Sitka School District

Mathematics Audit Report

Summer 2012

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K-12 MATHEMATICS CURRICULUM AUDIT

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Acknowledgements

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INTRODUCTION

This document constitutes the final report of a K–12 Mathematics Curriculum Audit of the Sitka School District. The Sitka School District Board of Education, within the scope of its policy-making authority, commissioned the audit. The advance work was begun November 4, 2011 through December 4, 2011. The on-site portion of the audit was conducted during the time period of December 5–9, 2011, and the post analyses were conducted from December 10, 2011 through May 25, 2012. Document analysis and survey analyses were performed off site, as was detailed analyses of data from focus groups, interviews, and personal communications.

A curriculum audit is designed to reveal the extent to which officials and professional staff of a school district have developed and implemented a sound, valid, and operational system of mathematics curriculum. Such a system, set within the framework of adopted board policies, enables the Sitka School District to make maximum use of its human and financial resources in the education of its students. When such a system is fully operational, it assures district taxpayers that their fiscal support is optimized under the conditions in which the school district functions.

Mathematics curricula based on the NCTM *Standards* (2000) are not in themselves panaceas, but they hold great potential for creating positive change and for helping teachers and administrators provide a richer, more challenging experience to students. Early studies on the impact of these curricula have consistently demonstrated that students using these curricula perform as well as control groups on traditional measures of mathematics achievement and significantly outperform students on measures of problem solving and reasoning (Reys, Reys, Barnes, Beem, & Papick, 1997).

Background

This is the third content specific curriculum audit commissioned by the leadership of the Sitka School District within the past few years. In 2010 a K-12 Language Arts curriculum audit was completed with a final audit report presented to the superintendent in March. This audit report contained findings and recommendation for actions district leadership can take to improve the design and delivery of the district's Language Arts program. In 2009 a technology curriculum audit was completed with the report presented to the leadership in April 2010.

Located in Sitka, Alaska, the Sitka School District is a single-site public school district serving the City and Borough of Sitka. The **Sitka School District** provides for the educational needs of citizens of Sitka, Alaska. The district's offices are located in the same building as Keet Gooshi Heen Elementary School and accessed through a separate entrance. The Sitka School District's enrollment figure is around 1,300 students K-12. A common misconception especially among those outside of Sitka is that the statewide public boarding high school, Mt. Edgecumbe High School, is part of the district when in fact it is administered directly by the State of Alaska and primarily serves Native Alaskans from small, rural communities.

Table 1 Socio-Economic Status by School

School	Grade	% Low SES
Baranof Elementary	K-1	37%
Keet Gooshi Heen Elementary	2-5	38%
Blatchley Middle	6-8	38%
Pacific High School	9-12	91%

Alternative		
Sitka High	9-12	26%
REACH Home school	K-12	18%

Table 2 Comparison of Language Arts and Mathematics Proficiency

Student Groups	% of Students* Proficient or Advanced in Language Arts	% of Students* Proficient or Advanced in Mathematics
All students	84%	69%
African American	N/A	N/A
*Alaska Native/American Indian	74%	58%
*Asian/Pacific Islander	79%	58%
*Caucasian	91%	78%
Hispanic	N/A	N/A
*Multi-Ethnic	83%	60%
Economically Disadvantaged	74%	57%
Students with Disabilities	45%	27%
Limited English Proficiency	59%	41%

***Performance Discrepancy.**

Background Purpose and Scope of the Work

The Curriculum Management Audit (CMA) is a process that was developed by Dr. Fenwick W. English and first implemented in 1979 in the Columbus Public Schools, Ohio. The CMA is based upon generally-accepted concepts pertaining to effective instructional management and curricular design and delivery, some of which have been popularly referred to as the "effective schools research." An audit is an independent examination of three data sources: documents, interviews, and site visits. These are gathered and triangulated, or corroborated, to reveal the extent to which a school district is meeting its goals and objectives, whether those objectives are internally or externally developed or imposed. A public report is issued as the final phase of the audit process. Because Sitka School District audit scope is centered on K-12 mathematics curriculum and instruction, not all aspects of a larger Curriculum Management Audit are included in this analysis. Thus, Sitka School's Math audit is neither as extensive nor as detailed an independent examination as its larger predecessor. Neither the Sitka School District

nor the audit team should extend any of the findings or implications beyond those explicitly stipulated in this report.

The purpose for the audit was to examine the mathematics curriculum to determine its effectiveness for Sitka students. To accomplish this task we needed to:

1. Develop an understanding of the enacted curriculum.
    a. The enacted curriculum is what teachers actually do in the schools, what they actually teach, how long they teach it, and the frequency with which they teach it. In some cases teachers do not actually teach the school's adopted curriculum and this could be for many reasons. As part of this, we explore underlying reasons when a school district's enacted curriculum is not the adopted curriculum. As part of this broad topic we examine the underlying expectations that govern the mathematics teaching and learning process with special attention to how teachers interact, plan, and receive professional development.
2. Develop an understanding of students' value for their own mathematics learning.
    a. Students express different levels of comfort with what they learn. They express frustration when mathematics is hard and they express elation when they do well. What we need to determine is whether or not they feel empowered to be mathematically successful and if they feel they are adequately prepared for each subsequent math course they take. In part we need to understand why some students take 3 or 4 years of math while others take only the required 2 years.
3. Examine the necessary components underlying implementing a successful and highly effective K-12 mathematics program:

    a. Textbooks
    b. Professional Development
    c. Materials
    d. Planning
    e. Articulation

Audit Team

The auditors are professors and researchers experienced in curriculum design, curriculum audits, and statistical inference. Members of this audit team were:

• **Dr. Robert M. Capraro, Ph.D.** – 8 years of teaching experience, 7 years of administrative experience, and 12 years as a university professor and researcher.

• **Dr. Trina J. Davis, Ph.D**., – 5 years of teaching experience, 4 years of administrative experience, 9 years as director at the university level and 6 years as a university professor and researcher.

• **Dr. Mary Margaret Capraro, Ph.D.** – 14 years of teaching experience, 10 years of administrative experience, and 12 years as a university professor and researcher.

***Biographical information about the auditors is found in the appendix.**

Sitka School District Sitka Mathematics Curricula

The district implemented standards-based curricula throughout all grade levels (K-12) for more than seven continuous years including *Bridges in Mathematics* (grades 1 and 2); *Math Trailblazers* (grades 3-5); *Connected Mathematics* (grades 6-8); and *Core-Plus* (grades 9-12).

Bridges in Mathematics is a full elementary curriculum providing tools, strategies, and materials teachers need to meet state and national standards. It was developed with initial support from the National Science Foundation. *Bridges* offers an exceptional combination of problem solving and skill building in an openly articulated package that takes students through each grade level with shared models, teaching pedagogies, and goals. A *Bridges* classroom contains a combination of whole group, small group, and independent activities. Lessons encompass increasingly complex pictorial models - seeing, touching, working with manipulatives, and sketching ideas. By encouraging students to discover, experiment, and justify their reasoning, the curriculum facilitates the development of mathematical thinking for students with different learning styles (The Mathematics Learning Center, n.d.)

Math Trailblazers is a complete, research-based elementary mathematics program that is aligned to the Common Core State Standards and integrates math, science and language arts. **Math Trailblazers** is based on the belief that children learn best when engaged in problem-solving exercises that use real-world contexts to help students make sense of mathematics. It provides additional teaching tools and corresponding student activities designed to support educators during the transition to the new standards (Kendall Hunt Publishing Company, n.d.)

The ***Connected Mathematics Project*** (CMP) was developed with funding from the National Science Foundation (NSF) in 1991-1996 for middle school teachers and students. CMP helps students develop understanding of important mathematical concepts, skills, procedures, and ways of thinking and reasoning, in number, geometry, measurement, algebra, probability and statistics. CMP is based on research, and was field-tested in diverse sites across the country. Through CMP, students develop knowledge of and skill in the use of vocabulary, forms of representation, materials, tools, techniques, and intellectual methods of the discipline of mathematics, including the ability to define and solve problems with reasoning, insight, inventiveness, and proficiency (Michigan State University, 2009).

Core-Plus Mathematics Program (CPMP) is an NSF-funded curriculum for high school students and was developed in accordance with the NCTM's (1989) *Standards* (Schoen, Cebulla & Winsor (2001). The CPM program is organized into a four-year curriculum with the first three years intended for all students and the fourth year intended for students preparing for post-secondary education. Across all four years, students engage in exploration and sense making by "investigating problems set in real-life contexts within an integrated curriculum that includes algebra and functions, geometry and trigonometry, statistics and probability, and discrete mathematics" (Latterell, 2003, p. 6).

There have been several evaluations of the CPMP curriculum. Most recently, Harwell et al. (2012) compared the impact of college students' previous completion of either the CPMP curriculum or a traditional (commercially developed) curriculum on college participation in mathematics courses. Their findings indicated that there were no significant differences between type of high school mathematics curriculum and

subsequent enrollment in advanced mathematics courses or grades in mathematics courses.

Other studies of the CPMP curriculum have found more favorable results associated with CPMP usage in terms of improved student achievement and attitudes towards mathematics. Schoen et al. (2010) conducted a longitudinal study, which examined student achievement outcomes in three schools using the CPMP curriculum. The researchers found that in Year 2 of the curriculum, students scored higher on the Educational Testing Services (ETS) End of Year course examination in Algebra than the national average. In Year 3, students scored as high on the mathematical literacy tasks on the 1995 Trends in International Mathematics and Science Study (TIMSS) as Norway, which indicated that they were far above the average score for 12th grade students in the U.S. Importantly, the researchers also found that students had much more positive attitudes towards mathematics in Years 3 and Years 4 as assessed by the *Conceptions of Mathematics Scale*.

Capraro, Capraro, Yetkiner, Rangel-Chavez and Lewis (2010) examined the impact of the CPMP curriculum use in one urban district on Hispanic students' performance on the Colorado Student Assessment Program (CSAP) and Measurement of Academic Progress. Results showed that Hispanic students had modest gains in their mathematics achievement scores although they still underperformed relative to other racial/ethnic groups with the exception of Black students.

Nelson (2005) compared student performance on the Washington Assessment of Student Learning (WASL) between 22 schools in at least their second year of using the CPMP curriculum and 22 matched schools, which used a variety of traditional curricula. Findings showed that 9th and 10th grade students at schools using the CPMP curriculum had significantly higher pass rates on the WASL than schools using traditional curricula.

Three Types of Curriculum

The *intended* curriculum is content stipulated by districts or state and national standards. The *implemented* curriculum is what is actually taught by teachers. While the *attained* curriculum is what students actually learn. A large percentage of teachers and parents think these three are congruous, however, there is often a large discrepancy between them. This is partly due to teachers using textbooks as the "curriculum" for a course and not being able to cover all the material. Thus they frequently make "independent and idiosyncratic" decisions about what will be taught; this in turn directly effects students' opportunities to learn. Research concerning opportunity to learn speaks to a compelling argument for planned curriculum articulation (Marzano, 2003).

Research on Standards Based Instruction

The National Council of Teachers of Mathematics (NCTM) publication of the *Curriculum and Evaluation Standards for School Mathematics* document in 1989 and the revised *Standards* document issued in 2000, "*Principles and Standards for School Mathematics,*" has been influential in the development of standards-based curricula in mathematics. The NCTM *Standards* recommended that mathematics curricula be developed that emphasized problem solving, reasoning, and making connections between different areas of mathematics while reducing the emphasis on memorization and direct teacher instruction (Harwell, Medhanie, Post, Norman, & Dupuis, 2009; Riordan & Noyce, 2001).

The National Science Foundation (NSF) has played a critical role in the development of *Standards*-based curricula. During the 1990s, the NSF funded the development of several mathematics curricula, including five for high school students. These curricula were developed in accordance with the NCTM *Standards* (1989; 2000). Specific features of the NSF-developed curricula for high school students included: 1) integration of content areas (i.e. algebra, geometry, probability and statistics) at each grade level; 2) inclusion of technology; 3) problem-based instructional approach and 4) a wide range of assessment methods (Harwell et al., 2009; Schoen, Ziebarth, Hirsch, & BrckaLorenz, 2010).

Research has shown that standards-based mathematics curricula can have significant positive effects on student achievement. Post, Harwell, Davis, Maeda, Cutler, Andersen, Kahan, & Norman (2008) examined the impact of the NSF standards-based curricula on middle school students' performance on standardized achievement tests. Students who received three years of either MathThematics or the Connected Mathematics Project (CMP) performed significantly higher on the Open-ended and Problem Solving subtests on the Stanford 9 compared to the national averages.

Increasing the achievement of all students in mathematics begins with early recognition of mathematics deficiencies and evaluation of not only mathematics achievement but also mathematics growth. Furthermore, educators, administrators, and researchers may learn valuable information about the achievement of Black and Hispanic students by investigating early trends in mathematics growth. As a result, the purpose of this study is to compare the mathematics achievement and mathematics growth of minority students and their White peers in an urban school district in Colorado. The skills that students possess when they enter elementary school and their academic progress while in elementary school have a great impact on subsequent academic outcomes and experiences (National Association for the Education of Young Children [NAEYC]; National Council of Teachers of Mathematics [NCTM], 2002). Thus, this study seeks to explain student achievement across grade levels in regards to closing the achievement gap among constituents in a large urban school district, particularly Black and Hispanic students, who are usually impacted the most by standardized testing under NCLB.

Initial academic achievement differences in primary school are most pronounced between poor students and their more affluent counterparts and between minority and White students (Benson, Borman, & Wisconsin Center for Education Research, 2007). Students who enter school with varying degrees of mathematical knowledge may gain mathematics skills differentially than their peers. For example, if one student enters kindergarten with a firm understanding of the concept of quantity, then he or she is at an advantage because any further enrichment adds to the student's foundational understanding.

