

Math Intervention at Cascade Middle School

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Introduction

Henry David Thoreau said “Things don’t change; we change.” This is very true for the staff and students at Cascade Middle School in the Bethel School District in Oregon. Faced with being one of two schools in Lane County that had a low report card the first year report cards came out, during the 1999-2000 school year, provided the catalyst needed for change. Even though attendance was the main reason for the low report card, it provided the opportunity for self evaluation and focus on what needed to change. Changes in the reading program came first, and then the focus turned to math. This report presents the background, processes, and results of the successful math intervention at Cascade Middle School.

Background and History

During the 2000-2001 school year, Cascade implemented a school-wide reading program, consisting of 50 minutes of reading and study skills as the first period of the day, Monday through Friday. Every teacher participated in the reading program. The reading program showed huge increases over time in oral reading fluency data and state test scores in reading at all three grade levels.

The guiding principle for the reading program, and later the math intervention program, was TGDD or Timing, Grouping, Design, and Delivery. Timing refers to making time in the schedule for the intervention. To be successful, any intervention program must have a fixed amount of scheduled time during the school day. The second component is grouping. Carefully determining which students will be targeted for the intervention is key to success. Knowing who is receiving intervention helps to determine exactly what gaps exist and what instructional materials will fill the gaps. This leads to the design component. The design of the intervention must make sense and fill the clearly identified needs of the students targeted for intervention. Finally, the delivery of the intervention requires consistency, with direct, explicit instruction.

With the reading program successfully underway, reading results were rising but math results were flat, so Cascade turned to math. Upon the advice of trusted advisors, the Vmath® curriculum from Voyager Expanded Learning was evaluated and purchased for the 2006-2007 school year. Vmath satisfied the design and delivery components of TGDD framework. The timing and the grouping components were next.

Targeted Population

Students targeted for the Vmath intervention were in the Nearly Meets population on the Oregon Assessment of Knowledge and Skills (OAKS) state test from the previous school year. On the OAKS, there are four levels of performance, Exceeds, Meets, Nearly Meets, and Does Not Meet. The Nearly Meets students were targeted for intervention because they were just a few questions away from the Meets performance level. Additionally, if students were right at Meets or reached Meets on the third attempt, they were targeted for math intervention because without additional help the odds of reaching Meets the following year with harder material were slim. While the OAKS was the main factor in deciding which students were targeted for math intervention, other factors were also considered. These included oral reading fluency scores, the Bethel Math Assessment Scores, and teacher recommendations.

In a perfect world where money is not an object, all students who did not reach the Meets category on the OAKS would have received math intervention. In the real world, the staff at Cascade targeted the students who had the greatest chance of success first. When those students succeeded and moved out of the math intervention, students in the Do Not Meets performance category were admitted to the intervention classes. This kept the classes full throughout the school year and allowed more students to receive math intervention.

At Cascade Middle school, 73% of the students qualified for free and reduced lunch over the intervention period, from 2006 to 2009. The mobility rate was 27% over the same time period. The Social Economic Status ranking was in the lower 25th percentile. On average, 20% of the student population at Cascade Middle School received Special Education services. About 27% of the student population had minority status, with the largest subgroup being Hispanic, 13%. The staff at Cascade did not see these demographics as a barrier to being successful.

Scheduling Math Intervention

In a traditional seven period schedule, it was impossible to find the time to fit in math intervention without replacing something. The Vmath intervention was supplemental and did not supplant the core math instruction. It was decided that the Math Lab class would be offered during one period of the two period elective block and that math was important enough to give up an elective, at least for one semester.

All three grade levels at Cascade used Vmath for the entire school year. Math lab classes were capped at 20 students at any given time. This involved gaining consensus from staff teaching other electives because those classes would necessarily be larger to accommodate the overflow.

Oregon Senate Bill 318 monies were used in 2007-2008 to hire two educational assistants to work in the math lab classes, effectively reducing the student to staff ratio from 20 to 1 to 7 to 1.

