CLUSTER-GROUPING, CO-TEACHING, AND PROFESSIONAL LEARNING COMMUNITIES FOCUSED ON MATHEMATICS INSTRUCTION LEAD TO IMPROVED ENGAGEMENT AND ACHIEVEMENT IN MATHEMATICS FOR STUDENTS

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Introduction

Since 2009, there has been increased rigor in the *Mathematics Standards of Learning for Virginia Public Schools* (*SOL*) [1]. Emphasis on rote memorization has been decreased. Retention and application of content from previous years, as well as vertical alignment, are now essential to support mathematics instruction at the elementary school level.

With the increasing difficulty of the *SOL* assessments, the mathematics SOL scores of Jamestown Elementary School's students began to decline, and a number of other disturbing trends became apparent. There was an overall decrease in assessment results, with more students failing, as well as a significant decrease in the number of students scoring in the "Pass/Advanced" range. When Jamestown's Leadership Team analyzed mathematics data over time, students at Jamestown demonstrated higher proficiency in mathematics in their primary years than in their upper elementary years. Therefore, while we needed to continue to emphasize mathematics instruction in the primary grades, a plan of action for the 2013-2014 school year that focused on mathematics instruction in grades 3-5 was crucial.

Special education students, even if they did not have mathematics goals on their Individualized Education Programs (IEPs), were not passing their mathematics SOL assessments at the same rate as their peers. Another disturbing trend was the inequity in mathematics performance between girls and boys. The SOL mathematics data from 2013 showed that, in all grade levels, boys outperformed girls at a rate that increased with each grade level. In the third grade, there was a one percentage point difference; in the fourth grade, a seven percentage point difference; and in the fifth grade, an eight percentage point difference in pass rates.

Many of the students identified as gifted in mathematics did not perform at the advanced rate on the 2012 and 2013 mathematics SOL assessments. In 2012, 47% of the students identified as gifted in mathematics scored 525 or below on the mathematics SOL assessments. In 2013,

43% of students identified as gifted in mathematics scored 525 or below. Because Jamestown has had a high number of students scoring in the Pass/Advanced range on the mathematics SOL assessments in the past, these performance issues were disturbing. As a school community, we knew that significant changes had to be made in the upper elementary mathematics instruction.

After Jamestown's principal attended the "Virginia Principals' Institute: Partnering to Raise the Ceiling and the Floor in the New Era of Mathematical Standards" in July 2013, she knew that the school's vision for mathematics instruction needed to change. She modified the Institute's goals and was determined to do two things during the 2013-2014 school year:

1) Collaborate with Jamestown's teachers to build a mathematics program that would utilize all available resources to increase understanding and proficiency for students at all mathematics levels; and,
2) Develop the capacity of Jamestown's administrators and teachers to encourage rigorous mathematics instruction that would include integration of both Virginia *SOL* mathematics content standards and process goals.

In order to have thirteen highly effective mathematics classrooms in grades 3-5, basic procedures and practices needed to change. As Jamestown's Leadership Team collaborated over the summer, it decided to implement three practices in grades 3-5 to improve instruction in mathematics:

1) Cluster-group students for mathematics instruction;
2) Implement co-teaching teams for mathematics instruction; and,
3) Focus the efforts of the Professional Learning Communities (PLCs) on improving mathematics instruction.

Resources in Place

There were a number of important components in place at the beginning of the 2013-2014 school year that could help with the transformation:

- Administrators and Teacher Leaders had participated in professional development related to PLCs, co-teaching, and higher order mathematics instruction.
- The math coach, experienced both as a classroom teacher and a Mathematics Specialist, was respected, skillful, and collaborative.

- The Resource Teacher for the Gifted (RTG) was collaborative, passionate about co-teaching, and skilled at differentiation.
- The mathematics Lead Teacher had excellent knowledge of elementary level mathematics instruction related to both content standards and process goals.
- The three special education resource teachers had significant experience co-teaching, differentiating instruction, utilizing technology, and collaborating.

