# How Math Communities Effect

# 7th Grade Middle School Students' WASL scores

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A Special Project

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Monica Ramos

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How Math Communities Effect

7th Grade Middle School Students' WASL scores

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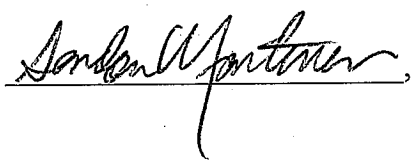 , Faculty Advisor

## ABSTRACT

In order for students to get an understanding of math problems students needed to learn how to articulate their mathematical thinking, A how to ask well thought out questions regarding math problems, to find and use different sources of mathematical ideas, and students needed to take responsibility for their own learning. The best way to have accomplished this was to use math communities in the classroom. (The author's math classes at Toppenish Middle School were used in the study.) First period was the intervention group and third period was the control group. Math communities were active in the classroom twice a month from October 2006 through March 2007. The researcher then compared the t-test for independent samples for the 2006 WASL scores of .63 and the t-test for independent samples for the 2007 WASL scores of -.04. There was not a significant difference in the t-test values. Therefore the hypothesis was not supported and the null hypothesis was rejected.

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# CHAPTER 1

## Introduction

### Background for the Project

Under the No Child Left Behind Act (NCLB), American schools have been required to prepare all students to be successfully educated in order to compete in a global economy (U.S. Department of Education Website). As a result the state of Washington has introduced the Washington Assessment of Student Learning (WASL), the Essential Academic Learning Requirements (EALRs), and the Grade Level Expectations (GLEs) for reading, math, writing and science (OSPI Website). Students must have meet standards in reading, writing, math, and science by passing the WASL. Washington schools were obligated to make sure all students met these standards (OSPI Website).

Conditions and consequences were made through all levels of public education in the state of Washington. The conditions were that all Washington schools must meet Annual Yearly Progress (AYP) in math, reading, and writing (OSPI Website). The consequence were if schools did not meet AYP targets in math, reading, and writing for two consecutive years then they would have entered the Step 1 of the school improvement process. The following were examples of what they must have done:

1. Developed an improvement plan and received technical assistance.
2. Dedicated 10% of funding to professional development.

3. Made *public school choice* available within district.

4. Notified parents of school improvement status (OSPI Website).

There was also a Step 2, Step 3, Step 4 and Step 5 of the school improvement process. For each year a school continued not to meet AYP they would enter the next step consecutively (OSPI Website).

Toppenish Middle School (TMS) was in Step 5 last year of not meeting adequate yearly progress. Toppenish Middle School was now required to implement a restructuring plan. A significant change needed to take place. A small part of that change was math communities.

Statement of the Problem

Evidence of the need to change was obvious as can be seen on the Figure 1, WASL Seventh Grade Math: Percent of Students by Level. Each year Toppenish Middle School's seventh grade math WASL scores were not increasing adequately as set forth by OSPI (OPSI Website).

According to Figure 1, WASL Seventh Grade Math Percent of Students by Level, the 2001 scores as compared to the 2002 scores had only increased by one percent. Toppenish Middle School during the 2001-2002 school year was now in Step 1 of the school improvement plan. Then the scores did increase by ten percent from the 2002 scores as compared to 2003 scores, but TMS in 2002-2003, had to meet AYP twice in a row before it would be out of Step 2 of the school improvement plan. The following year, 2003-2004, the scores increased by nine percent, one percent short of meeting adequately yearly progress. Now TMS was

in Step 3 of the school improvement plan. Then the following year, 2004-2005, things got worse. The scores dropped twelve percent and definitely not meeting AYP again for the third year in a row. Now TMS was in step 4 of the school improvement plan. The following year 2005-2006 things looked better. The scores had increased by two percent, but still not enough to meet AYP. By the 2006-2007 school year Toppenish Middle School (TMS) was in Step 5 of the school improvement plan. This was the last year the state would give TMS to improve it's scores. If something was not done the consequences could be devastating. This included getting rid of all faculty members and administrators at Toppenish Middle School.

Purpose of the Project

The following question was considered when the researcher looked at the purpose. What did Toppenish Middle School do to help increase math WASL scores? After having attended a training with Lucy West the researcher found that in order for students to get a deeper understanding of math problems students needed to learn how to do four things. One was students needed to articulate their mathematical thinking. Another was students needed to learn how to ask well thought out questions regarding math problems they were having trouble with. Students also needed to find and use different sources of mathematical ideas. And lastly, but most important was students needed to take responsibility for their own learning. The best way to have accomplished this was to use math communities in the classroom.

Delimitations

Toppenish School District had a 95.3% student population that qualified for free or reduced price meal lunch. Toppenish Middle School was predominately Hispanic at 79.5% and American Indian at 15.6%. Other special programs included special education at 9.6%, transitional bilingual at 39.7% and migrant at 15.4%. The districts total student population was 3,317. There were 176 classroom teachers with average years of teacher experience of 10.4 years (OSPI Website). There were four elementary schools, one middle school, and two high schools. At the middle school the author's 2007-2008 math classes were the focus of this study.

Assumptions

The author assumed the students involved in math communities were cooperative, participated fully in math discussion, worked to the best of their ability on math problems, were fully alert, were present at all math community days, and were listening to their community member. The author also assumed the community members were fully trained by Carmen Gonzales, Toppenish School District K-12 Mathematics Director, that they were present at all math community days, that community members followed through with getting students to communicate their thoughts on math problems, and that community members also followed through with getting students to have a quality math discussion.

Hypothesis or Research Question

Under the No Child Left Behind Act, American schools were required to prepare students to meet certain academic standards. In the state of Washington that standard was the Washington Assessment of Student Learning.