Several empirical studies indicate that initial performance predicts positive subsequent academic growth (Aunola, Leskinen, Lerkkanen, & Nurmi, 2004; Bodovski & Farkas, 2007; Rescorla & Rosenthal, 2004). The opposite was found for some students that entered school with lower initial mathematics achievement. Fan (2001) suggested that some students are faced with ―double barreled‖ barriers of low initial performance and lower growth rates than their peers. Yet, some students may enter school with low mathematics achievement but progress at nearly the same rate as their peers. Ding and Davison (2005) suggested that students can enter school with lower initial achievement and manage to progress at a rate that is not statistically significantly different than their peers. However, because of their lower level of initial

achievement, the students were unable to reach the same academic levels as their peers. Students identified as Limited English Proficient (LEP) and students in special education have particular difficulties closing the initial gap in achievement (Ding & Davison, 2005). Initial achievement differences do not account for all the subsequent variation in student academic progress and achievement; however, it puts the student at a disadvantage early in the educational pipeline.

Environmental Factors Affecting Mathematics Growth

Students enter the public school system with one or more factors that may contribute to lower academic achievement in mathematics (Rathbun, West, & Walston, 2005). Specifically, coming from poverty, status as a racial or cultural minority, having parents who did not complete high school, and having parents who speak a language other than English in the home can negatively influence academic achievement and growth (Croninger & Lee 2001; Natriello, McDill, & Pallas, 1990; Rathbun & West, 2004). The aforementioned risk factors for lower academic achievement can possibly affect any student regardless of race or ethnicity. When considering the effects of language on mathematics performance students whose native language is not English had substantial difficulties on the mathematics portion of the NAEP (Abedi, Lord, & Plummer, 1997). Kindergarten students enter schools from various backgrounds and academic skills. Initial academic differences may equate to differences in achievement and mathematics growth. Some suggest that achievement trajectories may vary between different subgroups (Jordan, Kaplan, Olah, & Locuniak, 2006). Due to these factors, initial academic differences in some cases are more profound for some groups of students as opposed to others.

Fidelity of Implementation with Administrative Support

Fixsen (2006) found that educators need to understand that "implementation is not an event… [it is] a mission-oriented process involving multiple decisions, actions, and corrections" (p. 25). This requires that educators take a dynamic part by intentionally looking at how a program is implemented in their schools—and then make modifications as needed. Researchers Wallace, Blase, Fixsen, and Naoom (2008) directly connected implementation to student achievement and learning: "Improved outcomes in education are the product of effective innovations and effective implementation efforts" (p. 7).

Thus even well-designed programs cannot just be taken off the shelf. Administrators and researchers realize that teachers are a vital part of program success: "In education, teachers are the intervention. Well-described innovations inform when and how they interact with students and stakeholders, but it is the person (the teacher) who delivers the intervention through his or her words and actions." (Wallace et al., 2008, pp. 54–55). Therefore, well-prepared teachers are critical for successful implementation a new program. Principals may need to elicit district support to garner support for teachers

The main point for administrators is that implementation matters—and ensuring that programs are implemented effectively is yet another important responsibility for success.

Audit Approach

The Mathematics Curriculum Management Audit has established itself as a process of integrity and candor in assessing public school districts. It has been presented as evidence in state and federal litigation concerning matters of school finance, general resource managerial

effectiveness, and school desegregation efforts in Kansas, Kentucky, New Jersey, and South Carolina. The audit served as an important data source in state-directed takeovers of school systems in New Jersey and Kentucky. The mathematics curriculum management audit has become recognized internationally as an important, viable, and valid tool for the development of educational institutions and for the improvement of curriculum design and delivery. The mathematics curriculum audit represents a "systems" approach to educational improvement, that is, it considers the system as a whole rather than a collection of separate, discrete parts. The interrelationships of system components and their impact on overall quality of the organization in accomplishing its purposes are examined in order to "close the loop" in curriculum and instructional improvement.

The Model for the Curriculum Management Audit

The model for the Curriculum Management Audit is shown in the schematic below. The model has been published widely in the national professional literature, including the bestselling book, *The Curriculum Management Audit: Improving School Quality* (Frase, English, & Poston, 1995).

General instructional quality assumes that the basic three elements must be present in any educational system. These are: (1) a work standard, goal/objective, or operational mission; (2) work directed toward attaining the mission, standard, goal/objective; and (3) feedback (work measurement), which is related to or aligned with the standard, goal/objective, or mission. When activities are repeated, there is a "learning curve," i.e., more of the work objectives are achieved within the existing cost parameters. As a result, the organization or a subunit of an organization becomes more "productive" at its essential short- or long-range work tasks.

Within the context of an educational system and its governance and operational structure, curricular quality control requires: (1) a written curriculum in some clear and translatable form for application by teachers in classrooms or related instructional settings, (2) a taught curriculum, which is shaped by and interactive with the written one, and (3) a tested curriculum, which includes the tasks, concepts, and skills of pupil learning, and is linked to both the taught and written curricula. This model is applicable in any kind of educational work structure typically found in mass public educational systems, and is suitable for any kind of assessment strategy, from norm-referenced standardized tests to more authentic approaches.

Figure X. Schematic View of Curricular Quality Control

The Curriculum Management Audit assumes that an educational system, as one kind of human work organization, must be responsive to the context in which it functions and in which it receives support for its continuing existence. In the case of public educational systems, the support comes in the form of tax monies from three levels: local, state, and federal. In return for such support, mass public educational systems are supposed to exhibit characteristics of rationality, i.e., being responsive to the public will as it is expressed in legally constituted bodies such as Congress, state legislatures, and locally elected/appointed Boards of Education.

FINDINGS

CRITERION 1: A School System Has Established Clear and Valid Objectives for Students and Teachers.

i. What the Auditors Expected to Find

The audit team expected to identify clear and valid horizontally and vertically aligned objectives with continuity between and among grade levels for student performance. Specific sets of learning clearly articulated between grades within a school but especially for transitions from one school and grade band to another. For example, specific and well articulated planning meeting to facilitate student transitions from Baranof to Keet Gooshi Heen elementary schools, and from Keet Gooshi Heen elementary to Blatchley middle school, and from Blatchley to Sitka High School. Further, there should be expectations that teachers within a school meet the same instructional standards and use similar instructional techniques. In small districts where all students attend only one traditional high school that teachers at other school that feed into the high school also meet, plan, and receive systemic and sustained professional development where expectations are held and peers help to maintain the continuity.

ii. Overview of What the Auditors Found

1. The design of the district's mathematics curriculum documents is inadequate in scope.
2. The quality of mathematics curriculum documents is inadequate to serve as an effective tool to guide instructional decisions.
3. Instructional resources in use in the Sitka Alaska School District have not all been adopted by the board of education; available resources have not been linked to specific learning objectives and are not used consistently.
4. Board policies do not provide adequate quality control to guide sound curriculum Management

CRITERION 2: Results from System Wide Longitudinal Analyses of Students Mathematics Achievement.

iii. What the Auditors Expected to Find

The audit team expected to find three important indicators of student success, students and parents would be able to clearly and concisely explain salient and vital components of the mathematics program. The longitudinal effect on student mathematics learning would have a positive slope from 6th grade through high school mathematics.

iv. Overview of What the Auditors Found

1. A comprehensive student assessment and program evaluation plan is not in place to direct instruction for improved student achievement of the mathematics curriculum. The elements of a student assessment and program evaluation plan that are in place are considered inadequate to guide curriculum, instruction, and program decisions.

2. The scope of student assessment in mathematics is adequate to guide curricular and instructional decision-making.

3. Gaps persist in student mathematics achievement as measured by state assessments, and trend analyses indicate little or no movement toward parity.

4. The use of formative and summative student achievement data is inadequate to inform curricular, instructional, and programmatic decision-making.

5. Student longitudinal mathematics performance was higher prior to 2008 but since 2009 student achievement has declined.

6. On average student absences from class regardless of excused or unexcused are negatively related to student academic gains in mathematics.

Data Analyses and Graphs

There was a slightly positive relationship between student absences and progressing through school. As students progress from 6th grade through 11th grades, the absence rate increases somewhat dramatically. In extreme cases, students are missing significant portions of the school year. It is important to note in the graphs that extreme numbers of absences are somewhat infrequent in 6th grade but students from one grade to the next the graphs goes from extreme positive slopes at the far end, to a more linear relationship encompassing many more students with large numbers of absences.

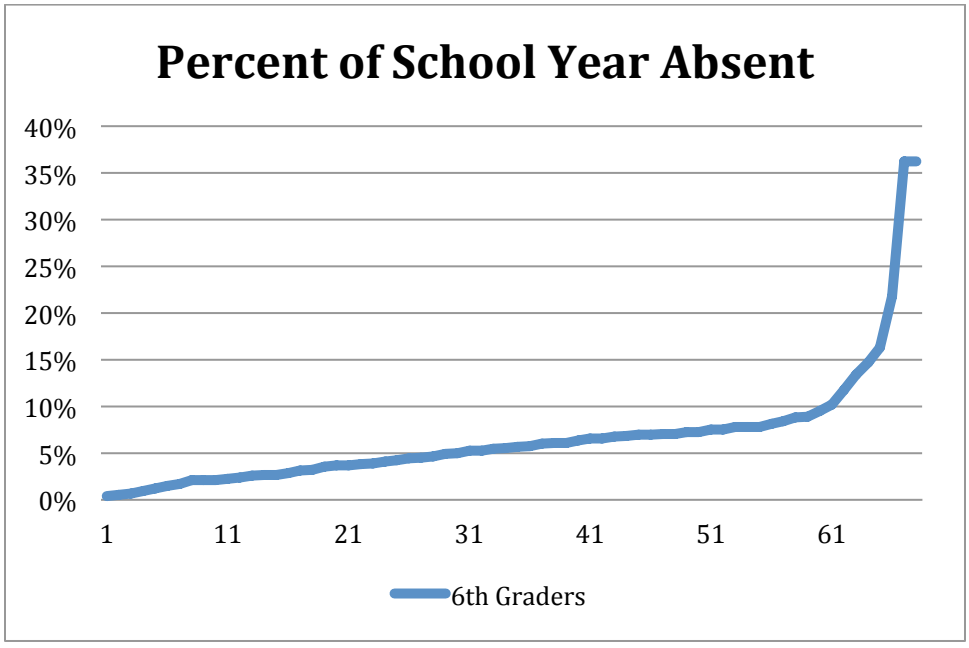


Figure 1. Absenteeism for 6th graders.

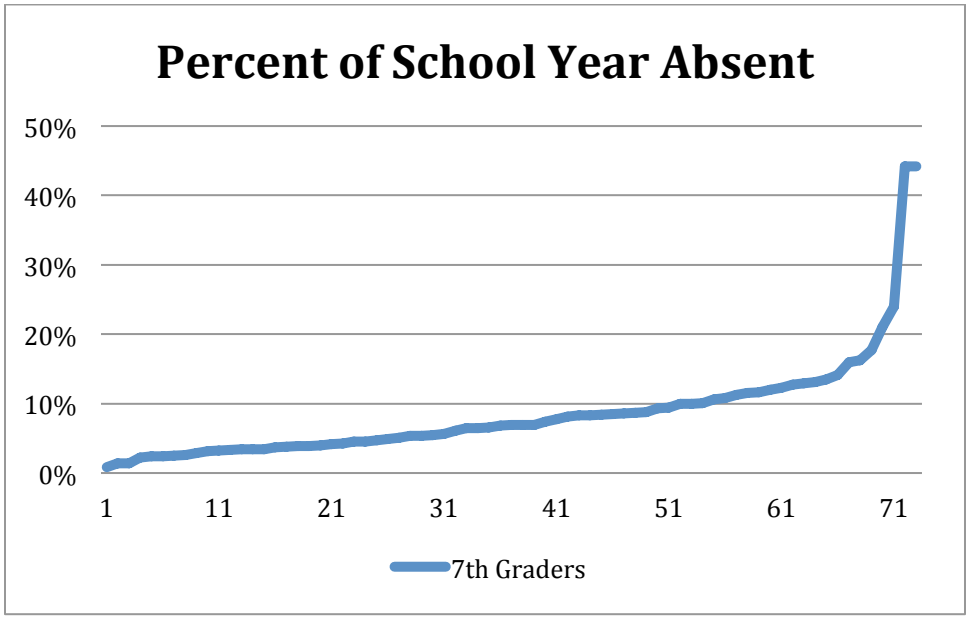


Figure 2. Absenteeism for 7th graders.

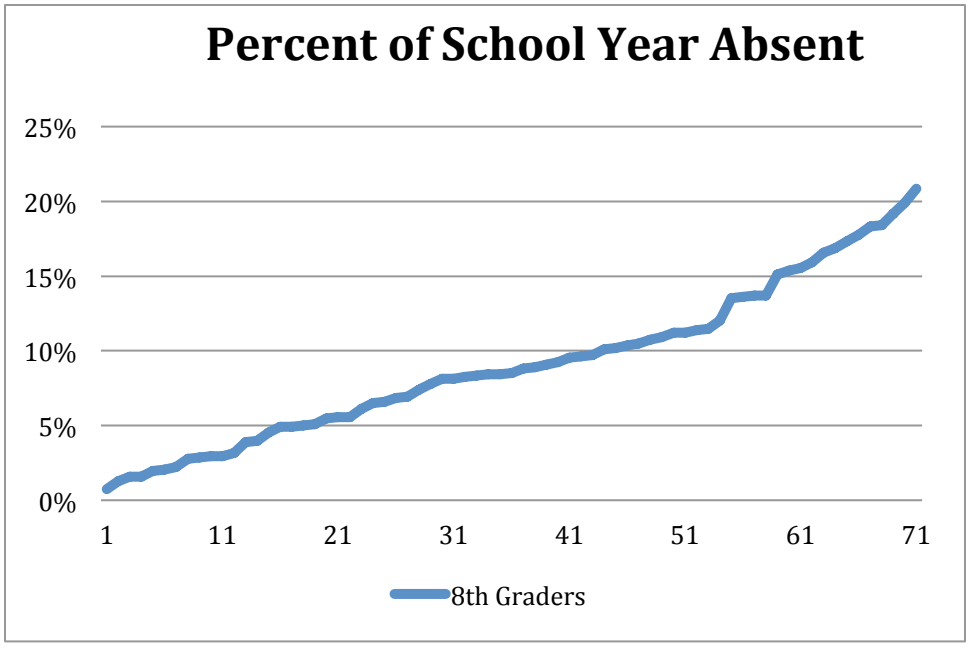


Figure 3. Absenteeism for 8th graders.