There was a stable group of classroom teachers in grades 3-5. All of the teachers were experienced teachers who had collaborated successfully on the same grade-level teams.
The Arlington Public Schools' (APS) Supervisor for Mathematics Instruction and the Supervisor of Gifted Services supported the cluster-grouping and co-teaching models, providing insight as well as professional development for the math coach and the Resource Teacher for the Gifted (RTG). There were districtwide and schoolwide initiatives to implement PLCs during the 2013-2014 school year.

The *Math Expressions* grade-level series published by Houghton Mifflin Harcourt had been the primary textbook resource of APS for three years [2]. Teachers were familiar with the content, strengths, and challenges of this adopted textbook series:

- Grades 3-5 had a consistent 60-minute mathematics block daily.
- Grades 3-5 had a 90-minute block weekly for PLC meeting time.

Explanation of Cluster-Grouping

Cluster-grouping is a research-based, best practice in mathematics instruction, a model where students are clustered in a classroom within the ranges described below. In our cluster-grouping model, teachers differentiate and scaffold lessons, while incorporating both the content strands (number and number sense, computation and estimation, measurement, geometry, probability and statistics, patterns, functions, and algebra) and the process goals of problem solving (communication, representations, proof/reasoning, and connections). In cluster-grouped classes, students have the opportunity to learn from each other while being challenged with their intellectual peers.

During Summer 2013, Jamestown's Leadership Team read and discussed *The Cluster-Grouping Handbook: How to Challenge Gifted Students and Improve Achievement for All* [3].

The team adapted the strategies and procedures presented in this book and created a process for dividing students in grades 3-5 into cluster groups for mathematics instruction. Because cluster-grouping was different than performance or aptitude grouping that had previously been implemented at Jamestown, the practice of cluster-grouping was discussed with parents and classroom teachers throughout the summer.

In the Jamestown interpretation of the cluster-grouping model, all students at each grade level received a grouping number:

1. — Students identified as gifted in mathematics
2. — Highly able mathematics students who were not identified as gifted
3. — Students performing on grade level in mathematics
4. — Students achieving below average in mathematics
5. — Special education students with mathematics goals on their IEPs

The Leadership Team analyzed the available mathematics data for each student, primarily the Spring 2013 SOL mathematics data, and the APS Fall 2013 beginning-of-the-year mathematics assessment results, to assign each student in grades 3-5 a grouping number. Based on these analyses, students were placed in heterogeneous classes with three clusters of learners in each group.

According to Winebrenner and Brulles, there are procedures that need to be followed when placing students in classes in order to narrow the overall range of learners while maintaining the heterogeneity of the classroom [3]. The overall goal is to create classrooms where all students can be both challenged and remediated as needed:

- The highly able students, who were not identified as gifted, needed to be separated from the students who were identified as gifted.
- The students who were identified as gifted in mathematics needed to be separated from the special education students who had mathematics goals on their IEPs.
- Students who were achieving below average in mathematics needed to be separated from students with mathematics goals on their IEPs.

Table 1
Cluster-Group Configuration for Each Class

Grade Level	Teacher	Cluster Numbers
3	Teacher 1 Co-teacher: RTG	1, 3, 4
3	Teacher 2 Co-teacher: RTG	1, 3, 4
3	Teacher 3 Co-teacher: SPED	2, 3, 5
3	Teacher 4 Co-teacher: Math Coach	2, 3, 4
3	Teacher 5 Co-teacher: Math Coach	2, 3, 4
4	Teacher 1 Co-teacher: RTG	1, 3, 4
4	Teacher 2 Co-teacher: RTG	1, 3, 4
4	Teacher 3 Co-teacher: SPED	2, 3, 5
4	Teacher 4 Co-teacher: Math Coach	2, 3, 4
5	Teacher 1 Co-teacher: RTG	1, 3, 4
5	Teacher 2 Co-teacher: RTG	1, 3, 4
5	Teacher 3 Co-teacher: SPED	2, 3, 5
5	Teacher 4 Co-teacher: Math Coach	2, 3, 4

Advantages of Co-Teaching

This cluster-grouping model has allowed Jamestown to use their Mathematics Specialists, the math coach, RTG, and special education resource teachers strategically.