One of Toppenish Middle School's remedies was to introduce math communities into the morning seventh grade math classes. Therefore students who participated in math communities did better on the mathematics portion of the WASL exam than students who did not participate in math communities.

Null Hypothesis

Math communities were not used in the researcher's third period math class. Therefore students who were not participants in math communities did not perform significantly better on the math portion of the WASL.

Significance of the Project

A significant change had needed to take place at Toppenish Middle School. Toppenish Middle School was in step five, the last year of not meeting adequate yearly progress as set forth by OPSI. The middle school had now been required to implement a restructuring plan. Even though math communities had been only a small part of this plan they might have had a huge impact on student math WASL scores, but more importantly a bigger impact on the way kids approach solving math problems for the future. The reality was that students needed to be successfully educated in math in order to compete in a global economy. Even though a new curriculum had been adopted students were still at a

significant disadvantage. Students lacked the skills to explain their mathematical thinking with full descriptions and more over they also lacked the skills to defend their answers and methods with full confidence. Math communities were the solution. Hufferd-Ackles, Fuson, and Sherin (2004) stated the following:

> *Principles and Standards for School Mathematics* (NTCM, 2000) emphasizes the importance of learning in a mathematic community because it fosters students' communication of mathematical ideas and helps students to build mathematical understandings. Discussion of mathematical ideas provides opportunities for students to reason, defend, and prove their conceptions to one another. (p. 82)

Procedure

The researcher focused on the seventh grade math classes at the Toppenish Middle School. The author's first period math class and third period math class were included in the study. First period was the intervention group and third period was the control group. Math communities were organized by Carmen Gonzalez, Toppenish School District K-12 Mathematics Director. Math communities were active in the classroom twice a month from October 2006 through March 2007. In April 2007 the Toppenish Middle School students took the WASL exam. In September 2007 WASL scores were released by the Office of Superintend of Public Instruction (OSPI Website). The researcher calculated the t-test for independent samples for the 2006 WASL scores and 2007 WASL scores. The researcher examined the statistical analysis of the data.

Definition of Terms

adequate yearly progress. This term was used to explain that a school has met state reading and math goals. The School district's report card let parents know whether or not a child's school has made adequate yearly progress (U.S Department of Education Website).

essential academic learning requirements. The Washington State learning Standards gave an overview of what students should be able to do and should know in grades kindergarten through tenth grade (OSPI Website).

grade level expectations. These expectations were detailed information about what students should have been able to do and should have been able to know by each grade level. These expectations were aligned from kindergarten through tenth grade. Educators, parents, and students, could have seen how knowledge and skills build from year to year. There were grade level expectations for each content area. These content areas were reading, math, writing, and science (OSPI Website)

National Council of Teachers of Mathematics. The National Council of Teachers of Mathematics was a national public voice for math education, leadership to support teachers, provided vision in math education, professional development that supported teachers in ensuring equitable math learning of the best quality for all students (NCTM Website).

No Chile Left Behind. President Bush committed to ensure that all children in the United States would receive a high quality education so that no child was left behind. No Child Left Behind, commonly was known as NCLB, was a United States federal law that reauthorized a number of federal programs of U.S primary and secondary school by having increased the standards of accountability for state, schools and school districts, as well as having provided parents more flexibility in choosing which schools their child would have attended (U.S. Department of Education Website and OSPI Website).

Office of the Superintendent of Public Instruction. OSPI led, supported, and oversaw kindergarten to twelfth grade education. This office ensured the success of all children in collaboration with students, families, educators, business, local communities, labor, and government (OSPI Website).

Washington Assessment of Student Learning. The WASL measured the learning of students with the state's academic standards. Each spring students were tested in math and reading in third grade through eighth grade and again in tenth grade. Students were also tested in science in fifth, eighth, and tenth grades. Lastly students were also tested in writing in fourth, seventh, and tenth grades (OSPI Website).

Acronyms

AYP. Adequate Yearly Progress

EALR. Essential Academic Learning Requirements

ESL. English as a second language

GLEs. Grade Level Expectations

NCLB. No Child Left Behind

NCTM. National Council of Teachers of Mathematics

OSPI. Office of the Superintendent of Public Instruction

WASL. Washington Assessment of Student Learning

# CHAPTER 2

## Review of Selected Literature

### Introduction

To have begun establishing a math classroom community among students and teacher, the teacher needed to build a math talk learning community or a community where students helped one another's learning of math by having engaged themselves in very meaningful mathematical dialogue. There were four targets in the math talk learning community structure that established important mathematical dialogue. These four targets were mathematical questioning, explaining mathematical thinking, expressing sources of mathematical ideas, and taking responsibility for mathematical learning.

### Explaining and Questioning Mathematical Thinking

The importance of mathematical conversations and its connection to developing theoretical understanding and reasoning was well recognized throughout NCTM's *Principles and Standards for School Mathematics* (National Council of Teachers ofMathematics [NCTM}, 2000, p. 21). The following was an example of that importance.

Robyn Silbey (1999), was a school based main specialist in Montgomery County, Maryland. Silbey (1999), knew the importance of communication among students in learning mathematics. A key to deepening mathematics understanding depended on the communication of students when it came to solving math problems (Silbey, 1999, p. 24).

Having talked about a problem, having listened to other student solutions, and having written the steps to solve the problem helped students to organize and combine their math thinking (Silbey, 1999, p. 24). One of the five important NCTM process standard in mathematics was communication (Silbey, 1999, p. 24).

