematics Program Review update in December, the goal is to have all 8th graders taking an Algebra 1 course. In order for this to be accomplished textbooks will need to be purchased at all three grade levels. It will be necessary for teachers at Wydown Middle School be given time to write curriculum during the summer in preparation for the implementation of the textbooks. This preparation includes becoming familiar with newly purchased textbooks as well as compacting course work to allow the 6th through 8th grade Common Core State Standards be covered in the 6th and 7th grade mathematics program and beginning the high school course, Algebra I in eighth grade.

> The textbooks being recommended for purchase is the Holt McDougal series for all three grade levels, with eighth grade Algebra 1 students using Holt McDougal (Burger series) and eighth grade Challenge Algebra students using Holt McDougal (Larson series).

The Mathematics Committee is recommending the purchase of textbooks at the high school level for incoming freshmen and continued purchase the following years until the Honors, College-Prep, and Informal sequences are complete. Due to the arrangement of mathematics topics in the College-Prep Integrated sequence it would be inappropriate to move students out of the sequence at this time. The College-Prep Integrated sequence has approximately 60% of any given grade. It will be necessary for teachers at Clayton High School be given time to write curriculum during the summer in preparation for the implementation of the textbooks for all three mathematics sequences. This preparation includes College-Prep teachers becoming familiar with the newly purchased text as well as compacting course work to allow for topics not covered in our current Algebra 1 course to be addressed in preparation for College-Prep Algebra 2. It will be necessary for College-Prep Algebra 2 teachers the following summer to do similar work.

The textbooks being recommended for purchase are the Glencoe McGraw-Hill series for students enrolled in the College-Prep or Informal Mathematics sequence and Holt McDougal (Larson series) for the Honors Mathematics sequence.

The Mathematics Committee is recommending the adoption of textbooks for the K-5 Mathematics program be delayed. Below are the reasons for the delay.

a. The current textbooks under review align to the Common Core State Standards. However, as the "Progressions" from the Common Core State Standards committee are released this June textbook companies are likely to edit their textbooks accordingly, possibly making any purchases premature.

b. Teachers need more information/training in regards to the Common Core State Standards and the changes it will make to the elementary mathematics program. This information will allow teachers to have a better understanding of the materials under consideration and a better understanding of the textbook rubric indicators.

c. Many of the books that are being considered for adoption at the elementary level are recent releases with minimal to no student achievement data. By delaying the purchase of elementary textbooks, it would allow Clayton time to gather performance data from other districts.

d. The analysis of the elementary texts, both at the Committee level and the District level, did not result in conclusive data on text selection.

As a result of the delay at the elementary level the Mathematics Committee is recommending that Everyday Mathematics Fourth Edition (aligned to the Common Core State Standards), Go Math and Math in Focus: A Singapore Approach be evaluated against the Common Core State Standards "Progressions" for consideration for piloting during the 2011-2012 school year. The protocols for piloting textbooks include:

a. Determining which grade levels, which units within the pilot textbooks will be used and which classrooms will use the pilot materials and which classrooms will be the control group.

b. Teachers will need to be trained on the proper use of the pilot materials prior to the implementation.

c. Prior to the unit beginning, students in both the pilot classrooms and the control group classrooms will need to take a pre-assessment. The assessment must be independent of the critical routines in any one textbook. The assessment will be written by the Director of Assessment and Mathematics.

d. During the implementation of the pilot, the Director of Assessment and Mathematics will conduct observations of both pilot classrooms and control group classrooms. The purpose of the observations is to monitor implementation of curriculum materials and the engagement of students.

e. After the implementation of the pilot unit students in both the pilot classrooms and the control group classrooms will take a post-assessment to determine the level of growth and a qualitative survey regarding their engagement of the text, ease of use and overall opinion of the materials that were used during the unit.

f. Teachers who used the pilot materials will debrief with the Director of Assessment and Mathematics to report on the strengths and weaknesses they found while teaching the pilot unit with their students.

Results of the qualitative student surveys, notes from the teachers participating in the pilot, and the student growth data will be carefully considered by the Mathematics Committee. The committee will make a recommendation in the Spring of 2012 of the preferred textbook to be considered for adoption.