The math coach has been able to co-teach with four teachers in grades 3-5 on a regular basis instead of working with all thirteen classroom teachers separately. This model allows her to co-teach in three or four mathematics classes at each grade level on a weekly basis. Because she is able to co-teach regularly in classrooms, she can collaborate with classroom teachers to plan and to model differentiation for the range of learners in the mathematics classes. Working together, the math coach and the classroom teachers are able to provide differentiated activities for students who need extensions, as well as for students who need remediation by using rotations, tiered lessons, independent work, and learning contracts that compact the curriculum. This year, the math coach has also been more available to consult with the special education resource teachers during PLC meetings.

The RTG is making more of an impact on the instruction of the students identified as gifted in mathematics when this cluster-grouping model is used. Many of the gifted learners are abstract thinkers. The importance of cluster-grouping for those identified as gifted in mathematics is that teachers are differentiating and creating lessons that challenge students' thinking about a concept through problem solving and higher-level questioning. On a daily basis, all students have the opportunity to solve challenging problems with their peers. The classroom teachers and the RTG plan together weekly and collaborate during PLC meetings. Co-teaching by the RTG has resulted in effective modeling of innovative ideas, shared responsibility for students' outcomes, and the utilization of a wider repertoire of those resources previously used only in the gifted resource room. The differentiation is often invisible to the students.

In the co-teaching model, a special education resource teacher has co-taught five days a week with the classroom teacher whose cluster-grouping includes the Cluster 5 students, those with mathematics goals on their IEPs. For classes that include these students, we know it is critical that teachers are differentiating and giving students many different opportunities to learn a concept. Especially in classes with students in need of special education services in mathematics, conceptual and hands-on lessons have been emphasized.

This focus on mathematics which has emphasized co-teaching and planning, as well as participation in PLCs, has allowed special education resource teachers to apply their special areas

of expertise related to lesson planning and differentiation with the efforts of the entire team. Resources and strategies employed by the special education resource teachers have been shared with the grade-level team members during PLC meetings, and many have been adapted and implemented by all the teachers on the grade level. After establishing trust with the grade-level teams, there has been honest, courageous, and sometimes uncomfortable conversations among PLC team members about what needs to be done to meet the needs of all learners. The climate at Jamestown has started to change from the climate of "The student isn't learning the way I am teaching" to "How can I change my teaching practices so the student can learn?"

The special education lead teacher has found that the biggest benefit has been the level of commitment from her co-teacher. In the past, she has observed that teachers with students who have IEPs have been curious and invested, but with co-teaching she has found that there is a true, shared interest. The students in the class feel it, too. They approach both teachers for assistance. They know they have two dedicated adults that they can equally trust for help. When one of the co-teaching teams, a fourth grade classroom teacher and a special education resource teacher reflected on their collaboration, they agreed.

A major benefit of co-teaching is the discourse that occurs between the two teachers during lesson planning and in the reflection that occurs after instruction. When you plan instruction together, you are forced to verbalize your go-to strategies and philosophies. Once these ideas are on the table, they are tweaked and improved upon on a daily basis. Both teachers are able to ask probing questions of one another; such as, what the core objective of the lesson is or how the lesson will engage and challenge the strongest students in the class while also ensuring that the struggling learners' needs are met. After the lessons, both teachers are able to offer daily, observation-based, constructive criticism about delivery and content of instruction as well as behavior management. The end result of all of this is more individually tailored instruction for the students, which leads to improved learning outcomes.

This year, because of co-planning and co-teaching, the expert mathematics educators (who have had training and experience with the process goals) have been able to influence mathematics instruction for all students. On a daily basis, "math talk moves" have been implemented and there is more mathematics discourse. The regular use of the *Exemplars* mathematics tasks at grades 3-5 has emphasized problem solving, proof/reasoning, and communication [4].