There were several parameters and constraints related to scheduling the math intervention. For students who wanted to take both band and choir as electives, they usually gave up one semester of choir rather than band since learning to play an instrument was developmental in nature. Students were generally not allowed to be in both a reading lab and a math lab at the same time. Considerations included the selection of staff to teach the math lab classes, the mobility of students in terms of new students entering the school during the semester, and the writing intervention class for the 7th grade students. Scheduling was not a nightmare, but rather a series of trade-offs that had to be negotiated.

Vmath was an all year program, but students who are able to meet two of the three following criteria were allowed to exit the intervention after one semester:

1. Meet or exceed the benchmark on the State Test in Mathematics at the first administration
2. Earn a “B” or better in the class
3. Teacher Approval

As it turned out, given the choice to stay in the math intervention or return to an elective, many students stayed in the math intervention class. One of the most compelling reasons was these students felt successful for the first time in math and the feeling motivated them to want to continue the intervention instruction.

The Vmath Curriculum

Vmath is designed to complement all major math programs by providing an additional 30-40 minutes of daily, targeted concept, skill, and problem solving development. Each level of Vmath contains ten individual modules covering the basic strands of elementary mathematics. The content of these modules is aligned with the grade level expectations for the National Council of Teachers of Mathematics (NCTM) content standards presented in the *Principles and Standards for School Mathematics*. The Vmath modules include instruction on: whole numbers; decimals; number theory; fractions; data analysis, statistics, and probability; measurement; geometry; ratio, proportion, and percent; integers and rational numbers; and algebra.

Instructional Design: Vmath is designed using widely accepted principles of effective intervention instruction for struggling students. The direct, systematic instruction in Vmath provides carefully sequenced, specific, and detailed dialogue for every lesson. This form of explicit, highly structured lesson delivery uses a direct instruction model based on research by Stein, Silbert, and Carnine (1997).

According to Stein, Silbert, and Carnine, the following are the nine essential steps necessary to designing an effective instructional program:

1. Specifying long- and short-term objectives
2. Devise instructional strategies
3. Determine necessary pre-skills
4. Sequence skills
5. Select a teaching procedure
6. Design teaching formats
7. Select examples
8. Specify practice and review
9. Design progress-monitoring procedures (p. 4)

Rosenshine (1983), in a review of research on teacher effectiveness, concluded that instruction that is highly interactive, briskly paced, and clearly presented was related to high rates of student success. He referred to this type of teaching as direct instruction (explicit, teacher-directive practices). The term *direct instruction*, however, is generally used to refer to the instructional theory work of Engelmann and Carnine (1991). Research provides consistent support for using an explicit approach to teaching mathematics. Adams and Engelmann (1996) analyzed 34 intervention studies and found this approach to be more successful in 32 of the 34 studies they reviewed. Bottge (2001) asserted that teachers should continue to foster competence in basic skills by providing students explicit instruction. Kroesbergen and Van Luit (2003) reported in a study of 58 research reports that direct instruction was found to be more effective than mediated instruction. All of these studies provide convincing evidence that such pedagogy facilitates the learning process.

Vmath instruction is characterized by a clear 4-step lesson format consistent with the tenets of direct instruction: Getting Started, Guided Practice, Independent Practice, and Error Analysis.

Each Vmath lesson begins with a review of preskills in the Getting Started section. “Because students learn by connecting new ideas to prior knowledge, teachers must understand what their students already know” (NCTM, 2000, p. 18). The first few problems review the prerequisite skills for the lesson or review the component skills of the process being taught later in the lesson. After a review of the preskills, the teacher carefully models the new skill or strategy needed to achieve the lesson objective. In Getting Started, the instruction is explicit with a script for the teacher to follow. No student instructions are written in this section, ensuring that the teacher will use the script to model each step needed by the student to effectively learn the new skill or strategy.