According to Chapin, O'Conner, and Anderson (2003), applying students way of thinking to the interpretation of others ("Do you agree or disagree and why?) caused the evaluation of other student's reasoning and in turn the exchange of ideas. Chapin, O'Conner, and Anderson were not the only ones who had the same idea. The Five Practices for orchestrating productive mathematical discussions by Stein, Engle, Hughes, and Smith (2003), anticipated a collection of strategies, both correct and incorrect, that students might use to solve a math problems. But more important they also anticipated how those approaches related to the mathematical ideas, representations, processes, and practices of students doing math. They also monitored student's responses as they explored a task, made notes of certain strategies, representations, and other ideas that were important to share during a whole-class discussion (Stein, Engle, Hughes, & Smith, (2003, p. 173). In conclusion explaining and questioning mathematical thinking orchestrated productive math discussions (Stein, Engle, Hughes, & Smith, 2003, p. 173).

Robyn Silbey had a student named Allan who had only been in the United States for less than a year and was a non native speaker. He was reluctant to speak up in class. Most students were that way even if they had good math abilities. Allan first listened to his classmates speak their way through a solution to a math problem. Then the students shared their writings about the math solution in groups. He was then able to compare his problem solving strategies with their problem solving strategies. Finally, using his groups' oral and written thought procedures as a model, Allan was able to communicate his own mathematical thinking in writing. In time his own mathematical understanding developed. Robyn Silbey (1999), was then able to assess Allan's progress.

The National Research Council (2003) supported Robyn Silbey's ideas. To have accomplished the goal of math proficiency for all students, many factors of U.S. school mathematics had to be modified. Proficiency according to the National Research Council (2003) was more likely to widen when a math classroom was a community of learners rather than a room of isolated individuals. In such a classroom, students were given the confidence to produce and share solution methods, mistakes were assessed as opportunities for students to learn, and correctness was decided by the students examining the logic and structure of the problem, rather than by the teacher (National Research Committee, 2003, p. 26).

Questioning and discussion that draw out students' thinking and explanation strategies and build on those explanation strategies led to greater precision and clarity (National Research Committee, 2003, p. 26). A large amount of class time was used in developing math ideas not just practicing math skills.

What did this mean to teachers, students, administrators, and parents? On state assessments across the nation, students were required to explain their mathematical thinking and justify their answers in writing (Silbey, 1999, p. 25). For students to be successful at writing about mathematics, talking about mathematics needed to be a fundamental part in the daily classroom (Silbey, 1999, p. 25). Conversations that were rich in math discourse involved students to think about their approach in solving math problems and to express why these solutions made sense (Silbey, 1999, p. 25). These math community conversations were the requirement for conveying thoughts and ideas in writing (Silbey, 1999, p. 25). As a result students were more successful in passing mandatory state assessments across the country (Silbey, 1999, p. 25). In addition, with the growing rate of second language learners in the nation, math communities helped them articulate their thoughts and in time also helped them increase their understanding of the English language (Silbey, 1999, p. 25).

Another noteworthy study carried out by Kimberly Hufferd-Ackles, Karen C. Fuson, and Miriam Gamoran Sherin (2004), from Northwestern University proved how important explaining and questioning mathematical thinking can be. Based on their analysis, it was determined that the practice of explaining and questioning math thinking in the classroom of a third-grade teacher had exhibited remarkable change over the course of a school year (Huffer-Ackles, Fuson, & Sherin, 2004, p. 86). Three themes emerged from the data analysis. These themes were strong evidence of mathematics community, teacher actions, and student actions (Huffer-Ackles, Fuson, & Sherin, 2004, p. 87). Within these actions, the researchers identified four distinct, but related components that captured the growth of the math-talk learning community over time (Huffer-Ackles, Fuson, & Sherin, 2004, p. 87). Two of those actions were questioning math thinking and explaining math thinking (Huffer-Ackles, Fuson, & Sherin, 2004, p. 87)

Steve Reinhart who taught mathematics at Chippewa Falls Middle School noticed that he had fallen into a familiar teacher centered, direct-instruction model which did not fit well with the more in-depth problems and tasks that new math curricula demanded (Reinhart, 2007, p. 478). As he stood in front of the class explaining the lesson he noticed many of his students were not listening. Reinhart realized that students had to do the explaining and questioning of mathematics and the teacher had to do the listening and monitoring.

After much frustration Reinhart finally came up with a few techniques teachers should implement to create a math community in their classroom (Reinhart, 2007, p. 478). A few of these techniques were to ask good open-ended questions, use more process questions than product questions, replace lectures with sets of questions, and be patient with students because wait time is very important for students who need time to process their thoughts (Reinhart, 2007, p. 480).

In accordance with another analysis done by Hakkiday, Stubbs, Hodge and Kress, who examined how the students used modality indicators to express social and mathematical attitudes (Bills, 1999, p. 161). The study was used to draw comparisons between the ways in which two students respond to the classroom mathematical culture (Bills, 1999, p. 161). In conclusion a wide examination of the data included the teacher's questioning and student discourse (Bills, 1999, p. 171). It was found that student inquiry of problems and description of problems was an important step in the expansion of the culture of the mathematics classroom (Bills, 1999, p. 171).

Expressing Sources of Mathematical Ideas

National Council of Teachers of Mathematics Learning Principle emphasized the responsibility in sustaining student learning, noting that classroom discourse and social interaction can be used to promote the recognition of connections among ideas and the reorganization of knowledge (NTCM, 2000, p. 21).