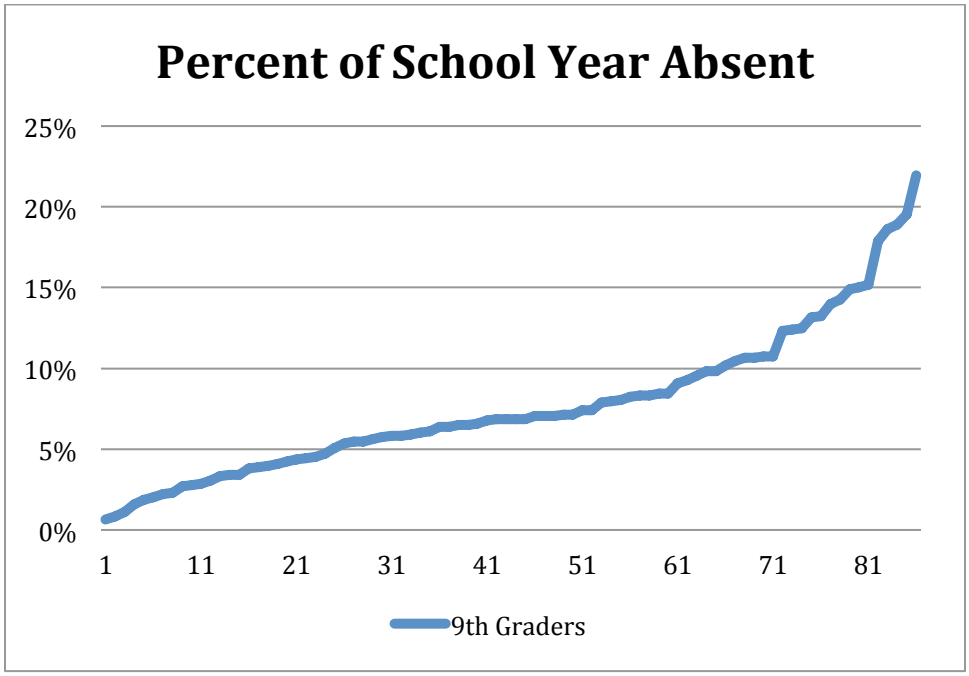


Figure 4. Absenteeism for 9th graders.

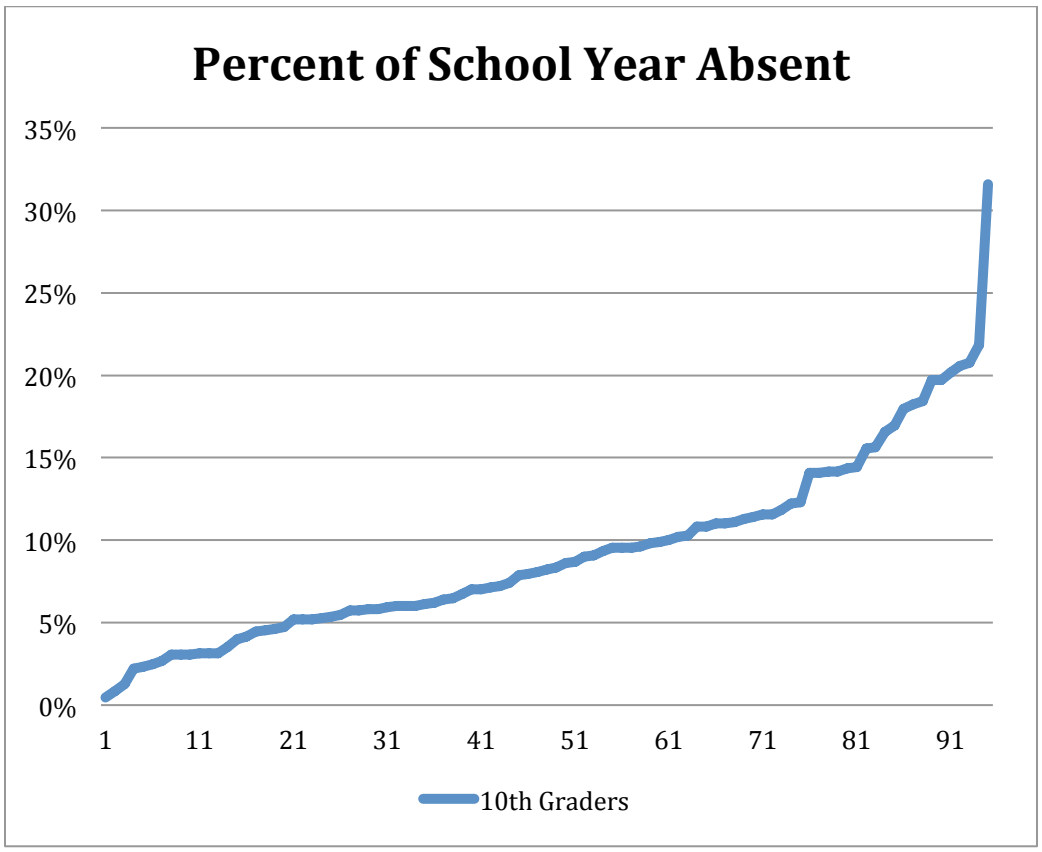


Figure 5. Absenteeism for 10th graders.

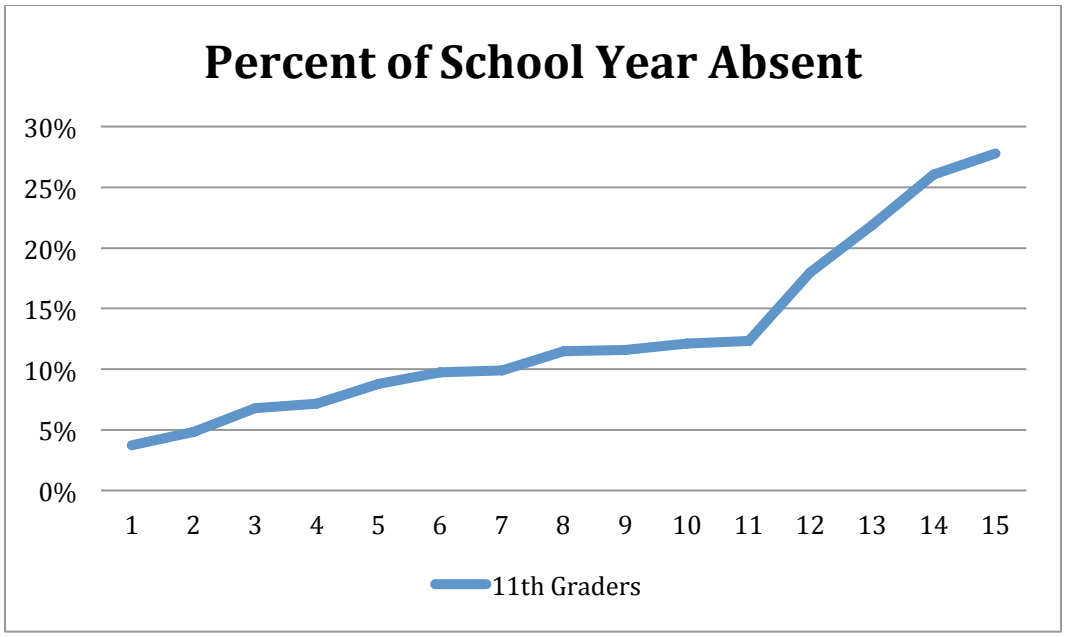


Figure 6. Absenteeism for 11th graders.

Figure 7 shows that the absence trend is increasing. The odds ratio indicated that the average student in 11th grade would miss nearly 13% of the 11th grade school year. This is equivalent to 23.5 days of instruction. Given the academic performance is sliding there are too few students capable of making up this amount of classroom instruction. If this trend is to continue, parents will need to identify a significant community resource where they can pay to provide supplemental instruction to makeup for the absences. By the time a typical student had reached the 11th grade he or she had missed nearly one in 6 years of classroom instruction.

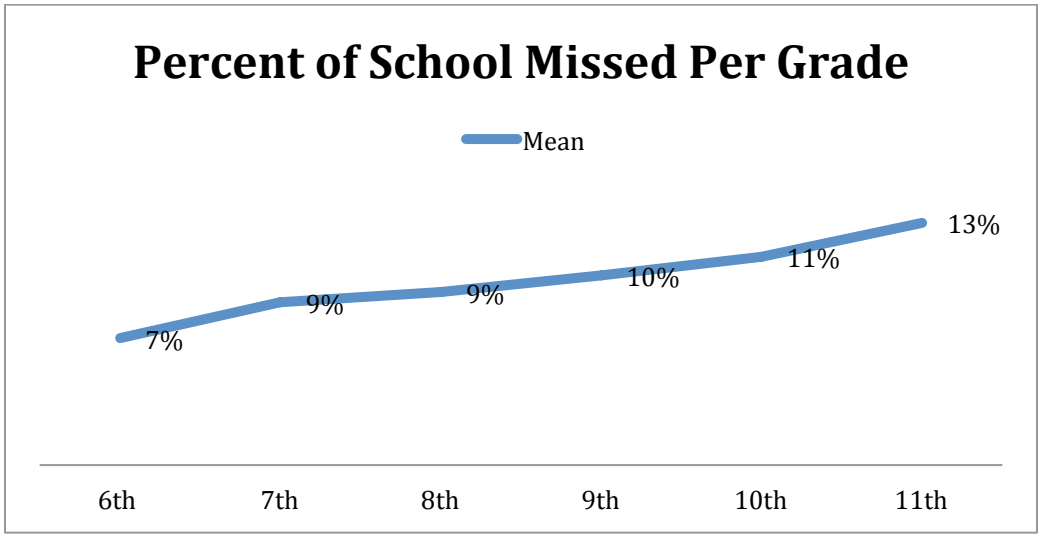
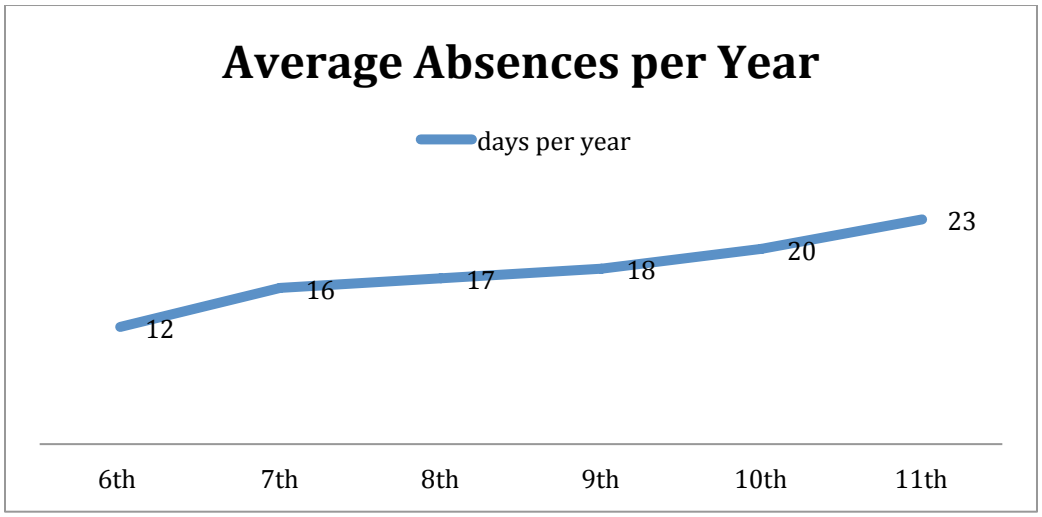
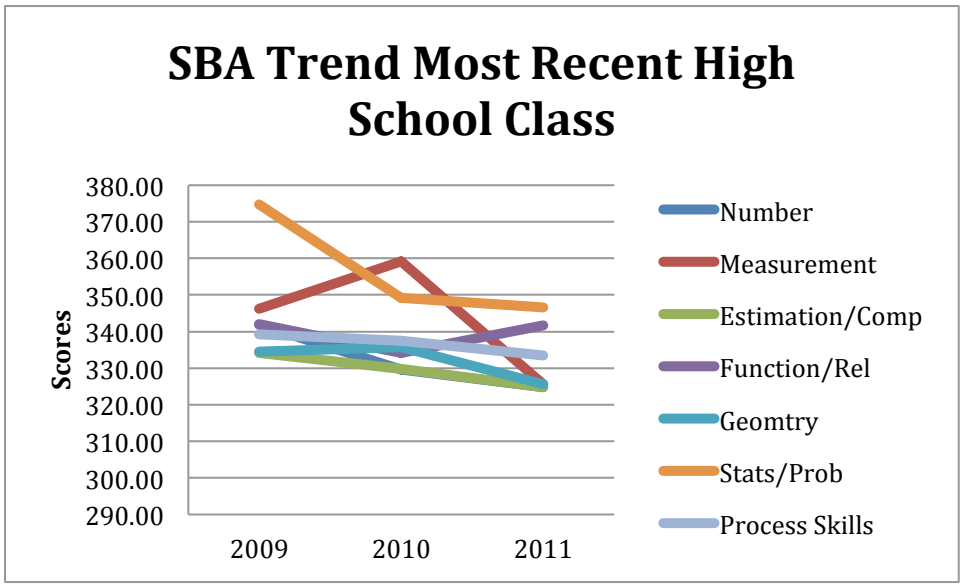


Figure 7. Percent of school missed per grade.