In the Guided Practice section of each Vmath lesson, strategic integration of content provides a concise and clear procedure for acquiring new knowledge in a “How To” box. The teachers are provided with a specific dialogue that will lead the student in acquiring this knowledge. The “How To” box summarizes for students the steps needed to master a concept, skill, or strategy. Vmath students are guided by the teacher through the lesson with effective use of prompts and questions

that ensure proper student responses (Cybriwsky & Schuster, 1990; Good, Grouws, & Ebmeier, 1983). In Guided Practice, the teacher-directed dialogue is used to scaffold instruction while supporting the student during completion of the problems. Scaffolding provides students with temporary support by structuring the task into manageable chunks. Teachers then assist students in thinking about the chunks. Teachers are guided in the lesson dialogue in the gradual and purposeful removal of the scaffolds (Hall, 2002). During Guided Practice, the teacher monitors student performance and uses standard correction procedures to give the student immediate feedback. Thus, Vmath Guided Practice is a primary means by which the teacher verifies that students can apply the concepts in the next phase of the lesson, Independent Practice.

Vmath students practice lesson content and previously learned skills from Getting Started and Guided Practice on their own in the Independent Practice section. Students can refer to the “How To” box while completing the problems in the Independent Practice. The teacher monitors and checks each student’s work daily. This teaching technique is supported by Smith and Geller (2004), who indicate that feedback is important in effective math instruction for all learners, including learners with disabilities and those at risk of school failure. Students keep a personal graph of their Independent Practice achievement and progress in the back of their student book. This practice of self-monitoring has been shown by researchers to enhance academic achievement (Lan, Repman, & Chyung, 1998).

After Independent Practice, Vmath offers students a Test Prep and Error Analysis section that allows them to apply what they have learned in a format similar to a high-stakes assessment situation. Three questions that check the learning in the lesson provide the teacher with information so that effective reteaching can occur, if necessary. Questions written in multiple-choice and short-answer formats are an effective and efficient way to track daily progress. Some of the distracters presented in the multiple-choice problems represent common errors made by students. When these specific wrong answers are selected, the teacher uses the provided correction procedures to correct the error. Error analysis is another of the common attributes that have been identified as positively affecting student learning (Smith & Geller, 2004). This practice of error analysis with reteaching is aligned with the research findings of Good and Grouws (1979) related to improving learning through reteaching.

Essentials of Math Instruction: The lessons in Vmath address three essential components of math instruction—concepts, skills, and problem-solving—with a major goal of developing students’ computational fluency. A major goal in grades 3–5 is the development of computational fluency with whole numbers (NCTM, 2000). Additionally, Vmath students reach for computational fluency with fractions and decimal numbers by the end of grade 6 or in the beginning of grade 7.

Concepts: Vmath teaches the underlying concepts, or big ideas, needed for understanding mathematics by using visual models and pictorial representations.

Skills: Vmath provides clear step-by-step procedures to guide students through the processes needed to complete basic algorithms successfully.

Problem-Solving: As students master the fundamental math concepts and skills, they also must develop appropriate problem-solving skills and strategies. In Vmath, students use a problem-solving plan, develop problem-solving strategies, and practice problem-solving applications. Explicit instruction in these problem-solving techniques is consistent with results of research studies examined in a meta-analysis of research on instructional strategies (Gersten, Chard, Baker, Jayanthi, Flojo, & Lee, *under review*).

Using a Problem-Solving Plan: The problem-solving plan in Vmath incorporates the four phases devised by George Polya (1957) in his book *How to Solve It*. In the Getting Started section, the teacher guides the students through the process of understanding the problem, making a plan, carrying out the plan, and looking back to review. In the Getting Started and Guided Practice sections, the student is directed to ask questions such as, “What am I trying to find?”, “How can I find the answer?”, “What operation should I use?”, and “Why is my answer correct?”

Developing Problem-Solving Strategies: Vmath teaches four basic strategies that struggling math students should be able to apply in the context of problem-solving. Using the direct, explicit, and systematic format of Vmath, the teacher models the critical-thinking skills and unique procedures in learning and applying each strategy. The strategies include: Using Patterns, Working Backward, Using a Table, and Solving a Simpler Problem.