A study was conducted by Stephen J. Pape (2004), from Ohio State University on 98 sixth and seventh grade students' problem solving behavior. In his study Pape (2004), used theories of mathematical problem solving to understand the cognitive processes and stages of development of problem representations that led to math solutions from students. Pape (2004), also used reading comprehension perspectives to further understand the processes and the behaviors students used to comprehend math word problems. In the results it was found that when students recorded information given in the problem, wrote conditions of explanations and justifications on math problems, and expressed circumstances such as units and relationships in math problems (all components of math communities) all had higher reading and mathematic achievement in exams, greater success rates, and fewer errors in math problems (Pape, 2004, p. 187).

According to Chapin, O'Conner and Anderson (2003), student revoice ("Can you repeat what he just said in your own works?") was a way to give students more time to process different versions of solutions they've just heard. The students had the opportunity to clarify or add-on (Chapin, O'Conner, and Anderson, 2003, p.95). This increased the probability that students will follow the conversation and understand what is being said (Chapin, O'Conner, and Anderson, 2003, p.95).

This created a culture that student responses are valued and expected (Chapin, O'Conner, & Anderson, 2003, p.95). Also, according to the Five Practices for orchestrating productive mathematical discussions by Stein, Engle, Hughes, and Smith (2003), expressing student responses of math ideas took full advantage of the chances that the math objective for any math discussion will be accomplished.

Teachers also played a key role in getting students to express mathematical concepts. Magan Staples and Melissa M. Colonis (2007), studied three teachers who were successful in creating learning environments in their classrooms that were aligned with NCTM's vision of good practice. These teachers focused on two kinds of classroom discussions. One was sharing discussions and the other was collaborative discussions. These teachers positioned students to attend to one another's ideas setting the ground for a learning math atmosphere. (Staples & Colonis, 2007, p. 258)

In relation to another study done by Kimberly Hufferd-Ackles, Karen C. Fuson, and Miriam Gamoran Sherin (2004), from Northwestern University proved how important explaining source of mathematical ideas can be. Based on their analysis, it was determined that the practice of a third-grade teacher had exhibited striking change over the course of the school year (Huffer-Ackles, Fuson, & Sherin, 2004, p. 86). Three themes emerged from the data analysis. These themes were evidence of mathematics community, teacher actions, and student actions (Huffer-Ackles, Fuson, & Sherin, 2004, p. 87).

Within these student actions, the researchers identified four distinct, but related components that captured the growth of the math-talk learning community (Huffer-Ackles, Fuson, & Sherin, 2004, p. 87). One of these actions was explaining source of mathematical ideas to other students. (Huffer-Ackles, Fuson, & Sherin, 2004, p. 87)

Steve Reinhart (2007), who taught mathematics at Chippewa Falls Middle School came up came up with a few methods teachers should implement to make sure students express sources of mathematical ideas. One of these techniques included no one is finished until everyone in the group can explain and defend the answer (Reinhart, 2007, p. 482). This forced students to work together communicate, be responsible for the learning of everyone in the group, but especially it forced them to communicate their basis of mathematical ideas (Reinhart, 2007, p. 482).

Taking Responsibility for Mathematical Learning

In 1999, the National Council of Teachers of Mathematics offered professional development opportunities to teachers of mathematics (Sanzeni, 2000, p. 38). The plan also involved a concrete commitment from teachers, schools, and the state and federal government (Sanzeni, 2000, p. 38).

Former President Elect of National Council of Teachers of Mathematics (NTCM), Dr. Lee Stiff revealed that in most states teachers teaching math in kindergarten through twelfth grade were not specialists in building a math community in their classroom (Sanzeni, 2000, p.38). Teachers needed more assistance in teaching their students to develop communication skills, problem solving skills, and mathematical reasoning skills (Sanzeni, 2000, p. 39).

Dr. Lee began at Louis Armstrong Middle School in New York City. In partnership with Queens College, Louis Armstrong Middle School closed early one day each month and students went home at 12:30 p.m. (Sanzeni, 2000, 39). Teachers stayed until 3:30 p.m. To train in creating a math community in their classrooms (Sanzeni, 2000, p. 40). This professional development proved to be successful in the classrooms. This flourishing partnership continued with Louis Armstrong Middle School and Queens College (Sanzeni, 2000, p. 40). Sixteen graduate student interns and twenty student teachers in the middle school each year took part in this highly successful program that combined education theory with math communities (Sanzeni, 2000, p. 41).

Consistent with to Chapin, O'Connor, and Anderson (2003), encouraging for further participation ("Would someone like to add on?", " Did anyone approach this problem in a different way?", or "Did anyone else get a different answer?") was an invitation for others to enter into the conversation so that they could put forward their own opinions and calculations, or they can also place forward new math information for exploration. Furthermore, after asking a question, students

needed time to process and organize their thoughts so that they could give a well thought out answer (Chapin, O'Connor & Anderson, 2003, p. 95). More importantly this allowed, and even showed an expectation for students to respond. (Chapin, O'Connor, & Anderson, 2003, p. 95) According to the Five Practices for orchestrating productive mathematical discussions by Stein, Engle, Hughes, and Smith (2003), selected students needed to share their work with the rest of the class so that to compel students to take responsibility for their own learning.

Magan Staples and Melissa M. Colonis (2007), studied three teachers who were successful in generating a learning atmosphere in their classrooms that were aligned with NCTM's vision of good preparation. These teachers had students share their math ideas by presenting their problem solving work to classmates. Connecting and linking each students' ideas helped them take responsibility for their own learning (Staples & Colonis, 2007, p. 259). This approach allowed for students to use mathematical language and also allowed for students to show their procedures and strategies to their classmates (Staples & Colonis, 2007, p. 259). More critical, it exposed other multiple approaches to problem solving from different students. In conclusion, illustrated and shared discussion was important for student responsibility and mathematical learning (Staples & Colonis, 2007, p. 258).