F*igure 8.* Average absences per year.

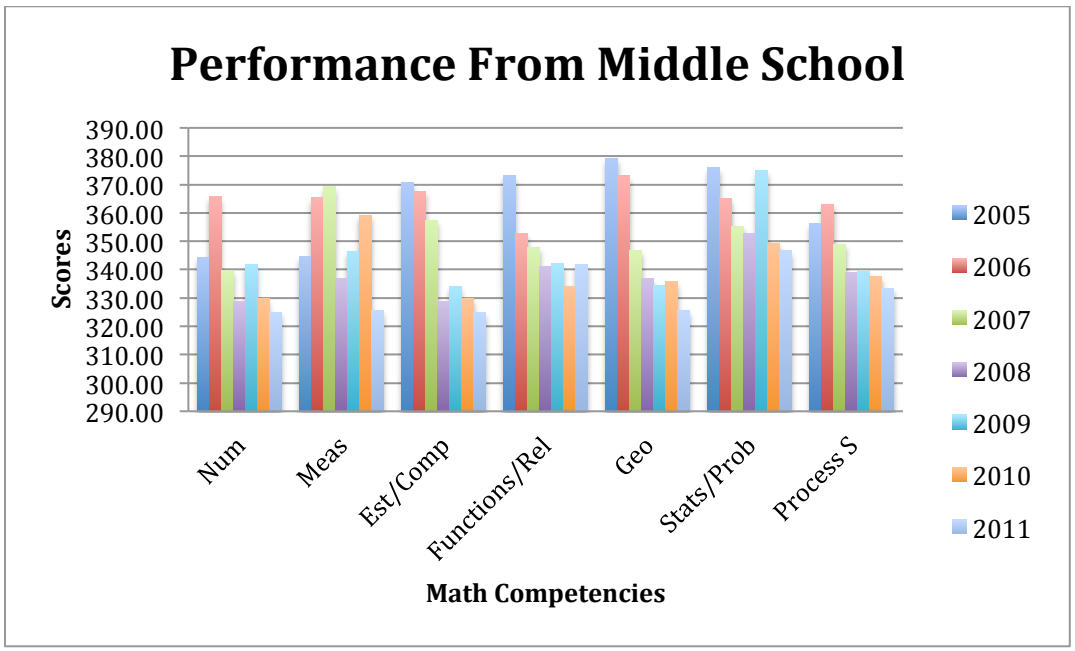
We were asked to comment on academic performance over-time. We considered the issues in terms of both faculty and curriculum. To differentiate the faculty effect we considered only the most recent group completing state testing. It is clear in Figure 9 that high school mathematics performance is declining over time. Figure 9 shows that over time, NOT GRADE, in high school performance is declining.



F*igure 9.* Average SBA Performance for the most recent high school class.

Student Performance From Middle School

The trend is somewhat negative albeit somewhat misleading given differences in the tests. However, performance is erratic at the middle school level. There was no clear trend across middle school students. While the mathematics performance was somewhat higher in middle school, the decline begins there as the decline is consistent and nearly linear. It is erroneous to believe the full decline can be attributed to events or conditions contained solely within the high school. A linear decline is closely associated with our conclusions about the systemic issues facing students' mathematics learning.



F*igure 10.* Average SBA Performance for the most group completing state testing in high school.

Disentangling the Curriculum Effect

To examine the curriculum effect for students we examined average high school student performance in 2008 going back two years. From discussions with administrators and teachers this time period reflected a high degree of fidelity to the curriculum and its full implementation. The mean score for 11th grades shows that most of the SBA areas are trending upwards. Students in 2008 were making positive gains in all areas except for Geometry and Measurement (see Figure 11). Compare the average trend for the most recent high school senior class (see Figure 12). There is a strong negative trend from 9th grade, with a much lower starting point than for students in 2008, with the exception of Stats/Probability (see Figure 12). Regardless of the level of fidelity to the curriculum or whether the enacted curriculum is teacher decided, students who enter Sitka for the last two years of their education do not perform well (see Figure 13). This may be attributable to a poor mathematics foundation prior to arriving in Sitka or whether the results are indicative systemic failings within the instructional framework within the district.

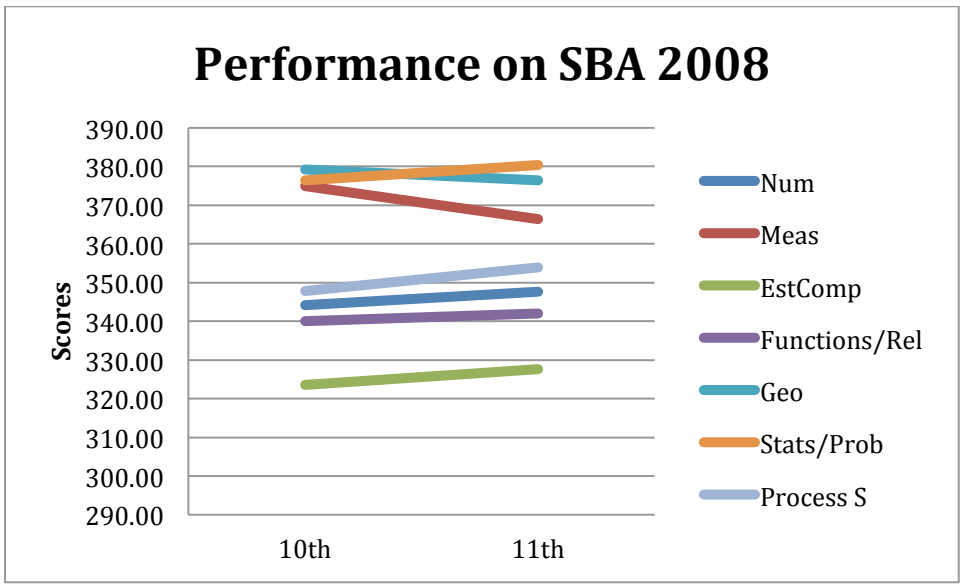


Figure *11.* Average SBA Performance 2008 senior high school class.

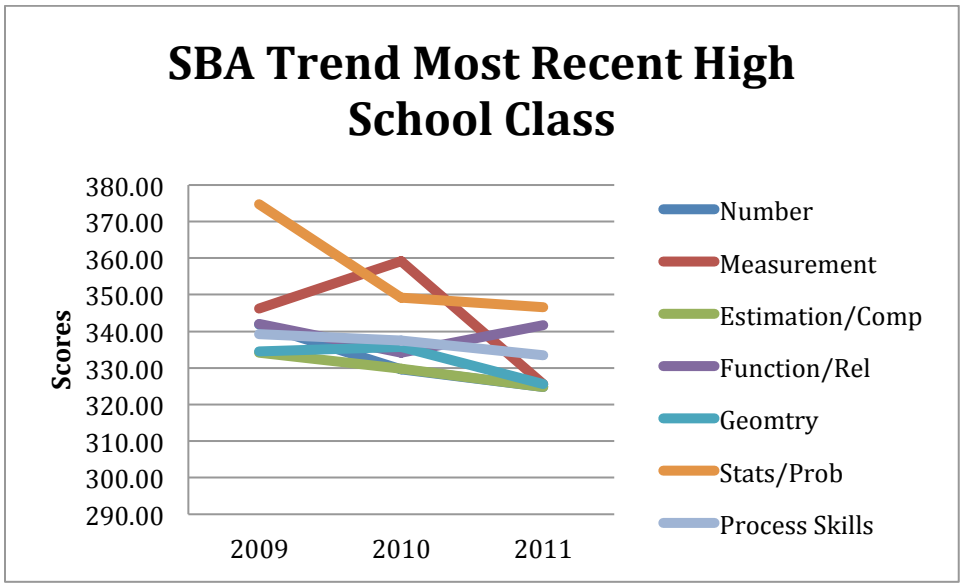
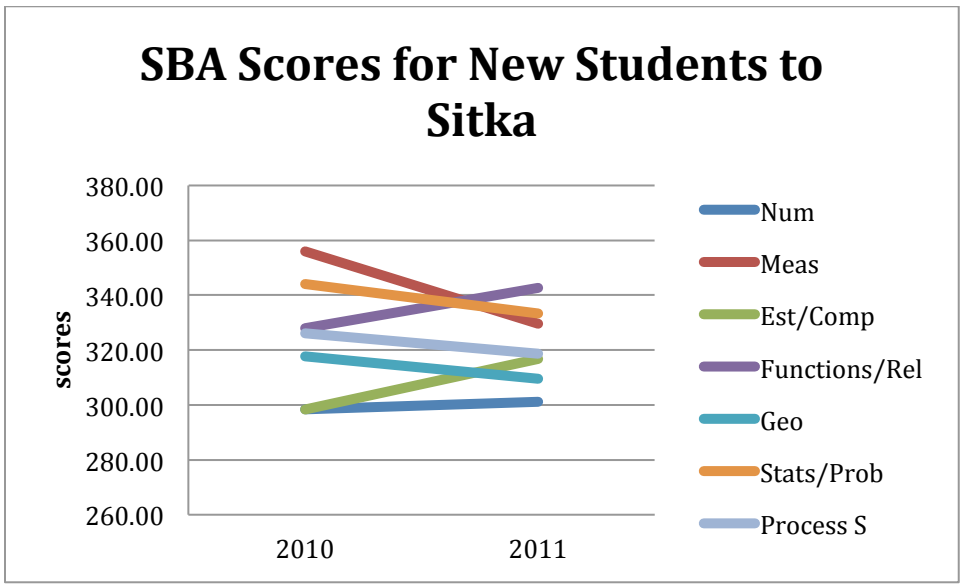


Figure *12.* Average SBA performance for the most recent high school senior class.



Fi*gure 13.* Average SBA performance for transfers into Sitka.

Sitka School District Teacher Observations

Table 3 Teachers by Grade Level and Experience

Teacher	Gr. Level	Yrs. Exp.	Yrs. in Sitka
Williams, Karen	1st	5	5
Loomis, Marlie	1st	6	4
Peterson, Stephanie	3rd	20	20
Bryner, Chris	4th	2	2
Rogers, Emily	5th	20	20
Riva, Deb	6th	15	10
Robbins, Melissa	7th	3	3
Jordan, Bobbi	8th	21	14
Jorgensen, Janine	HS	9	4
Miller, Royce	HS	20	3
Strong, Jeremy	HS	3	1

Acknowledgement

We wish to thank the following teachers for allowing us to visit their classrooms and watch Sitka students as they were learning mathematics: Karen Williams, Marlie Loomis, Stephanie Peterson, Chris Bryner, Emily Rogers, Deb Riva, Melissa Robbins, Bobbi Jordan, Janine Jorgensen, Royce Miller, and Jeremy Strong.

Classroom Observation Background

During our visit to Sitka Schools, 11 teachers were observed from grades 1 through 12. Teachers ranged in teaching experience from 1 to 20 years of experience with a mean of 11.3 years of experience. A purposeful sample of teachers (n = 5) were observed at the elementary level, while all middle (n = 3) and all high school (n =3) teachers were observed. The observation instrument contained 14 indicators shown below, we will report the mean scores and standard deviations; then we will interpret and explain the data further using justifications written during classroom observations. Average scores ranged from a low of 2.65 (goals were stated) to a high of 3.75 (teachers worked with all students) indicating that on average the teachers displayed effective strategies while teaching mathematics to Sitka students.

Sikta teachers excelled in the areas of working with all students, lessons provided coherent clear understanding, and teaching fundamental concepts. Teachers continuously circulated around the room as students worked individually, in pairs, or groups asking questions and making comments that kept students engaged and on task. Teachers focused on the topic of the lesson and provided an environment that was math-rich with little distractions or interruptions. Teachers picked out important mathematical topics that were based on their state objectives. Students participated and listened attentively to the mathematics and classroom discourse was centered around the mathematics topic of the day.

Improvements could be made in the areas of goals and foundations. Teachers should let students know what the purpose of the lesson is for the day by either verbally stating the goals and objectives of the lesson or writing them on the board. Additionally, at the end of the lesson teachers could ask students what they learned or have the students write a quick entry into a math

journal to demonstrate their grasp of understanding for the day and whether they were able to accomplish the goals of the lesson. Another area of weakness on the part of Sitka teachers was building a foundational knowledge of the topic when background knowledge was lacking. The team heard the teachers talk about this problem during focus groups and interviews but did not see all teachers do this during their classroom instruction. Checking for prior knowledge should be done at the beginning of the lesson and then the teacher needs to adjust the lesson to help students who lack the prior knowledge necessary to learn the new concepts being taught.

Although these observations did not directly address the mathematics curriculum in Sitka, teachers who implement these strategies are displaying characteristics that effectively allow them to implement constructivist, reform curriculum. If we observed teachers who were unable to teach mathematics using these strategies, then it would be impossible for them to effectively implement *Bridges, Trailblazers, Connected Math,* and *CORE Plus*. We did not find that to be the reality. The Sitka teachers are very dedicated to their profession and to making sure that their students learn mathematics. Indicators of effective teaching of mathematics can be seen by the comments from the team in each of the 14 indicators listed (see Appendix I). The fairly small standard deviations (SD) indicate that there was little difference between the teachers and that all of them displayed teaching behaviors that were very close to the mean scores listed.