There are many students struggling to communicate their mathematical thinking orally and in writing. Teachers continue to reflect on this issue and to implement strategies that help students practice using appropriate mathematical vocabulary. The co-teachers who teach multiple grade levels are able to give students and classroom teachers information about the "big picture" view of mathematics that helps them make connections across the grade levels. When co-teachers teach across three grade levels, they can see the connections in the curriculum and then help the students make those connections.

One of the characteristics of gifted learners is their ability to quickly make connections within content areas. If this is expected of gifted learners, then it should be modeled in the classroom. For example, learning how to break apart a harder multiplication fact into the easier facts (12 x 8 becomes 10 x 8 plus 2 x 8) in the third grade becomes an essential foundation for the fifth grade *SOL* objective involving the distributive property. Co-teachers who teach the curricular connections across the grade levels are able to make this "connection building" a daily component of their mathematics instruction in ways that classroom teachers, who are only familiar with the curriculum standards of one grade level, cannot.

Professional Learning Communities (PLCs) Focused on Mathematics Instruction

A major initiative of Arlington Public Schools has been the districtwide implementation of PLCs. Because of this initiative, Jamestown staff was able to form PLCs at each grade level for the 2013-2014 school year.

As teachers closed out of the 2012-2013 school year, they received a copy of *Learning by Doing: A Handbook for Professional Learning Communities at Work* [5]. They were asked to read the book over the summer with the expectation that their teams would start forming PLCs during the pre-service week in August 2013. According to the authors of this book:

> A PLC is an ongoing process in which educators work collaboratively in recurring cycles of collective inquiry and action research to achieve better results for the students they serve. Professional learning communities operate under the assumption that the key to improved learning for students is continuous, job-embedded learning for educators [5].

Members of the Leadership Team decided to focus on three essential concepts of the PLC process during the 2013-2014 school year:

1) The purpose of our school is to ensure all students learn at high levels;
2) Helping all students learn requires a collaborative and collective effort; and,
3) Assessing our effectiveness in helping all students learn, we must focus on results evidence of student learning, and use results to inform and improve our professional practice and respond to students who need intervention or enrichment.

During Summer 2013, members of the Jamestown Leadership Team attended a week-long intensive training on PLCs. During the training, the Leadership Team decided that focusing our PLC initiative on mathematics instruction in grades 3-5 would enable teachers and administrators to collaborate on the improvement of mathematics instruction. This type of implementation would also narrow the focus of our PLC implementation enough to make it manageable for the grade-level teams as well as the Specialists working with these three grade levels.

During the development of the master schedule, weekly PLC meeting times were designated on the master schedule, along with sixty-minute blocks of time for mathematics instruction at all grade levels. The following non-negotiables were established for the implementation of the PLC process with a focus on mathematics instruction:

- All classroom teachers and Specialists who co-taught would attend the weekly PLC meetings;
- At least one administrator would attend all PLC meetings;
- Minutes would be written in *Google Docs*™ for all PLC meetings; and,
- All members would contribute to the *Google Docs*™ agendas for PLC meetings.

As the school year progressed, the following became the normalized practices of PLC meetings for grades 3-5:

- Discussions about Virginia *SOL* mathematics content strands and process goals that needed to be covered each quarter and how students would master them.
- Discussions of management, procedures, resources, and strategies necessary to differentiate instruction.
- Creation of common assessments with a focus on backward design, which has also encouraged conversations around what the students do and need to master by the end of each unit.
- Discussions about how students were/were not learning mathematical concepts.

- Common planning focused around the idea of problem solving, especially the use of mathematics tasks from the *Exemplars* website and other types of problem solving.
- Analysis of data from formative assessments and using that data to drive future instruction.
- Discussions about the shared responsibility for student achievement and the concept that all members of the grade-level PLC were responsible for the progress of all students at that grade level.
- Discussions of the students' progress toward the mathematics goal shared by all the members of the grade-level PLC.