Practicing Reasonableness, Estimation, and Guess-and-Check Techniques: The final question in the Test Prep and Error Analysis section is an open-ended question that provides the teacher with an opportunity to model the techniques of Checking for Reasonable Answers, Estimation, and Guess-and-Check.

Assessment: Vmath provides a full range of assessments to enhance instructional decisions, including a Curriculum-Based Measurement component, Pre-Test and Post-Tests, and several opportunities for ongoing assessment. Research suggests that the practice of providing feedback on student performance as well as information related to a student’s specific strengths and weaknesses is a combination beneficial to student achievement (Gersten, et al.).

Extensions to Vmath

In addition to the Vmath curriculum, students in the math intervention at Cascade used the technology lab once a week to use VmathLive™. VmathLive is the online math program where students practice and sharpen their math skills, prepare for high-stakes tests, and play in real-time competitions of speed and skill with other students from around the world. Students have access to VmathLive outside school hours also. It can be accessed from any computer with an Internet connection. At Cascade, using VmathLive became a time to have fun and be a bit louder

than usual while still practicing math skills. The real-time reports enabled teachers to monitor participation and progress in VmathLive.

Implementation at Cascade

The teachers at Cascade set the tone for the math intervention classes. Students were told it was OK to be wrong and that there would be no homework. Students knew they would be on task for 45 minutes with no wasted time. The student materials were ready at the beginning of the class. A large plastic bag, with the student material, pencil, and any other material needed for that lesson, was at the student's desk at the beginning of Math Lab. Students were able to come into the classroom and get started with little reason for delay.

The Initial Assessment was given at the beginning of the year to identify weak skills. Armed with that knowledge, teachers chose the modules which would target those skills, moving students towards achievement on the state exam. The module pre- and post-tests were used to identify areas of difficulty, enabling the teacher to focus on known areas within the module needing extra emphasis and directing the teacher to the appropriate reteach opportunities that were required after finishing the module.

Beyond the motivation generated by being able to return to other electives by being successful on the state test, students also received more immediate rewards. Based upon the school's Positive Behavior Support (PBS) program, students received rewards for their hard work, such as a "head of the lunch line" pass and school "bucks" to use for purchasing pens, pencils, and other school supplies. The importance of maintaining the motivation and enthusiasm of the students was a central part of the program at Cascade.

Results

Results indicate Cascade Middle School has made steady, sustained progress with students receiving math intervention instruction using Vmath. Table 1 shows the number of students who received math intervention for the second and third year of Vmath implementation at Cascade Middle School. Notice that the number of students who received Vmath instruction was higher than the cap for the math lab classes of 20. This is due to students moving out of intervention at the semester and other students in need of math instruction moving in.

Table 1. Cascade Students Receiving Vmath Intervention

2008-2009	All Students Receiving Vmath Instruction	Students who got a Meets or Exceeds on the OAKS	% Passing OAKS
6 th Grade	39	29	74%
7 th Grade	51	40	78%
8 th Grade	43	11	26%
All Grades	133	80	60%

2007-2008	All Students Receiving Vmath Instruction	Students who got a Meets or Exceeds on the OAKS	% Passing OAKS
6 th Grade	36	21	58%
7 th Grade	37	24	65%
8 th Grade	20	4	20%
All Grades	93	49	53%

During the 2008-2009 school year, 133 out of 392 students (34%) received math intervention using Vmath. During the 2007-2008 school year, 93 out of 401 students (23%) participated in math intervention.

Figure 1 represents the percent of students who had the Vmath intervention and passed the OAKS with a Meets or Exceeds performance level for the 2007-2008 and 2008-2009 school years. During the 2008-2009 school year, more students received math intervention instruction using Vmath. Additionally, the percentage of students passing the OAKS increased. This is attributed by school officials to the fact that as teachers gain more experience with the curriculum, they are more confident and are able to deliver the curriculum more effectively.