School District Teacher Parent and Student Survey and Focus Group Collection and Results

Data were collected in four distinct stages using surveys administered through Qualtrics, a web-based survey tool. The **first stage** was a Parent survey distributed by each school; the link was posted to the school's web page and distributed on flyers at school events. The survey remained open for 4 weeks with periodic reminders posted. In the **second stage**, three parent focus groups were held at convenient times for the parents during an advertised one-week period. Additionally, one student focus group was conducted toward the end of the data collection period. The focus groups were advertised 3 weeks in advance of the first focus group. The **third stage** was a Student Survey; again advertised 4-weeks prior to the start of the data collection and the web-based questionnaire remained open for 2 weeks. The student responses to the survey were used to triangulate parent responses. The **fourth stage**, Parent and Student Follow-up Survey, was a random sample of family units (student and parent) from each grade, 4-12. The random sample was designed to oversample secondary families. Students (grades 4-8) had a 20% chance of being selected whereas; secondary students (grades 9-12) had a 33% chance of being selected. The Parent and Student Follow-up Survey was advertised for two weeks prior to the start of the data collection and the web based questionnaire remained open for six weeks.

Survey Descriptions and Alignment for Triangulation

Parent Survey was distributed to all parents of the school district. The survey was designed to gather information about the standards-based mathematics textbooks used in the district, its implementation, and parent satisfaction with the curriculum enactment. The open-ended items are contained in the Appendix and were intended to capture the parents' perspectives about their abilities to participate in their child's learning of mathematics. These were triangulated by questions on the *Student Survey* (see Appendix).

Parent Focus Groups were conducted during two evenings and one afternoon in order to gather as much information as possible. A total of 82 parents were in attendance at all three events. Focus group sessions were recorded and notes were captured throughout the sessions. The focus group protocol can be obtained from the authors. Questions were asked that allowed parents to openly discuss both their involvement and mathematics authority. These were triangulated through an open-ended, high-school student focus group asking parallel questions.

Parent and Student Follow-up Surveys. The final survey was predominately designed as a member check to confirm findings and to clarify previous information gathered from parents and students perceptions of the mathematics curricula used in the district and parents' overall perspectives and experiences related to their involvement with their children's mathematics learning. Therefore, the survey was used with a random sample of participants about the specific issues revealed from previous data collection in which a much smaller group participated. Further students' perspectives on their parents' experiences helping them with mathematics were also added.

Results

Each sub-header represents a main theme that was generated from the coding stage. Four themes emerged from the study: *issues with textbook use and the curricula*, *feelings of helplessness*, *parents' mathematics expectancy, experiences, and conceptions*, and *college-related issues*. In addition, the quantitative data were summarized and contextualized.

Issues with Textbook Use and the Curricula

The data reduction revealed that parents felt they could not help their children with mathematics homework because they saw the current textbooks as "too hard" "too theoretical", containing "no examples", "lacking helpful terminology", or not a "mathematics program". In response to the question do you feel comfortable helping your child with homework, one parent wrote:

> No, I found it difficult to follow the book when trying to refresh my memory so I can help my children. I usually end up [G]oogling the type of problem and finding a more understandable description/explanation to help both of us understand it.

Another parent shared:

> I am comfortable helping her with math but have yet to see a textbook with samples or examples to understand the process being used to teach the students. The biggest issue my child has is the lack of solid examples to follow. I need examples to work through as refreshers to remind me of the processes.

Some parents reported that their greatest frustration was that their child would receive seemingly random dittos for homework that their child claimed to not have done in school.

> My child gets homework he cannot do, not because he doesn't know it but because the teachers say they all give review dittos for homework because the textbook does not provide suitable homework. And the students should all be able to do it. But my child does not remember it and there is no explanation.

Other parents who reported being more comfortable with mathematics also described difficulties they had with the textbook's lack of examples. Notably, in response to the question *if they were*

happy with the textbook their child was using for mathematics parents responded with a mean of 29%. Another participant shared their perspectives as both a parent and teacher, s/he wrote:

> From the perspective of an educator and a parent, the math program does not introduce skills at age appropriate levels, it is confusing and awkward to work with and not enough time and practice is given for the students to move the skills from learning to comprehension. There is not enough basic drill and practice on math facts or the concept introduced. Too many teachers have to create mini lessons within the curriculum to meet the expected national and state standards. I also believe that parents should not have to "teach" their children their math skills. This is the teacher's job to give a child enough foundation to come home and do their homework independently. The homework should be practice and review, not a new learning. This does not always seem to be the case.

Students also offered perspectives on the textbooks. Several students reported unfavorable experiences that included comments like: "the wording is very hard to understand", "the math isn't really explained in the book", and "no problems are even partly worked out in the book." Another student wrote,

> I don't really like our math textbook, because it doesn't give you that many practice problems. For example, if you get homework, and if you get one type of problem and try to do some practice, it doesn't give you more problems of the same [type].

Conversely, another student shared favorable insights about the textbook:

> I like the way problems are set up and linked to each other. Personally I've enjoyed working through problems in these textbooks. I'm currently in math 4 (pre-calc) and I've found that this has been the same experience as the 3 preceding books. I like the flow and real-world situations of these problems and would like to see more of it in the future.

Parents reported that their child was using the adopted math program for classroom instruction ($X = 80$, $SD = 7.2$). However, parents believed their child was receiving homework less than half of the nights of the week (X=41, SD=30.6) and only 30% of the time was homework from the adopted textbook. One explicit concern was the parents believed the general alignment of the adopted textbooks, Bridges, Trail Blazers, CMP, and CPM was lacking (40%). Parents expressed that they did not believe the reform textbooks were designed for all children (72%) and they lacked confidence in teachers' preparedness to fully implement the program (55%). These predominant positions seemed to indicate a general lack of satisfaction and faith in the district curriculum.

Feelings of Helplessness

Several parents expressed feelings of helplessness in terms of assisting their children with mathematics related to the adopted textbook. In addition to the issues that they raised about their discomfort with using the standards-based textbooks, they also felt inadequate in their mathematics knowledge related to the textbooks or conceptual understanding needed to help their children be successful with the mathematics contained in the adopted textbook. Further, parents expressed that they were unable to find tutors locally who knew enough about the various curricula to provide help. One parent reflected on her experiences: "When they were in the lower grades I was comfortable with the math, however I am not able to help with the upper math in the textbooks due to my lack of knowledge in the content." In addition, several parents

described solutions they came up with to find mathematics help for their children that they themselves were not able to provide. For example, they felt helpless in assisting their children and needed to either hire a tutor, access online tutorials, use the internet to find answers or solutions to similar problems, or have their children work independently on their homework. In addition, high school students told us that they went to tutorials before and after school rather than asking their parents for help.

Parents' feelings of helplessness were closely related to their beliefs about the textbook. They believed they could help their child learn the grade level mathematics (67%). They also believed they possessed the requisite mathematics knowledge to facilitate their child's mathematics learning (65%) and were confident they could help with homework (57%). However, the issue arose that the textbook did not contain any examples or worked problems that were similar to the homework, definitions were also lacking so they could not refresh their mathematical knowledge, and there were no descriptions or explanations of the mathematics contained in the textbook related to the child's homework.

Parents' Mathematics Expectancy, Experiences, and Conceptions

Several parents shared their concerns about the incongruence and disconnects between their experiences learning mathematics and their children's experiences with the standards-based curriculum. They saw this incongruence as an important issue. A parent wrote:

> My daughter Hailey is in the advanced math class. I do not feel I can adequately help her, because the math method is not the math process I learned, which has books and examples. She comes home with a problem and there is no example or book for me to help her. Hailey's dad is extremely strong in mathematics, he can sit and figure out a method to help her, but even though they get the answer correct, he does not agree with the way math is being taught at her level. I also do not understand the grading process. She has the answer correct, however, because she needs to explain her method in more detail she gets a 2.5 out of 4. To me the math program is frustrating and not the math I prefer my daughter to be learning. I am a businessperson and so is my husband. We use math and problem solving every day. I believe the math should follow a process of logical right and wrong answers.

Other parent responses suggested a lack of understanding and agreement with the approaches used in the standards-based curricula employed by the district. The parents stated that they would value an opportunity to learn about the curriculum and to attend school sponsored training in support of their child's learning at home (59%).

> Another parent described the need for reference materials for parents, she wrote:
> the lack of relevant reference materials for parents is a huge weakness of this program. Seemingly random worksheets come home every so often, and if my child has questions about the work, I do my best to guess what's being taught in class and how he is supposed to be approaching the work.

Parents felt the current reform mathematics curricula were not meeting the community needs (69%) for high school graduates who need to be mathematically literate and computationally proficient.

Students also shared their perspectives, one student indicated that her parents both: ". . .

felt strongly being successful in math is important, and want to help me. However, they often do not know how to help because they learned a different style and don't know what the math book is asking." Another student reflected:

> My father is a fisherman, who dropped out of high school when he was 15 years old to go fish, so he only acclaimed [completed] somewhat of a high school education, taking only one year of math. My mother didn't go to college, but she's a medical transcriptionist and she does the accounting for my father's boat. It's really frustrating because even though my mother is good at math, she wasn't taught the same way I was. Whenever I had homework and things weren't explained clearly, I found myself so angry and frustrated because nothing was helping. That includes my parents. And my brother, who went to this school (graduated in 2004), and who graduated college, isn't here to help.

Favorable experiences with the curricula were also reported. One student shared:

> My dad feels very comfortable helping me with my homework. He's a mechanical engineer and he does that same math processes and such in his everyday life as an engineer. I feel that he is a great help and continues even beyond the math we're learning to teach me more advanced concepts.

College-related Issues

Parents also conveyed that the standards-based mathematics curricula implemented in the school district did not adequately prepare their children for college. They reported, for example, that their children needed to take developmental mathematics courses when they matriculated to higher education courses. They also reported that higher education admission personnel were not familiar with evaluating CORE-Plus courses that appeared on their children's high school transcripts. Another parent wrote: "high school math is way off the beat[en] path from college. . . [the district] needs to change [the] high school math program and get them better prepared for college (I know this first hand with 2 of my graduated kids. . . " Another parent wrote: "I feel the current math program, which continues in the high school program is not used at the college level and is and not preparing my daughter for higher education." Parents felt the level, frequency, and complexity of homework were not well aligned with the expectations their children will face in college nor was it incorporated into the textbook so their child would not know how to read or use a college level mathematics textbook to learn math (48% and 27%), respectively. Finally, parents' response average to the question: I believe the math program prepares my child for college was 33%. This response demonstrated parents' lack of confidence in the adequacy of their child's mathematics preparation.

Parent and Student Focus Groups revealed that parents felt helpless with regard to their students' mathematics learning. They talked about relinquishing their after school homework time with their children and on the other hand encouraging them to attend before and after school labs for tutoring. They emphasized that the book did not contain worked out examples for them to follow nor were there enough "practice" problems. Additionally, they said, "CORE-Plus cuts parents out of the program" because "the book is too difficult and does not contain examples." Several parents described their feelings of frustration in not being able to help their children with math homework. Some elaborated on not understanding the new methods and approaches. Several parents raised concerns about their children's preparation for college. For example, they talked about the difficulty that college admissions officers had in reviewing and interpreting transcripts with Core-Plus course entries. They also recounted examples of their children needing

to take developmental mathematics during their freshman year in college to get "up to speed" for their required math courses.

Parents have felt that a more traditional program would better serve the families in the area. The following quote captured the deeply felt perspectives of many parents in this close-knit Alaskan school district:

> The students and families of the school district have lobbied for a traditional math curriculum since it was terminated. We will continue to demand it. Our child[r]ens' math education is too important and way to[o] many students continue to be handicapped by the current curriculum. I don't care how many math audits, superintendents or school boards it takes but we will get it back because students cannot afford not to have it.

Qualitative Data Collection and Analysis – Teachers and Administrators

The interview protocols described here complement the statistical, quantitative data collected from district personnel and gathered through online surveys conducted by the mathematics audit team. Qualitative interview data were collected during the Sitka School District audit site visits. Skillful interviewing and observation techniques were employed. For this inquiry, a set of interview questions were developed for district and campus visits, based on similar instruments used in other evaluations.

The interview protocols were designed to provide the framework for the focus and purpose of the mathematics program audit. The interview questions reflect the key evaluation questions researchers addressed in the mathematics program review. The open-ended nature of the participants' responses, allowed the audit team the opportunity to address other important issues not initially considered. Through structured prompts, the interviewer explored, reflected back, encouraged the participants to expand their expositions, and requested elaborations from the participants. All individual and focus group interviews were recorded. Careful notes were also taken of the participants' responses during the interviews. Following the site visits, the research audit team conducted debriefing sessions, reviewed notes, looked for incidents and emerging perspectives, and discussed their takeaways and findings in detail.

This report offers descriptions of mathematics program experiences for key stakeholders across the district. It provides perspectives that are illustrative of both challenges and successes in Sitka School District's mathematics program expressed by key district and campus personnel.

Teacher Focus Group Results

Fourteen teachers participated in the teacher focus group. The focus group included seven semi-structured open-ended questions, which include:

- What do you think are the most successful components of your math program?
- Do you feel that your math program meets the needs of most of your students? Why? Why not?
- What concerns do you have about your students' progress in mathematics?
- What are you most concerned about in your math program?

The following represent results from the teacher focus group interviews. Key perspectives are summarized.