Another study done by Kimberly Hufferd-Ackles, Karen C. Fuson, and Miriam Gamoran Sherin (2004), from Northwestern University proved how important making students responsible for learning can be. Based on their analysis, it was determined that the practice of a third-grade teacher had exhibited remarkable change over the course of the school year (Huffer-Ackles, Fuson, & Sherin, 2004, p. 86). Three themes emerged from the data analysis. These themes were evidence of mathematics community, teacher actions, and student actions (Huffer-Ackles, Fuson, & Sherin, 2004, p. 87). Within these student actions, the researchers identified four distinct, but related components that captured the growth the math-talk learning community (Huffer-Ackles, Fuson, & Sherin, 2004, p. 87). One of those actions was students taking responsibility for their math learning helped create a rich learning environment. (Huffer- Ackles, Fuson, & Sherin, 2004, p. 87)

Steve Reinhart (2007), who taught mathematics at Chippewa Falls Middle School came up with a few techniques teachers should implement to make sure students participated in classroom discussion and took responsibility for their own learning. A few of these methods were never say anything a kid can say and make participation mandatory not optional (Reinhart, 2007, p. 482). This sent a message to students that their participation is necessary (Reinhart, 2007, p. 480). Whether students were working in small groups or discussed a math problem with the class, every student was expected to contribute his or her fair share (Reinhart, 2007, p. 482).

Along with the National Research Council (2003), who conducted a study about what research says regarding successful mathematics learning found that students engaged in mathematical activity was key to success. With sufficient effort and experience students did learn. Students who were engaged in mathematics, and therefore taking responsibility for their learning, made them proficient in mathematics (National Research Council, 2003, p. 14).

Summary

Evidence of the need to change was obvious as can be seen on the Figure 1, WASL Seventh Grade Math: Percent of Students by Level. Each year Toppenish Middle School's seventh grade math WASL scores were not increasing adequately as set forth by OSPI (OPSI Website).

According to Figure 1, WASL Seventh Grade Math Percent of Students by Level, the 2001 scores as compared to the 2002 scores had only increased by one percent. Toppenish Middle School during the 2001-2002 school year was now in Step 1 of the school improvement plan. Then the scores did increase by ten percent from the 2002 scores as compared to 2003 scores, but TMS in 2002-2003, had to meet AYP twice in a row before it would be out of Step 2 of the school improvement plan. The following year, 2003-2004, the scores increased by nine percent, one percent short of meeting adequately yearly progress. Now TMS was in Step 3 of the school improvement plan. Then the following year, 2004-2005, things got worse. The scores dropped twelve percent and definitely not meeting AYP again for the third year in a row. Now TMS was in Step 4 of the school

improvement plan. The following year 2005-2006 things looked better. The scores had increased by two percent, but still not enough to meet AYP. By the 2006-2007 school year Toppenish Middle School (TMS) was in step 5 of the school improvement plan. This was the last year the state would give TMS to improve it's scores. If something was not done the consequences could be devastating. This included getting rid of all faculty members and administrators at Toppenish Middle School.

Mathematics educators had been called to teach math in a different way through problem solving using math communities in their classrooms. Explaining and questioning mathematical thinking, expressing sources of mathematical ideas, and taking responsibility for mathematical learning were the three important components for establishing math communities in the classroom. As it was stated in *Principles and Standards for School Mathematics* (2000), "Solving problems is not only a goal of learning mathematics but also a major means of doing so . . . . By learning problem solving in mathematics, students should acquire ways of thinking, habits of persistence and curiosity, and confidence in unfamiliar situations," (Journal for Research in Mathematics Education, 2000,p. 2). Thus through rich problem solving discussions in the classroom, students would have naturally learned to acquire ways of thinking strategically in all situations and in turn prepared them to compete in a global economy.

# CHAPTER 3

## Methodology and Treatment of Data

### Introduction

The purpose of the program was to encourage students to hold important math conversations. Students needed to develop their communication skills with one another, explain their mathematical thinking to one another not just to the teacher, explain their sources for their mathematical ideas, but most important students needed to start taking responsibility for their own learning.

### Methodology

Experimental method was used in this study. The design was non-equivalent groups. First period had 24 students and third period had 20 students. The sample used in the experiment was a convenient sample. The students were already in the author's first and third period math classes. The participants in the author's first period class were involved in math communities (the treatment group) for a period of six months. The author's third period class was not involved in math communities (the control group). All of the author's math students had taken the WASL in April of 2007. In September of 2007 WASL scores were released and these scores were compared to the 2006 math WASL scores. T-test for independent groups was used to compare the groups.

Participants

The participants in this study were seventh grade students in Ms. Ramos's math classes at Toppenish Middle School. This study focused on Ms. Ramos's first period math class and her third period math class. The first period math class was the manipulated group and did have math communities twice a month for six months. The third period class was the control group and did not receive math communities. Students were excluded from participation if they were receiving special education or English as a second language services, or did not complete all measures used in the study. Six percent of the students had scored at level four on the WASL. Seventeen percent of the students had scored at level three on the WASL. Twenty nine percent of the students had scored at level two on the WASL. Forty eight percent of the students had scored at level one on the WASL. Thirty eight of these students were bilingual with Spanish being their primary language at home, five were English only speakers, and one student's primary language was Pilipino. The sample of 44 students was predominantly Hispanic at 94%, with two percent White, two percent Native American, and two percent Pilipino. There were 24 students in the author's first period math class and 20 students in Ms. Ramos's third period math class. The distribution by gender was 57% female and 43% male. Most of the students came from low-income homes. All students were eligible for the free lunch program.