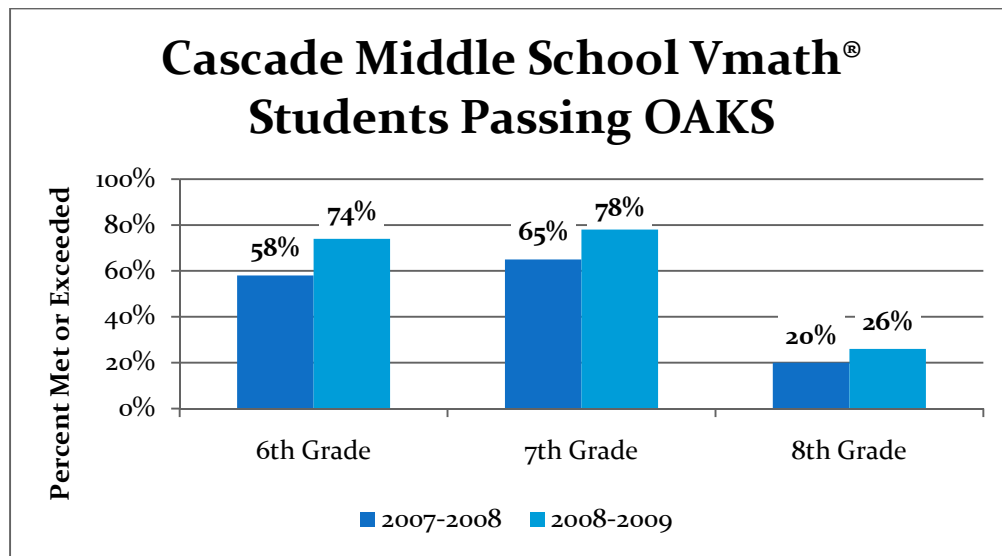


Figure 1. Percent of Students Passing OAKS

Although the students in the Nearly Meets performance category were the focus and the targeted group of students, when possible students in the Does Not Meet performance category were included in the math intervention classes. When students who achieved a Nearly Meets performance status were included, the numbers are quite inspiring, particularly the Does Not Meet numbers for the 2008-2009 school year.

Table 2. Cascade Students (Nearly Meets, Meets, Exceeds) Receiving Vmath Intervention

2008-2009	All Students Receiving Vmath Instruction	Nearly Meets, Meets, or Exceeds	% Nearly Meets, Meets, or Exceeds	Nearly Meets	Does Not Meet
6 th Grade	39	32	82%	3	0
7 th Grade	51	50	98%	10	0
8 th Grade	43	37	86%	26	4
2007-2008	All Students Receiving Vmath Instruction	Nearly Meets, Meets, or Exceeds	% Nearly Meets, Meets, or Exceeds	Nearly Meets	Does Not Meet
6 th Grade	36	30	83%	9	6
7 th Grade	37	32	86%	8	2
8 th Grade	20	8	40%	4	8

Student progress can be measured by the increase in RIT scores from one year to the next. The passing RIT score for 6th grade is 221, 7th grade is 226, and 8th grade is 230. Therefore, the expected increase between 6th to 7th grade is 5 RIT points and from 6th to 8th grade is 9 RIT points. There are four 8th grade students who have received Vmath instruction for three years, since the inception of math intervention at Cascade Middle School. All of these students scored well below passing in the 6th grade. All of these students scored above the passing RIT score in 8th grade and gained two to four times the expected RIT score growth. Figure 2 shows the individual gains for these 8th grade students.