Categories	Teachers' Perspectives
Successful components of your math program	• Student discovery, teachers do not lead. • Hands-on uses, manipulatives (Bridges) • Applicable and meaningful for real-life situations • Lends itself to students finding many solutions to problems* • Focuses on data collection and interpretation • Early elementary (Bridges) meets the developmental needs of students
Structure perspectives and issues	• When students travel math instruction is missed • Lab and office hours supplement missed when students leave for vacation and do NOT feel responsibility to make up work • Structure of investigations in CMP does not match 85 minute block • Consistent time fit on math instruction at elementary level • Teacher-designed math curriculum at alternative HS matches students' needs
Math program meeting needs of most students	• Limited opportunities for computation and practice • Teachers must provide supplementary materials to address gaps • Disconnect between the curriculum, report card standards, and state standards • There were some significant gaps that were articulated by multiple teachers within and across programs • Does NOT challenge the top students • Ability groupings are not in place
Concerns about students' progress in math	• Lack of basic computational skills • Gaps as students move across grade levels and schools • Some students did NOT feel challenged • Supplemented with Carnegie Math • GLE's are minimal requirements • Skims through, some topics not delved in deeply enough (Core Plus - CP) • Curriculum moves too quickly

	• Parents cut out of the program – because book is too difficult and doesn't contain examples
Like us to know	• Last math PD was 10 years ago* • Large turnover of teachers • Difficult to attend PD because of travel o Difficult to write substitute plans • PD on Fridays (no math focus in the Friday PDs) • Assessments do not match curriculum (accuracy, developed correctly) • If students do not pass assessments there are no interventions/strategies • Need a screening/diagnostic exam like reading and then get an interventionist to help (SWAT team for math) • Only two math courses are required at the HS level • Some teachers would like to see same program throughout elementary

Teacher Interview Results

Individual teacher interviews were conducted with all middle and secondary math teachers, two elementary math teachers, and one secondary science teacher. The interviews were comprised of ten semi-structured open-ended questions, which include:

- What do you think of the mathematics textbooks/curricula used on your campus?
- Describe the structure of your math period/block?
- What textbook and/or curricula do you use to teach mathematics?
- What concerns do you have about your students' progress in mathematics?
- What supports including professional development have been provided for mathematics teachers - you (e.g. coaching, PD to analyze student learning)?

The following represent results from the individual teacher interviews. Key perspectives are summarized.

Elementary Teachers Perspectives

Categories	Teachers' Perspectives
ELEMENTARY	
Thoughts on the curriculum	• Very appropriate for K-1 • Constructivists approach, hard to teach • Students [curriculum] have gaps • Needs to be supplemented by other curriculum

	• Links well with science units • There are various holes in student knowledge because not all teachers implement in the same way or have the same strengths • Bridges and Trailblazers need alignment because they do not align well (close but not perfect) • Professional Learning Community (PLC) time vertically and horizontally to plan • They also need to align to state standards
Successful Components	• Student discovery, teachers do not lead • Hands-on uses manipulatives (Bridges) • Applicable and meaningful for real- life situations • Lends itself to students finding many solutions to problems* • Focuses on data collection and interpretation • Early elementary (Bridges) meets the developmental needs of students • Good spiraling and revisiting of concepts • Powerful lessons with practice using math tubs • Teacher have freedom to individualize lessons and work at their own pace to meet the needs of students that do not grasp things the first time presented • Teacher "X" because she maps the curriculum and standards and teaches math daily • Both programs are hands-on discovery-based and interactive
Math program meeting needs of most students	• Limited opportunities for computation and practice • Teachers must provide supplementary materials to address gaps. Supplementary materials help to meet the needs that aren't addressed (e.g. Excel definitely helps because of self-pacing, Calendar corner meets the needs of all/most students) • Disconnect between the curriculum, report card standards, and state standards • There were some significant gaps that were articulated by multiple teachers within and across programs • Doesn't challenge the top students • Ability groupings are not in place

Structure	• When students travel math instruction is missed • Lab and office hours supplement missed when students leave for vacation and do not feel responsibility to make up work • Structure of investigations in CMP does not match 85 minute block • Inconsistent time spent on math instruction at elementary level (goes anywhere from 0 minutes to 1.5 hours each day) Elementary • Inconsistent amount of curriculum covered • Teacher-designed math curriculum at alternative HS matches students' • Each teacher allots between 40 and 50 minutes a day. But it probably doesn't happen • Math is often split because reading has been given the priority
Concerns	• Lack of communication between buildings. • District focused on literacy** • Students taken out of math for reading intervention, loose math instruction • Students are not prepared from previous grades • Difficult to coordinate GLEs and state standards • Need one coach at both buildings to see big picture • Administration should schedule [for] collaboration among teachers • Gaps in curriculum at primary and elementary levels • Biggest weakness is not enough practice, teachers have to do a lot of supplementations
Professional Development	• Little to no professional development provided • Can only do on our own or during the summer • PD that helps teacher align curriculum is needed • More focus on math PD
What would you like us to know?	• Respect and give time for math teaming • Give teachers small amount of money to buy core things • Allow teachers time to look at or get familiar with electronic resources • Teachers are hard-working and put in 50-60 hours per week

Middle School Teachers Perspectives

Middle school teachers began their interviews by describing the curriculum they used. Teachers expressed they were extremely different in their implementation of the Connected Mathematics Program (CMP). Implementation spans from one teacher who reported not using the curriculum at all to another that "uses a variety of materials that she gathers," to another teacher that develops all of her materials, to finally another teacher that uses the curriculum 90% of the time quite effectively. Other responses included:

- Use of CM with half the class, then go on computer and move at their own pace
- Lane County Math Project from Oregon used as a supplement
- Discovering Algebra
- Bits and Pieces of [CMP]
- Carnegie
- Uses STEM Curricula
- Supplements with worksheets for skills
- One teacher developed a toolkit (binder)

Categories	Teachers' Perspectives
MIDDLE SCHOOL	
Thoughts on the curriculum	• I like CM (Connected Math). I have to be careful with details • If I changed to Saxon, I would still integrate the investigations • I would choose that students would have a book that gives examples, CMP doesn't give any examples. Students do not have books • Would like curriculum that's good, that has the part of CMP that I like but also has t part of the CMP that I like, but also has practice Secondary (HS) • Students who struggle in reading have difficulty • Some topics need clarification • Applies to the real-world • Students not afraid to investigate • Students have lack of notation (growth area), but they are not afraid to investigate
Successful Components	• Appreciate that students have to think. Materials are interesting and engaging • Problem solving

	• Algebraic thinking • Ability to talk and plan together • Investigative projects/units
Structure	• Trying experiments: In the morning do 45 minutes daily (teacher likes this better) • They are remembering the math much better • Carnegie math is self-paced • They forget the math when it's not taught everyday • A HW every other night is difficult to manage (referencing A/B schedule) • I would like to see all of my students at least three to four times a week
Math program meets needs of most students	• Students are not coming in with regular skills • Need more consistency • There are gaps in understanding • Hope they are prepared for high school*
Concerns	• Middle school needs consistency in program • Concerned that students aren't retaining what's being taught • Are we pushing too much out, not going deep enough • They do not remember what they've learned • Concerned that they are not prepared for HS • Student are coming to us with less and less skills, and are not prepared • Concerned that elementary teachers do not love match
Professional Development	• PD on writing assessments • More PD on CMP • No PD for teaching math, teachers need more training • Lack of preservice teacher training • More time on math PD, less PD time on literacy, math needs to be brought to the forefront • Time to meet in teams for conversations • Need to bring PD to Sitka • Learning Communities would be good • Better communication with parents
What would you like us to know?	• Need 4 years of math in HS

	• The grading on report cards of 1, 2, 3, 4 is difficult

Secondary Teachers Perspectives

In response to the question, *what curriculum do you use,* secondary teachers report using mainly the Core Plus program. They use another text in AP Calculus. Additional materials (worksheets) from the Internet are also used, and supplementary materials are used in 1A and 1B. The following represent results from the individual teacher interviews. Key perspectives are summarized.

Categories	Teachers' Perspectives
SECONDARY	
Thoughts on the curriculum	• Students who struggle in reading have difficulty • Some topics need clarification • Applies to the real-world • Students not afraid to investigate • Students have lack of notation (growth area), but they are not afraid to investigate
Successful Components	• Review materials in the new edition are helpful • Book is strong in statistics • Lots of context are built around problems • Real-world applications, investigations are strong • Cannot just turn it over to the students
Structure	• Just one full week of instruction in November (Ex. of extensively decreased instructional time) • Upperclassmen sometime miss a week of class instruction
Math program meets needs of most students	• Ranging from 60 - 100% yes. • 75% get C or better • Native students have difficulty with curriculum, they have to translate the problems • Would like to keep curriculum and provide supplements
Concerns	• Lack of correct written notation • Never giving students exact formulas • Students going off to college not being successful • Freshman do not have understanding of the properties of

	algebra • Students can use calculators but do not understand what they are doing
Professional Development	• Teachers would like to go to NCTM every three years • Want to attend state math conference • Go back to Western Michigan for more Core Plus training now that they have some familiarity with the curriculum
What would you like us to know?	• Native students are low in reading skills, they read and write slowly • We need to understand parents • Give up some arts for math • Math and science are below 5 other subjects • More parents need to participate • Parents are frustrated

Miscellaneous

- Lack of books were reported by some teachers
- Coast guard family students are having difficulty with the math program in Sitka as they transfer in at various times of the year

District and Campus Administrator Perspectives

All district and campus administrators were interviewed to glean their perspectives and insights on the mathematics program in the district. Interviews were conducted with the superintendent, associate superintendent, all campus principals, and the SHS assistant principal.

District Administrator Perspectives

What do you think of the mathematics textbooks/curricula used in your district?

- Stakeholders in SSD above all want a well-rounded education
- Admin brought Core Math in last district
- Would like to have ongoing working groups (go-to people) in each content area including math

What do you think are the most successful components of your math program(s)?

- Total number of students that stay in math for more than two years is a real strength, would like to perhaps track students' success in science or engineering fields later.
- Strong teachers with high expectations, is just critical.
- *Bridges* and *Trailblazers* – do these fit together and dovetail well as students matriculate to the middle school program. "We were tying those together at one point"

- Amazing teachers who are kid-centered and want all to succeed, very dedicated but need more tools in their toolbox

Do you feel that your math programs (meet the needs of most students? Why? Why not?

- *Math program does not meet the needs of students (low income, SE, and Alaskan Native (30%) do not meet standards) – most worried about these students*
- *Need socio-cultural learning, culturally responsive curriculum for large group of Alaskan Natives*

What concerns do you have about overall student progress in mathematics?

- *Issue with reading in the district – changing at the K-1 level – not producing readers at the 2nd grade level - losing students who cannot read*
- Students in 5th grade do not know basic facts, low in computational skills

What are you most concerned about some of the math program(s) in the district?

- We need "problem solvers"
- Understanding or defining the "problem" in math is important, research tells us that this is a high need area. Students also need to have basic skills, at same time students need to be strong problem solvers
- Community's expectations and perceptions of mathematics are very important. I understand, everyone wants his/her child to be educated. Want to step up to the plate. Have concerns of what's going on around the country wanting everyone to be in lock step, concerned about this being the correct path.
- We have tried to hang onto a well-rounded education. Concerns that as budgetary problems continue in the country, there may be more issues. As budget shrinks we may have hard times.
- It is not Core Math or traditional math program that are the issue, we can solve the math problem in community if we had one more math teacher and could offer both pathways.
- Some believe it's not the right program for diverse student needs
- Successes: Have students taking 3 or more years of math (70 percent). 50 percent of students taking 4 or more years of math.
- Concerns about cultural needs: want to be culturally responsive
- Concerned about gaps seen in other programs in the country. Administrators recognize the transition to a new math program for example is costly. Going from reform-based to traditional math program, concerned about gap when students loose on the deal during transition to a new program
- Integrated math requires reading and it is difficult for some students
- Many students miss school (leave Wed. evening miss Thur. & Fri. and Mon. (week after week) for state and regional competitions - music, drama, sports (low opportunity

to learn)
- Students are weak in basic computational skills and their number sense and problem solving skills (around reading)
- With an additional math teacher and could offer both pathways for students to take

What supports including professional development have been provided for mathematics teachers (e.g. coaching, PD to analyze student learning)?
- Real problem is no professional development for teachers (basic PD was done 10 years ago)
- Want to have ongoing working groups (go to people) in each content area including math
- Teachers are not a part of a professional learning community
- We need to develop a learning community of math educators, we have no math coaches but we have reading coaches - we need a functional practicing group of math educators
- Take 13 math teachers and do intensive PD in Spring 2012

What would you like us to know that we haven't asked about?
- We are a standards based district but not a standards based assessment and reporting district (SBAR), parents do not understand this
- Math audit group needs to make recommendations for PD focus
- PD to do it right might take 5 years with 110 classroom teachers
- As a district we have not supported the teachers to be effective math teachers

Campus Administrator Interviews

What do you think of the mathematics textbooks/curricula used on your campus?
- Bridges and Trailblazers might not transition well (2^{nd} into 3^{rd})
- There are various holes in student knowledge because not all teachers implement in the same way or have the same strengths
- Need alignment between grade and state standards and between 2nd-3rd and 5th-6th to help transition between programs.
- Do not think there is anything wrong with it, just do not think it's the correct curriculum for the way we do business at SHS
- Community has an expectation of out of building travel with students gone for large periods of time (HS)
- Diversity of the students make the math curriculum challenging. Most students are behind and they have holes due to changes in curriculum and schools, and their behavior

Describe the structure of math period(s)/block(s) on your campus?