Some dealt with the added burden of their parents working in agricultural jobs to provide for their families; therefore, they missed a lot of school or did not have

the support or encouragement at home when it came to education. There were other students that come from stable homes but had language as a barrier. There were no students with serious disciplinary issues in the classroom.

Instruments

The data gathered for this project was the 2006 WASL math scores from the author's first and third period math classes and the 2007 WASL math scores from the author's first and third period math classes. Statistics used was the t-test for independent groups provided by the STAT pack from the book *Educational Research: Competencies for Analysis and Applications 8th Edition.*

Design.

In this experimental study, the WASL math scores from 2006 from first and third periods were compared to see if there was a significant difference between them. These two classes were non-equivalent groups. Also, the Washington Assessment of Student Learning (WASL) math scores from 2007 from first and third period were compared to see if there was a significant difference between them.

The author then compared the significance of the WASL math scores in 2006 to WASL math scores in 2007. The author then used the results to see if the first period math class did better than the third period math class or if there was not any significance in their scores.

Procedure

The researcher focused on the seventh grade math classes in the Toppenish School District. The author included Ms Ramos's first period math class and her third period math class in her study. First period was the manipulated group and third period was the control group. Math communities were organized by Carmen Gonzalez, Toppenish School District K-12 Mathematics Director. Math communities were active in the classroom twice a month from October 2006 through March 2007. The participants were organized in six groups of three to four per community member. Community members included two counselors, a math coach, an assistant principal, a drug intervention specialist, and a Gear Up assistant. Each participant solved WASL item released four point problems which took approximately 10 to 15 minutes. A community member prompted the students to have a math conversation which took approximately 10 to 15 minutes. They prompted the students to say as much as possible about how they acquired their solutions. In this way, the community members attempted to increase the degree to which students could articulate their math thinking and their solution processes. Students were informed that community members could not answer questions related to mathematical content or solution processes. If students could not resolve a math problem, then they were asked to give details on the difficulty they encountered in the problem.

Treatment of Data

In this quasi experimental study, the WASL math scores from 2006 from first and third periods were compared to see if there was a significant difference between them. Also, the WASL math scores from 2007 from first and third period were compared to see if there was a significant difference between them.

The author then compared the significance of the WASL math scores in 2006 to WASL math scores in 2007. The author then used the results to see if the first period math class did better than the third period math class or if there was not any significance in their scores.

The data gathered for this project was the 2006 WASL math scores from the author's first and third period math classes and the 2007 WASL math scores from the author's first and third period math classes. Statistics used was the t-test for independent groups provided by the STAT pack from the book *Educational Research: Competencies for Analysis and Applications 8th Edition.*

# CHAPTER 4

## Analysis of the Data

### Introduction

The purpose of the program was to encourage students to hold important math conversations. Students needed to develop their communication skills with one another, explain their mathematical thinking to one another not just to the teacher, explain their sources for their mathematical ideas, but most important students needed to start taking responsibility for their own learning.

### Description of the Environment

Toppenish School District had a 95.3% student population that qualified for free or reduced price meal lunch. Toppenish Middle School was predominately Hispanic at 79.5% and American Indian at 15.6%. Other special programs included special education at 9.6%, transitional bilingual at 39.7% and migrant at 15.4%. The districts total student population was 3,317. There were 176 classroom teachers with average years of teacher experience of 10.4 years (OSPI Website). There were four elementary schools, one middle school, and two high schools. At the middle school the author's math classes were the focus of this study.

Hypothesis/Research Questions

Under the No Child Left Behind Act, American schools were required to prepare students to meet certain academic standards. In the state of Washington that standard was the Washington Assessment of Student Learning.

One of Toppenish Middle School's remedies was to introduce math communities into the morning seventh grade math classes. Therefore students who participated in math communities did better on the mathematics portion of the WASL exam than students who did not participate math communities.

Null Hypothesis

Math communities were not used in the author's third period math class. Therefore students who were not participants in math communities did not perform significantly better on the math portion of the WASL.

Results of the Study

Table One showed the author's 1st period and 3rd period WASL (Washington Assessment of Student Learning) scores. Column two and six showed the 2006 WASL results for 1st period and 3rd period consecutively. Colum three and seven showed the 2007 WASL results for 1st period and 3rd period consecutively. Column four and eight showed whether the WASL scores increased from the 2006 WASL scores to the 2007 WASL scores. 1st period and 3rd period were non equivalent groups.

Table 1

| 1st Period | 2006 WASL | 2007 WASL | Score increased? | 3rd Period | 2006 WASL | 2007 WASL | Score Increased? |
|---|---|---|---|---|---|---|---|
| Student 1 | 359 | 359 | no | | 440 | 464 | yes |
| Student 2 | 396 | 388 | no | | 375 | 378 | yes |
| Student 3 | 335 | 301 | no | | 365 | 383 | yes |
| Student 4 | 354 | 352 | no | | 389 | 429 | yes |
| Student 5 | 351 | 349 | no | | 393 | 388 | no |
| Student 6 | 379 | 370 | no | | 339 | 324 | no |
| Student 7 | 410 | 435 | yes | | 424 | 459 | yes |
| Student 8 | 342 | 356 | yes | | 291 | 324 | yes |
| Student 9 | 379 | 356 | no | | 339 | 349 | yes |
| Student 10 | 365 | 359 | yes | | 379 | 381 | yes |
| Student 11 | 408 | 432 | yes | | 391 | 403 | yes |
| Student 12 | 453 | 413 | no | | 391 | 375 | no |
| Student 13 | 359 | 362 | yes | | 372 | 342 | no |
| Student 14 | 415 | 381 | no | | 362 | 352 | no |
| Student 15 | 335 | 345 | yes | | 345 | 365 | yes |
| Student 16 | 401 | 406 | yes | | 357 | 352 | no |
| Student 17 | 379 | 401 | yes | | 405 | 400 | no |
| Student 18 | 362 | 333 | no | | 348 | 352 | yes |
| Student 19 | 415 | 454 | yes | | 345 | 375 | yes |
| Student 20 | 372 | 375 | yes | | 377 | 381 | yes |
| Student 21 | 367 | 383 | yes | | | | |
| Student 22 | 386 | 421 | yes | | | | |
| Student 23 | 401 | 435 | yes | | | | |
| Student 24 | 335 | 314 | no | | | | |