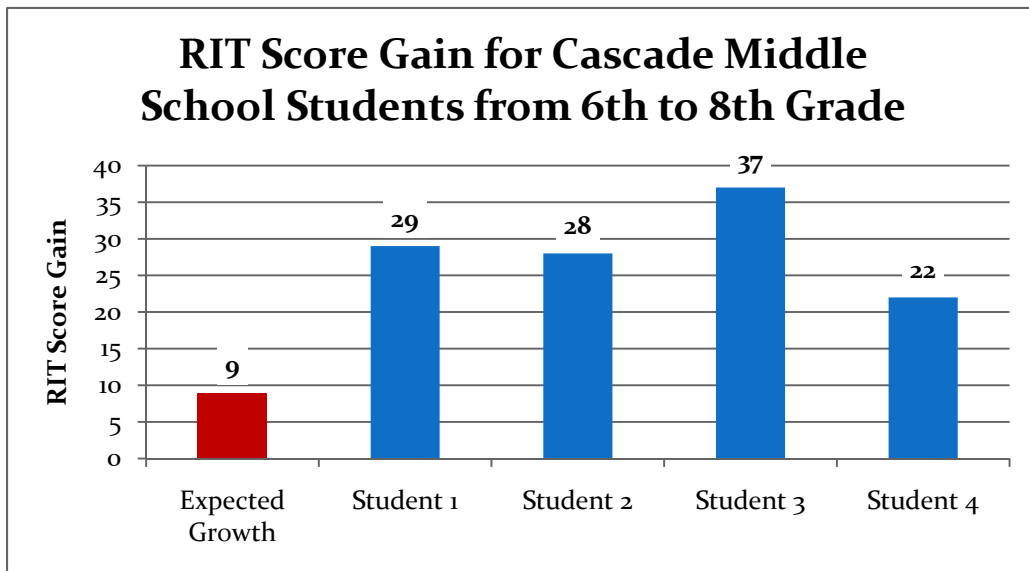


Figure 2. Three Years of RIT Score Growth by 8th Grade Students

Nine 7th grade students have been in the Vmath intervention for two years. Figure 3 shows the RIT score gain for these students. The students exceed the expected RIT score gain, some exceed the gain up to four times.

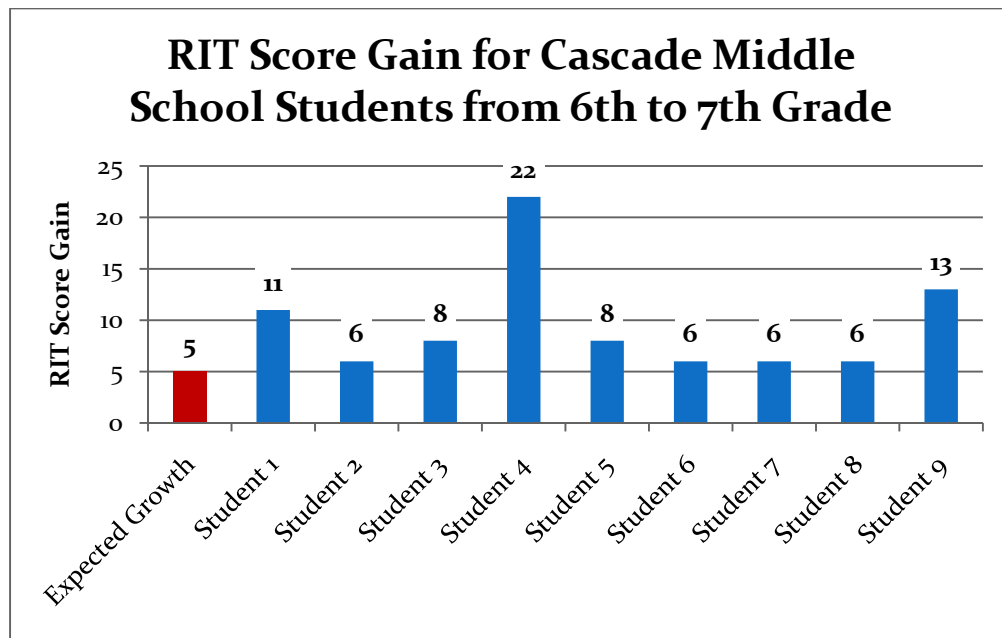


Figure 3. Two Years of RIT Score Gain by 7th Grade Students

Summary

Many factors go into successfully helping students advance their math skills. The staff at Cascade Middle School, using the TGDD structure, has found a successful formula for their students as demonstrated by the increasing number of students who are passing the OAKS and by the increase in RIT scores. As important as the changes made in the school schedule and the targeting of students who could most benefit from the math intervention instruction was the identification of a curriculum that could provide the appropriate pedagogy and skill that students needed. That curriculum was Vmath from Voyager Expanded Learning.

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