- I think classes vary a lot in terms of different amounts of time for math instruction between 40 and 60 minutes per day. Some do not teach it at all on one day and then some the next.
- Most teachers try to teach math before lunch but it is often split because reading is given the priority
- Teachers sometimes teach more on one day and none the next day. Teachers could benefit from PD
- Bridges taught in segments throughout the day

What do you think are the most successful components of your math program(s)?

- Students have greater affect in math. WE are bypassing the Math 2 requirement so students are passing without taking Math 2
- Active learning is incorporated
- Teacher's Projects.
- Problem solving is successful component of program (HS)
- Whether they know it or not students have been prepared for success in advanced science courses, SHS
- Collaboration that math program has is amazing (they have to "play" with the math)

Do you feel that your math program meets the needs of most of your students? Why? Why not?

- Teachers need to work more vertically and horizontally to be better aligned with what others are doing and to what needs to be accomplished the next year
- There are gaps, thus there is a need to do a *Gap Analysis*
- No specifics based on state tests – we have looked at the data but there was not a pattern
- Do not believe the curriculum meets the needs of most students (SHS)
- Anchorage, Wasilla, Fairbanks, do not have the same travel issues, they are in areas that don't require travel (SHS)
- Students travel Fridays, Saturdays, and Sundays. Students who have math on "B Days," then Fridays are not a good day to miss (they will miss a week before they have math again), SHS
- Neither Pacific High nor Sitka High's math program is meeting student needs. I do feel that our program builds math affect but the content is constrained and remedial in nature.

What concerns do you have about your students' progress in mathematics?

- There is not enough practice in either program so teachers are doing a great deal of supplementation
- Greatest weakness is the time allotted, consistency of implementation, frequency of mathematics teaching

Another Campus Admin:

- I am afraid [teacher] is not doing enough content that looks like the tested math.
- IMP is our curriculum but it is really not implemented
- Teacher might do a few lessons
- Not sure they are vertically and horizontally aligned
- Students not as fluent as they should be before they get to higher level math
- Would take more time to do both the creative and fluency components of the programs properly

What supports including professional development have been provided for mathematics teachers (e.g. coaching, PD to analyze student learning)?

- Like to see more PD for my teachers and have teachers work together to plan their lessons (develop PLCs) and align to the core state standards in AK
- Teachers participated in 4 hours of Math Whiz PD
- Went to training for Bridges 9 to 10 years ago
- No ongoing training, no math intervention program
- Have literacy coach but no math coach
- No diagnostic screening for math
- No PD beyond recent Master's degree

What are your teachers' greatest weaknesses with regard to implementing the mathematics program?

- Math teachers need more math content and pedagogy
- Teachers need to scale up rigor with more time
- Teachers need to maximize instructional time
- It would be good to see a great math teacher using IMP
- Teachers are just not covering enough to get them through to actually earn two math credits

What are you most concerned about in your math program?

Campus Admin (SHS):

- Concern no new PD for new strand of teachers
- Two teachers with little math savvy, very difficult to jump in and catch up, help students, hire tutors
- Textbook and curriculum are fine, but disconnect between needs
- Heavy on problem solving and collaboration, very fundamentals, practice
- Parents can not pick up book and help, unless they are very fluid in math
- The other piece that is very difficult, ELL, SPED students, rotary exchange students, heavily word driven program, has good sides but not good for community that students move in and out, limited plane service, need to go based on plane schedules
- Tutors are not poised to help (most people [Ex. tutors] do not know this curriculum)
- In other populations it's very successful, some other districts provide different options

- Changed out former teachers that were very strong, new folks are struggling. Not because they do not know math but because we do not have resources in place
- Do not think it has good sides for students that move in and out, not an easy piece
- Hard to drop into this program (student with issues, can drop in and out), notably would have same kind of problems with more traditional program (e.g. Saxon Math Program)
- Have a residential program here, these students are loss, this could be with anything, not just with this program
- Not as easy of an adjustment with new teachers
- Meeting needs of most students – **250 students out 350** were in one or more activities last year. (For Ex. not just in music, they may be in drama and debate, and maybe someone runs cross country, and maybe parent takes a vacation)
- Other subjects can work around the absenteeism, but in mathematics one can't. This is problematic, unless they have an "online" program
- As much as Promethean Boards are nice, you must have students there
- Coaches cannot help them with math while they are traveling. They can help with other subjects
- Do not have credit recovery program
- Many years ago when this was brought in it may have been the perfect program, but it is not ideal now
- You would imagine that our upper end (AP) students would do well, but this isn't the case when they get to post secondary courses (parents complain about paying for Algebra 100 at college)
- **Students are missing 10 to 25 percent of a given class (activities only), this does not include illness** (Example: Student missed 30% = 10% for activities + 20% for missing class)
- Pace is an issue as well (Middle School Admin)

What would you like us to know that we have not asked about?

- Public perception is that math program is fine in the elementary program.
- Math teachers need more math content and pedagogy.
- They need to scale up rigor with more time.
- We need to maximize instructional time.

Campus Admin (SHS):

- People look at curriculum, desperately need to look at the full context, we value activities, we want then in activities that are not always at school.
- People get out when the planes come in
- Community of people, if medical activity the whole family has to go to Seattle
- This is an issue in every school that I have been at - in this state
- Professional development piece is an issue

- Tried parent nights and they were not completely successful as well
- The transition from elementary to middle to high school is important
- In elementary, one teacher uses notebook and ones does not
- High school teachers do not use the toolbox in the same way

Campus Admin (Middle):

- No math coach
- No interventions for math
- Lack of instructional time
- More time in school day

RECOMMENDATIONS OF THE MATHEMATICS AUDIT TEAM FOR THE IMPROVEMENT OF SITKA SCHOOL DISTRICT.

a. **Recommendation 1:** Develop a comprehensive multi-year implementation plan that addresses the findings and recommendations contained in curriculum management audit reports. Align district decisions and actions toward closing existing gaps in students' mathematics achievement.

a. **Recommendation 2:** Develop and implement a curriculum management system that establishes an aligned curriculum available to all students and supports attainment of the board's student learning goals. Design a comprehensive K-12 mathematics curriculum that is aligned vertically, and horizontally and deeply aligned to state assessments.

b. **Recommendation 3:** Develop and implement a comprehensive plan for student and program assessment that will provide meaningful formative and summative data for decision-making leading to improved student achievement. Align student and program assessment with the curriculum management system.

c. **Recommendation 4:** Design and implement a comprehensive professional development process that provides for coordination with the curriculum management plan and for the use of student achievement data in the evaluation of the effectiveness of professional development and efforts.

Critical Elements For Mathematics Curriculum Implementation

Regardless of whether the district decides to stick with the current curriculum or to move on to a new one, for any curriculum to be successful there are some important ideas that the stakeholders should understand.

Getting involved. What can you do? Generally speaking, parents, teachers, administrators, and school board members should learn about the current [or new] mathematics curricula and then explore their implications for what mathematics our students learn as well as *when* and *how* they learn it. Teachers, administrators, and parents need to become informed about the unique characteristics of these curricula and about the support structures that are being established to make it easier for schools to adopt them.

We offer the following in hopes that they improve the mathematics achievement for the students of the district.

1. ***Administrative Support.*** Significant curriculum change in mathematics is enhanced by the leadership and support of administrators. In fact, more than half of teachers surveyed about curriculum singled out the administration as playing a key role. This support did not just facilitate change, but enabled it, as shown by the failure of districts lacking administrative support.

2. ***Opportunities to Study.*** Teachers need time familiarize themselves with the materials. During workshops teachers can engage in student activities that can help them learn about the curriculum and about alternative classroom practices. The teachers can work collaboratively to align their own decision making with the curriculum, and local needs.

3. ***Daily Planning.*** Teachers need to study the materials carefully to make sure that students would be learning concepts and skills identified locally as essential for their grade level. As students engage in the mathematical tasks, those tasks often require more time than teachers expect. Therefore, teachers should seriously reflect on the pacing of each unit to determine where to spend more time, what to skip, and what students can do at home. While pacing decisions have always been a part of teaching mathematics, the lengthy investigations make the issue of pacing ever more complex.

4. ***Interaction with Experts.*** Teachers need to hear from experts, such as national leaders, authors, directors of projects, and teachers experienced in using a curriculum. In particular, they value observing a teacher who is using the curriculum they are adopting in the classroom.

5. ***Communicating with Parents.*** Parental concerns can be a major issue when when implementing a curriculum. Teachers need to spend time educating parents and responding to their concerns. One of the main concerns for parents is how they could help their children at home. Firsthand experience at parent meetings can help build better understanding and appreciation for the curriculum.

Parents must also feel that the curriculum is supported by district leadership, and having parents and teachers take part in planning and conducting a parent night is a great way to get everyone involved. Teachers can also make presentations to their school board. Teachers can share the mathematical content and philosophy of the new curriculum, the nature of instruction, and the response from students.

Final Overarching Recommendations and Discussion

There are four guiding principles:

1) The SITKA school district has a unique culture that places a great deal of emphasis on both athletics and fine arts.
2) The school district is a recipient of a small but significant number of transfers in part, due to the base located on the island.
3) There is a low mobility rate for students leaving.
4) Changing the curriculum bears costs in dollars, personnel, and student learning.

Recommendations:

1) Given the emphasis on and strong community support for athletics and fine arts and the rather remote nature of the school district – it is impractical to suggest the development of a signature mathematics program.

2) The findings of the mathematics audit indicated that parents, teachers, and students were fairly satisfied with the teachers and the mathematics they provide. However, the mathematics audit revealed a troubling lack of teacher mathematics content knowledge, pedagogy, and curriculum implementation fidelity.
    a. We recommend the district pursue a systematic and unified mathematics professional development program incorporating curriculum specific inservice, content, pedagogy, technology, vertical and horizontal alignment, and teacher leadership over a three-year period. The minimum contact hours for high quality mathematics professional development should be 80 hours per year for a total of 240 hours over the 3-year period. Professional development cannot be left to individual schools because it is essential that teachers understand the mathematics they are expected to teach children but it is equally important for them to understand what mathematics their students learn before and after the mathematics they teach (vertical alignment). Unfortunately major gaps in content and continuity of instruction occur when teachers feel empowered to set the adopted curriculum aside in favor of something else because they believe they know what is best . Children learn what mathematics teaching and learning is all about. When the message is fragmented across teachers within a school district the results can be persistent poor mathematics learning for children. The professional development must lead to a teacher professional continuum where one teacher in a school becomes the lead mathematics teacher (chair, coach, or some other title) ensuring that the mathematics being taught actually meets the state mandated curriculum in a way that advantages as many children to succeed in mathematics as possible while maintaining strong continuity and fidelity to the content.
    b. We recommend that school board establish policy that holds district administration responsible for the means of instruction and not the outcomes. It has become de facto policy to focus on the outcomes of state accountability tests. However, this does not serve the American educational system nor the residents of Sitka Alaska, but politicians. The means of instruction include teacher preparedness, instructional alignment, and content coverage. If this policy is

enacted, we also recommend that the district mandate and hold accountable each school administrator for ensuring teachers are teaching the curriculum and that the state objectives are being covered and that homework is systematized so every student and parent across the district understands the math homework expectations, how it aligns with classwork, and where to go for assistance. Finally, developing strong adherence to a curriculum is one effective way to ensure students are prepared for the next step in life whether it be the mathematics for the next school year or life after school. Simply changing the curriculum will not ensure this happens. Oversight and diligence on the part of mathematics department heads/mathematics coaches is an accepted method for monitoring and remediating this instructional issue.

c. School administrators should be held responsible for developing a homework lifeline, either after school, before school, or through technology that provides support for completing mathematics homework. One model is having high achieving students provide assistance in a systematic way to students one grade below either before or after school. The service should also be available to parents.

3) An overwhelming request was for the district to offer a dual mathematics track. The dual track would negatively impact the district, fragment the program, and create a duality that would disenfranchise and establish barriers some students will never escape. The district is not sufficiently large enough to allow a dual mathematics track while continuing to maintain the level and quality of both the athletics and fine arts programs. Students already receive mathematics all too infrequently due to school-sponsored travel. Some students reported missing mathematics for two weeks or more given some are scheduled as infrequently as 2 or 3 days per week alternating weeks. Make up is the responsibility of the student who is inadequately prepared to make the difficult decision between extra curricular involvement and academics.
    a. We recommend that the district pursue one or both of the following alternatives 1) partnerships with local post-secondary institutions to offer dual credit courses for high school students who either enter the district new or who come from the middle school who would prefer a less rigorous program. 2) Highlight the home school program where parents can take a more hands-on approach to the mathematics they want their child to learn and experience. Offer these programs to all new families with children entering Sitka High.

4) There was an overwhelming sentiment expressed for the evaluators to either support or condemn the currently adopted curriculum.
    a. We recommend that the district make a clear and unequivocal decision about the curriculum given some points we know to be true and take the necessary steps to support the decision.
        i. Changing a curriculum will result in personnel change, some level of frustration, an added burden to learn a new curriculum, and require students to obtain new levels of expectations
        ii. Dollars that may have been better spent will be spent to acquire, support, and implement a new curriculum

iii. Student achievement will suffer. Especially for students entering 11th and 12th grades – they will loose the most ground mathematically, followed by 10th grades. Only 9th grades will have sufficient time for teachers to adjust to a new curriculum and administrators to learn how the support the teachers to make the adaptation necessary. Unfortunately, they will not be as well prepared if they did not switch the curriculum

Research is clear, a well implemented quality curriculum that is closely aligned to state standards shows results. However, just changing a curriculum does not address issues with fidelity of implementation, alignment, and persistence. Implementing the best curriculum poorly will obtain the same result as implementing the worst curriculum perfectly. An analogy, the best captain, with the best crew, most state of the art equipment, and best electronics money can buy who fishes in the bathtub isn't going to catch any fish. The curriculum and its implementation determines how well students learn mathematics. If the curriculum is going to be changed a clearly defined process should be adopted to explore options, determine the level training required for teachers, district cost to fully adopt the new program, for whom the curriculum works, and if it meets the expectations of the community.