Table 2

| Statistical Analysis of Data<br>1st period t-test for independent samples for 2006 WASL scores | |
|---|---|
| **Statistic** | Values |
| **1st Number of Scores in Group X** | 24 |
| **Sum of Scores in Group X** | 9058 |
| **Mean of Group X** | 377.42 |
| **Sum of Squared Scores in Group X** | 3439220 |
| **SS of Group X** | 21179.83 |
| **3rd Number of Scores in Group Y** | 20 |
| **Sum of Scores in Group Y** | 7427 |
| **Mean of Group Y** | 371.35 |
| **Sum of Squared Scores in Group Y** | 2779107.0 |
| **SS of Group Y** | 21090.55 |
| **Degrees of freedom** | 42 |

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\frac{ss_1 + ss_2}{n_1 + n_2 - 2}\right)(1/n_1 + 1/n_2)}}$$

$$t = \frac{373.25 - 378.333}{\sqrt{\left(\frac{-3000000 + 36383.33}{24 + 24 - 2}\right)(.042 + .042)}}$$

$t = ".63$

Table 3

| Statistical Analysis of Data<br>1st period t-test for independent samples for 2007 WASL scores | |
|---|---|
| **Statistic** | Values |
| **1st Number of Scores in Group X** | 24 |
| **Sum of Scores in Group X** | 9080 |
| **Mean of Group X** | 378.33 |
| **Sum of Squared Scores in Group X** | 3471650.0 |
| **SS of Group X** | 36383.33 |
| **3rd Number of Scores in Group Y** | 20 |
| **Sum of Scores in Group Y** | 7576 |
| **Mean of Group Y** | 378.80 |
| **Sum of Squared Scores in Group Y** | 2897770.0 |
| **SS of Group Y** | 27981.20 |
| **Degrees of freedom** | 42 |

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\frac{ss_1 + ss_2}{n_1 + n_2 - 2}\right)(1/n_1 + 1/n_2)}}$$

$$t = \frac{371.35 - 378.8}{\sqrt{\left(\frac{-131790.45 + 27981.2}{20 + 20 - 2}\right)(.05 + .05)}}$$

$$t = -.04$$

Findings

The researcher examined the statistical analysis of the data. The t-test for independent samples for the 2006 Washington Assessment of Student Learning (WASL) scores for first and second period classes resulted in a t-value of .63. A t- value of .63 meant that there was no significant difference in the scores between first period students and third period students.

The t-test for independent samples for the 2007 WASL scores for first and second period classes resulted in a t-value of -.04. Again a t- value of -.04 meant that there was really no significant difference in the WASL scores between first period students and third period students. The negative scores meant that first period students who did receive the treatment were slightly behind the students in third period who did not get the treatment.

The researcher then compared the t-test for independent samples for the 2006 WASL scores of .63 and the t-test for independent samples for the 2007 WASL scores of -.04. There was not a significant difference in the t-test values.

Given the analyzed data, students who participated in math communities did not do better on the mathematics portion of the WASL exam than students who did not participate in math communities. Therefore the null hypothesis was accepted and consequently there was no support for the hypothesis.

On the other hand, math communities were not used in the author's third period math class. The author's third period class did slightly better on the WASL exam than the author's first period class. Therefore students who were not participants in math communities did not perform significantly better on the math portion of the WASL. The null hypothesis was accepted. There was no significant difference in the performance of third period as compared to first period even though third period slightly performed better on the WASL exam.

Discussion

The outcome of the results were the null hypothesis was not accepted and the hypothesis was not supported. The researcher had found that math communities did not make a significant difference in the Washington Assessment of Student Learning (WASL) scores. This could have been because the 2006-2007 school year was the first time the author had utilized math communities in her classrooms. Also all persons involved in the math communities had done this for the first time and they were not teachers, but members of the community, administrators, counselors and classified staff.

Summary

The researcher compared the t-test for independent samples for the 2006 WASL scores of .63 and the t-test for independent samples for the 2007 WASL scores of -.04. There was no significant difference in the t-test values.

Given the analyzed data, students who participated in math communities did not do better on the mathematics portion of the WASL exam than students who did not participate in math communities. Therefore the hypothesis was not supported.

# CHAPTER 5

## Summary, Conclusion and Recommendations

### Introduction

Under the No Child Left Behind Act, American schools have been required to prepare all students to be successfully educated in order to compete in a global economy (U.S. Department of Education Website). As a result the state of Washington has introduced the Washington Assessment of Student Learning , the Essential Academic Learning Requirements , and the Grade Level Expectations for reading, math, writing and science (OSPI Website). Students must have meet standards in reading, writing, math, and science by passing the WASL. Washington schools were obligated to make sure all students met these standards (OSPI Website). Conditions and consequences were made through all levels of public education in the state of Washington. The conditions were that all Washington schools must meet Annual Yearly Progress in math, reading, and writing (OSPI Website). The consequence were if schools did not meet Annual Yearly Progress targets in math, reading, and writing for two consecutive years then they would have entered the step one of the school improvement process

### Summary

Toppenish Middle School (TMS) was in step five in 2006-2007school year of not meeting adequate yearly progress. Toppenish Middle School was now required to implement a restructuring plan. A significant change needed to take place. A small part of that change was math communities.