As a result of the PLC process, teachers have collaborated on analyzing data, planning lessons, developing differentiation strategies, and writing common assessments. Since this is the first year of implementation, teachers are working through the significant changes in their practice and the PLC teams are at different levels of proficiency.

Shared Responsibility for Students' Outcomes

After analyzing student mathematics data, each grade-level PLC created a goal focused on the needs of all of the students on that grade level. Since teachers and co-teachers have been collaboratively analyzing grade-level mathematics data, creating common assessments, solving issues related to teaching and learning, and planning collaboratively, all of the teachers at each grade level agreed to share the responsibility for the achievement in mathematics of all of the students. Achievement of the PLC goal will be a very important component of the teachers' annual evaluations, and students' academic progress in mathematics—related to the grade level goal—will be used as an important piece of evidence on teachers' annual evaluations at the end of the 2013-2014 school year.

Challenges

At Jamestown Elementary School, classroom teachers have traditionally taught their students all subjects. Our philosophy has been that elementary classroom teachers build strong and effective relationships with the students they teach and with their parents. Home-school communication is a strong bond between the classroom teacher and the parents. It includes weekly e-newsletters, frequent informal conversations, and formal parent-teacher conferences. With our new model of cluster-grouping, many students have a different teacher for mathematics than they have for their other subjects. Parents, who have been supportive of the cluster-grouping approach in mathematics, have been concerned that they do not have the same level of

communication with their children's mathematics teachers as they do with the classroom teachers. Consequently, the PLC teams have been working on improving communication with parents regarding progress in mathematics.

More professional development is needed in all aspects of this transformation, and the professional development needs to be differentiated. In some cases, teachers need more basic education in mathematics content, as well as more training in the new research-based pedagogies. Teachers need more support in understanding and implementing a wide variety of differentiated learning strategies—including rotations, compacting, and technology integration—because differentiating mathematics instruction is imperative for cluster-grouping to be successful. Finally, teachers and administrators need more professional development in data analysis and assessment.

Building a collaborative culture, which is absolutely essential for both effective co-teaching and functioning PLCs, is difficult. It takes commitment, time, and effort as well as more sustained and systematic professional development. Planning time is a major consideration. When co-teaching is the expectation, common planning time is extremely important. There is scheduled time for weekly PLC meetings, but these meetings often do not include time for planning and preparation for the co-teaching teams. At this point, much of the co-planning occurs after school or on weekends.

There is also the more subtle challenge of changing the conventional thinking of how students are grouped. Many teachers, parents, and even the students themselves only think of grouping students by their "level" in mathematics. If we are successfully implementing best practices, *all* of our students will be able to be educated in a heterogeneous environment in elementary school.

Next Steps

Our goals for the future are many. Specifically, we would like to offer professional development based on the following topics:

- Professional Learning Communities;
- Higher-level mathematics content for teachers;
- Data analysis, understanding, and utilization to inform instruction;
- Collaboration and co-teaching; and,

- Training related to the pedagogy of specific strategies, especially differentiated instruction.

Our combined perspectives, resource knowledge, and collaboration have provided us with a unique foundation. This insight has led us to create our other goals:

- Keep co-teaching teams together for next year; it can take several years for co-teachers to function at full potential because it takes time to build relationships and trust.
- Create more common planning time for the co-teaching teams of Specialists and classroom teachers.
- Utilize technology to support higher-order thinking skills, problem solving, mathematical communication, and differentiated mathematics instruction.
- Educate parents regarding the process of cluster-grouping, the need to increase the rigor of mathematics instruction, and the importance of problem solving and the communication of mathematical thinking.

References

[1] *Mathematics Standards of Learning for Virginia Public Schools*, Board of Education, Commonwealth of Virginia, Richmond, VA, 2009.

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[5] R. DuFour, R. DuFour, R. Eaker, and T. Many, *Learning by Doing: A Handbook for Professional Learning Communities at Work*, Solution Tree Press, Bloomington, IN, 2010.