References

Abedi, J., Lord, C., & Plummer, J. R. (1997). *Final report of language background as a variable In NAEP mathematics performance* (CSE Technical Report No. 429). Los Angeles: University of California, Center for the Study of Evaluation/National Center for Research on Evaluation, Standards, and Student Testing.

Aunola, K., Leskinen, E., Lerkkanen, M. K., & Nurmi, J. E. (2004). Developmental dynamics of math performance from preschool to grade 2. *Journal of Educational Psychology, 96*, 699– 713.

Benson, J. G., Borman, G. D., & Wisconsin Center for Education Research, M. (2007). *Family and contextual socioeconomic effects across seasons: When do they matter for the achievement growth of young children*? WCER Working Paper No. 2007-5, August 2007: Wisconsin Center for Education Research ED497830.

Bodovski, K., & Farkas, G. (2007). Mathematics growth in early elementary school: The roles of beginning knowledge, student engagement, and instruction. *Elementary School Journal, 108*, 115–130.

Capraro, M. M., Capraro, R. M., Yetkiner, Z. E., Rangel-Chavez, A. F., & Lewis, C. W. (2009). Examining Hispanic student mathematics performance on high-stakes tests: An examination of one urban school district in Colorado. *The Urban Review, 42*, 193-209.

Croninger, R. G., & Lee, V. E. (2001). Social capital and dropping out of high schools: Benefits to at-risk students of teachers' support and guidance. *Teachers College Record, 103*, 548–581.

Ding, C. S., & Davison, M. L. (2005). A longitudinal study of math achievement gains for initially low achieving students. *Contemporary Educational Psychology, 30,* 81

Fan, X. (2001). Parental involvement and students' academic achievement: A growth modeling analysis. *The Journal of Experimental Education, 70*(1), 27–61.

Fixsen, D. L., Naoom, S. F., Blase, K. A., Friedman, R. M., & Wallace, F. (2005). *Implementation research: A synthesis of the literature.* Tampa, FL: National Implementation Research Network.

Frase, L., English, F., & Poston, W. (1995). *The curriculum management audit.* Lancaster, PA: Technomic.

Harwell, M. R., Medhanie, A., Post, T. R., Norman, K., & Dupuis, D. N. (2012). Preparation of students completing a Core-Plus Mathematics-Plus or commercially developed high school mathematics curriculum for intense college mathematics coursework. *The Journal of Experimental Education, 80*, 96-112.

Jordan, N. C., Kaplan, D., Olah, L. N., & Locuniak, M. N. (2006). Number sense growth in kindergarten: A longitudinal investigation of children at risk for mathematics difficulties. *Child Development, 77*, 153–175.

Kendall Hunt Publishing Company. (n.d). *Math Trailblazers.* Retrieved from http://www.kendallhunt.com/mtb3/

Latterell, C. M. (2003). Testing the problem-solving skills of students in an NCTM-oriented curriculum. *The Mathematics Educator, 13*, 5-14.

Marzano, R. (2003). *What works in schools: Translating research into action.* Alexandria, VA: ASCD.

The Mathematics Learning Center. (n. d.). *Bridges in mathematics overview.* Retrieved from http://www.mathlearningcenter.org/curriculum/bridges/about

Michigan State University. (2009). *Connected mathematics.* Retrieved from: http://connectedmath.msu.edu/

National Council of Teachers of Mathematics [NCTM]. (1989). Curriculum and Evaluation Standards

for School Mathematics. Reston, Va.: National Council of Teachers of Mathematics, 1989.

National Council of Teachers of Mathematics [NCTM]. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.

NAEYC & NCTM. (2002). *Early childhood mathematics: Promoting good beginnings. A joint position statement of the National Association for the Education of Young Children (NAEYC) and the National Council for Teachers of Mathematics (NCTM)*. Retrieved from http://www.nctm.org/about/content.aspx?id=6352

Nelson, R. (2005). A matched study of Washington State 10th grade assessment of schools using *Core-Plus Mathematics-Plus Mathematics Program*. Retrieved from http://www.glencoe.com/glencoe_research/Math/CPMP_Achievement_WA_22Schools.pdf

Natriello, G., McDill, E. L., & Pallas, A. M. (1990). *Schooling disadvantaged children: Racing against catastrophe*. New York: Teachers College Press.

Post, T. R., Harwell, M. R., Davis, J. D., Maeda, Y., Cutler, A., Andersen, E., Kahan, J. A., & Norman, K. E. (2008). Mathematics curricula and middle-grades students' performance on standardized achievement tests. *Journal for Research in Mathematics Education, 39*, 184-212.

Rathbun, A., & West, J. (2004). *From kindergarten through third grade: Children's beginning school experiences*. U.S. Department of Education. NCES 2004-007.

Rathbun, A., West, J., & Walston, J. (2005, April). *Relationships between family risks and children's reading and mathematics growth from kindergarten through third grade*. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada.

Rescorla, L., & Rosenthal, A. S. (2004). Growth in standardized ability and achievement test scores from 3rd to 10th grade. *Journal of Educational Psychology, 96*, 85–96.

Reys B. J., Reys, R. E., Barnes, D., Beem, J., & Papick, I. (1997). Collaborative curriculum review as a vehicle for teacher enhancement and mathematics curriculum reform, *School Science and Mathematics, 97*, 253-59.

Riordan, J. E., & Noyce, P. E. (2001). The impact of two standards-based mathematics curricula on student achievement in Massachusetts. *Journal for Research in Mathematics Education, 32*, 368-398.

Schoen, H. L., Cebulla, K. J., Winsor, M. S. (2001, April). *Preparation of students in a standards-oriented mathematics curriculum for college entrance tests, placement tests, and beginning mathematics courses*. Paper presented at the annual meeting of the American Educational Research Association. Seattle, WA.

Schoen, H. L., Ziebarth, S. W., Hirsch, C. R., Brcka Lorenz, A. (2010). *A five-year study of the first edition of the Core-Plus Mathematics-Plus Mathematics curriculum*. Charlotte, NC: Information Age.

Wallace, F., Blase, K., Fixsen, D., & Naoom, S. (2008). *Implementing the findings of research: Bridging the gap between knowledge and practice*. Alexandria, VA: Educational Research Service.

Appendix I. – Teacher Implementation Criteria

1. **Teacher actively listened to questions and responded to them and encouraged questions by setting the stage in both tone and body language.**

   Mean = 3.1; SD = .83

   Small group settings encouraged questions; students felt comfortable making comments and answering the teacher; questions from the students were cut short by the teacher; teacher commented on what students were doing; teacher set the stage for learning.
2. **Teacher used a variety of open-ended questions.**

   Mean = 3.3; SD = 1.2

   Excellent variety of questions; all questions were closed ended and convergent; many types of questions asked of students; lack of questions during the lesson; appropriate variety of questions; use your imagination and tell me….; "who has a different opinion?".
3. **Teacher clearly stated the goals and tasks.**

   Mean = 2.65; SD = 1.14

   None stated; list of pages on the board; rules for the game activity clearly presented; "we are going to learn about subtraction today".
4. **Teacher facilitated students remaining on tasks using a variety of strategies.**

   Mean = 3.15; SD = .98

   All students were actively engaged; all on task; called attention to those off task; challenged students; students got restless; a variety of strategies utilized to keep students on task; everyone had their own small white board to write equations; T went around and helped students; called on a variety of students; many students calling out; reminders provided for students; students off task; active lesson**.**
5. **Teacher worked with ALL students.**

   Mean = 3.75 ; SD = .92

   Circulated around the room; walked around – very engaged; each group got a chance to use the board; checked on all students as they worked in groups; teacher pulled popsicle sticks with names to call on all students; teacher checked on all pairs as they worked; asked students questions to determine their thinking**.**
6. **Teacher digressed to build important foundational knowledge when background knowledge was absent.**

   Mean = 2.8 ; SD = 1.34

Teacher was able to do this based on what she was seeing; teacher went back to easier topic to help jog the students' prior knowledge; teacher lectured to students about topic of missing knowledge; connected the lesson to Excel Math; subtraction was connected to addition; worked problem out on the board.

7. **There was a high proportion of talk between (a) teachers and students and (b) between different students.**

   Mean = 3.2 ; SD = 1.0

   Too few questions from students; Teacher asked questions of students; students asked merely procedural questions; students developed their own subtraction stories; students were free to ask questions; teacher addressed all concerns; teacher admitted her mistake; students talked to their peers about; explanations valued; high level of conversation.

8. **Students were involved in communication using a variety of tools and means.**

   Mean = 3.2 ; SD = 1.0

   No discussion or group work; students provided real world examples; students worked in pairs; students shared their posed problems with their peers; mostly discussion; not a lot of variety; talking discussions.

9. **Students were actively engaged in the learning.**

   Mean = 3.25 ; SD = 1.0

   Exceptionally well done; all on task; students passed around the tablet; students evaluated themselves; many activities promoted active engagement; students showed with their hands; students spun spinners; all students engaged in posing problems with goldfish crackers and plates; engaged in hands-on activities; active discussions.

10. **Active participation was encouraged and valued.**

    Mean = 3.2; SD = .98

    Students could have been praised for completing task; everyone on target; students went to the promethean board; students showed with their fingers; students worked in pairs; raise you hand to show me which is more; all students ate goldfish crackers as they subtracted; "you have a lot of good explanations"; asked a series of questions and answers; high fives given to students by teacher to students.

11. **Technology was integrated either during the lesson or in special lab settings.**

    Mean = 3.1; SD = 1.0

    Promethean board; Flip chart included topic for the lesson; document camera was used; smart board was integrated.

12. **Appropriate resources were ready and available for student use.**

    Mean = 3.3; SD = .88

    All manipulatives available; flip chart and board ready with the content for the topic; warm up and project sheets ready; all materials were ready; all students had textbooks; worksheets for all.

13. **Lesson promoted strongly coherent conceptual understanding.**

    Mean = 3.5; SD = .88

    Rote practice; Teacher supplemented the topic; practice provided for the students; many activities promoting practice and reviewing; base ten connected to dimes; teacher moved from the concrete to pictorial to abstract; many examples shared

from the text; many concepts addressed.

14. Lesson involved fundamental concepts of the subject.

Mean = 3.4; SD = 1.1

Exceptionally well done; concepts were tangentially presented; teacher was aware of the lack of prior knowledge and filled in the "gaps"; appeared students were already fluent in the topic; teacher did not appear to know what the students knew; skip counting; teacher provided the definition of subtraction.

Appendix II.

The Mathematics Audit Team

Dr. Robert M. Capraro is a Mathematics Education Professor in the Department of Teaching Learning and Culture at Texas A&M University and Co-Director of the Aggie STEM Center. Dr. Capraro's expertise is applied research in school settings and program evaluation, the teacher as change agent for school improvement, and student achievement.

He is currently involved in research in four school districts with more than 20,000 students and 80 teachers. His editorial work includes Associate Editor of the *American Educational Research Journal*, *School Science and Mathematics, and Middle Grades Research Journal* along with serving on several editorial boards and on the Research Advisory Board for the Associate of Middle Level Education and a Research Scholar with Educational Testing Service. He has more than 70 publications and overseen more than 4.5 million in research.

Drs. Robert M. Capraro and Mary Margaret Capraro recently conducted a meta- analysis on NSF mathematics standards based curricula including CORE Plus.

Dr. Trina J. Davis is an Assistant Professor in Mathematics Education/Educational Technology at Texas A&M University in the Department of Teaching, Learning, and Culture. Dr. Davis was President of the International Society for Technology in Education (ISTE) from 2007 to 2009.

Dr. Davis has provided leadership on innovative mathematics and technology programs since she joined the College of Education and Human Development in 1997 as then Director of eEducation in the Dean's Office. Her earlier work includes the delivery of professional development to thousands of educators across the state and nationally. Support for her research and teaching include a program recently funded by the National Science Foundation ($2.8M), "Preservice Teachers' Knowledge for Teaching Algebra for Equity in the Middle Grades." She is the Co-Director of Glasscock Island (in Second Life) and serves as Co-Principal Investigator on the grant. Her research includes longitudinal statewide school technology and readiness studies from 2000 to 2011, as well as investigations related to technology applications in school mathematics teacher preparation, and teaching and learning in online and 3-D virtual environments. Her editorial work includes Associate Editor of *School Science and Mathematics.* She has over 40 peer-reviewed articles and national/international research presentations, and 14 invited keynotes. Since 2006 her external funding totals over 3.8 million.

Dr. Mary Margaret Capraro received her Ph.D. from the University of Southern Mississippi. She joined Texas A & M University in 2000 as a clinical professor in Mathematics Education.

She earned a position as an Assistant Professor in the Department of Teaching, Learning, and Culture in 2007 and was promoted to Associate Professor last month. Her research interests include teacher knowledge and preparation in mathematics education and student understanding of mathematical concepts. She was previously employed with the Miami Dade County Schools as both a teacher and an assistant principal.

She has over 45 peer-reviewed articles, and 60 national and international presentations. She is currently Co-PI of the Aggie STEM Center and works extensively with public schools and school districts around Texas planning mathematics Professional Developments and designing interdisciplinary project-based learning activities.

Dr. Capraro is on the Advisory Council for the Career and College Readiness Initiatives Faculty Collaboratives for Mathematics. She recently was awarded a CCRS grant to train preservice teachers about College and Career Readiness Standards.