Evidence of the need to change was obvious as can be seen on the Figure ~~One~~ 1, WASL Seventh Grade Math: Percent of Students by Level. Each year Toppenish Middle School's seventh grade math WASL scores were not increasing adequately as set forth by OSPI (OPSI Website).

The following question was considered when the researcher looked at the purpose. What did Toppenish Middle School do to help increase math WASL scores? After having attended a training with Lucy West the researcher found that in order for students to get a deeper understanding of math problems students needed to learn how to do four things. One was students needed to articulate their mathematical thinking. Another was students needed to learn how to ask well thought out questions regarding math problems they were having trouble with. Students also needed to find and use different sources of mathematical ideas. And lastly, but most important was students needed to take responsibility for their own learning. The best way to have accomplished this was to use math communities in the classroom.

One of Toppenish Middle School's remedies was to introduce math communities into the morning seventh grade math classes. Therefore students who participated in math communities did better on the mathematics portion of the WASL exam than students who did not participate in math communities.

Math communities were not used in the author's third period math class. Therefore students who were not participants in math communities did not perform significantly better on the math portion of the WASL.

To have begun establishing a math classroom community among students and teacher, the teacher needed to build a math talk learning community or a community where students helped one another's learning of math by having engaged themselves in very meaningful mathematical dialogue. There were four targets in the math talk learning community structure that established important mathematical dialogue. These four targets were mathematical questioning, explaining mathematical thinking, expressing sources of mathematical ideas, and taking responsibility for mathematical learning.

The purpose of the program was to encourage students to hold important math conversations. Students needed to develop their communication skills with one another, explain their mathematical thinking to one another not just to the teacher, explain their sources for their mathematical ideas, but most important students needed to start taking responsibility for their own learning.

Conclusion

The researcher compared the t-test for independent samples for the 2006 WASL scores of .63 and the t-test for independent samples for the 2007 WASL scores of -.04. There was no significant difference in the t-test values.

Given the analyzed data, students who participated in math communities did not do better on the mathematics portion of the WASL exam than students who did not participate in math communities. Therefore the hypothesis was not supported and the null hypothesis was accepted.

Recommendation

The researcher had found that math communities did not make a significant difference in the Washington Assessment of Student Learning (WASL) scores. This could have been because the 2006-2007 school year was the first time the author had utilized math communities in her classrooms. Also all persons involved in the math communities had done this for the first time and they were not teachers, but members of the community, administrators, counselors and classified staff. The researcher recommends to give persons involved in math communities more intense training and these persons should also have a few years experience working with students in math communities. The researcher also recommends continuing math communities for a few more years in the author's classrooms.

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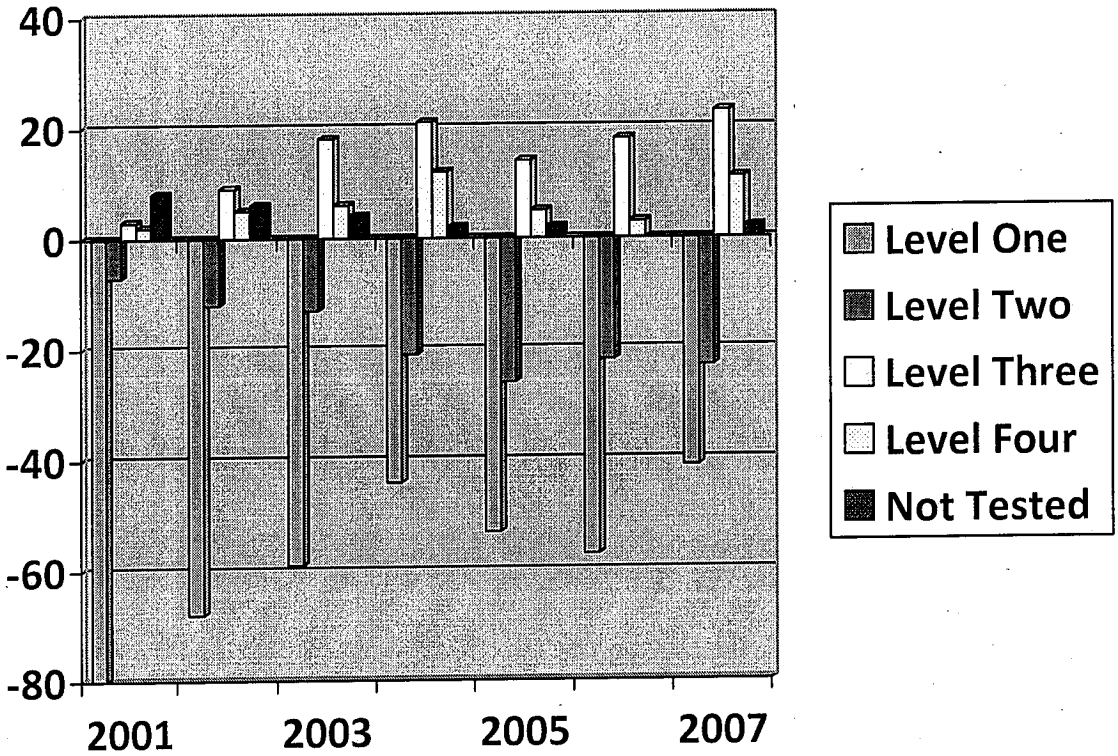


Figure 1:

WASL 7th Grade Math: Percent of Students by Level