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# Math in the George Middle School

Tiffany D. Lothrop

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## Abstract

*In this action research study of my classroom of 7th grade mathematics, I investigated uses of technology in my classroom essential in teaching and learning middle school mathematics. I explored how to enhance student involvement in learning and how to use problem-solving activities to build new mathematical knowledge, to applying knowledge and to adapt a variety of appropriate problem-solving strategies to daily life, AYP and STARS standards. I discovered that about 80% of the students reported that they liked having technology used in their math classroom, and that they feel more confident when problem solving in math with the use of technology. I found that the percentage of students mastering each standard had increased an average of 20% over the previous year. The percentage of students who felt good about themselves when they solved a math problem and said they liked math went up. As a result of this research, I plan to create a classroom that investigates and discusses how to solve problems in a collaborative environment using technology to support their growth and share that knowledge with teachers in my district.*

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## Introduction to Study

George Public Schools is located in the southeast part of the state of Nebraska. The population of George is approximately 6,000 people with approximately 1,400 students enrolled in the public school system. There are currently three schools that make up the district; they are the George Elementary for kindergarten through fifth grade, George Middle School for sixth through eighth grade, and George High School for ninth through twelfth grade. There are three class one districts (elementary only) and a Catholic private school within our district. The students at George Middle School will be the focus of my study.

George Middle School is located in the northeast quadrant of George. The district consists of lower to middle class residents. The seventh and eighth grade students are on teams of five teachers. The teacher teams include math, science, language arts, social studies and P.E./Health. The core teachers teach five class periods of their core subject, one period of advisory time called Homebase, one period of team planning and one period of personal plan time. There is one special education teacher for both grade levels. There is one English Language Learner (ELL) teacher for grades six through eight. The sixth grade is in two teams. One team is two teachers with 50 students and the other team is three teachers with 75 students.

The purpose of this study is to create techniques to incorporate technology into the 7th and 8th grade math classes to improve instruction and annual yearly progress (AYP). The purpose is also, in the 7th grade classroom, to incorporate problem solving, and in the 8th grade classroom, to incorporate test preparation and test taking skills and to share with 5th – 8th grade math teachers to help with curricular alignment and School-based Teacher-led Assessment Reporting System (STARS) Testing. We will create a curriculum and a pacing packet for each grade level with skills students need to learn for mastery at their grade level for the 8th grade STARS standards. We will create STARS standards tests for each grade level to support the learning of important mathematics at each level. We will also develop test preparation and test taking skills for these tests. We will create uses of technology in our classrooms essential in teaching and learning middle school mathematics and enhancing student involvement and learning. We will develop problem-solving activities to build new mathematical knowledge, apply knowledge, and adapt a variety of appropriate problem-solving strategies to daily life, AYP and STARS standards. We will create curriculum guides for all current and future teachers with the 8th grade standards as the outcome of their teaching. The curriculum guide will contain exactly which concepts are being taught, learned and mastered at the 5th – 8th grade levels. We will also be adopting new math textbooks for the next school year that reflect our new alignment and curriculum.

## Research Questions

The current state of our classroom is about 125 students per grade level who have had up to 12 – 15 different 6th grade math teachers and one level of math at the 7th grade level. From conversations with students there were lots of different topics covered and lots of different depth levels and techniques used through 6th grade.

The results of the study gave teachers in 5th and 6th grade classrooms a list of concepts to be taught at the same depth using similar teaching and problem-solving techniques. For the students, this will create continuity and stakeholders in 8th grade standards and AYP throughout the 5th through 8th grade years. Techniques of how the curriculum is presented using technology to improve instruction were created. Knowledge of problem-solving techniques, test preparation, and test taking skills for testing, AYP and STARs were also given to the 5th through 8th grade teachers. This will also involve and create stakeholders in the 5th and 6th teachers with the STARS and AYP testing.

## Literature Review

At George Middle School, we study and discuss adding, subtracting, multiplying and dividing rational and irrational numbers, geometry, and algebra topics in a hope that our students can translate these skills to other subjects that they learning about. We hope that the students will eventually become better problem solvers and develop critical thinking skills to apply this knowledge to real-life situations. The question is if this information is developing into critical thinking and problem-solving skills and whether we are doing enough to develop the skills needed to translate this knowledge to real-world applications.

Many different mathematics teachers and researchers have studied and stressed that problem-solving skills are an important part of a student's mathematical experiences. The National Council of Teachers of Mathematics (NCTM) includes this basic idea in many different standards such as mathematics as problem solving, mathematics as reasoning, mathematics as connections, and mathematics as communication (NCTM, 2000). In Nebraska, problem solving is included in Standard 8.2 Computation/Estimation with four of the strands including problem solving, and strand 8.2.2 which states that students will identify the appropriate operation and do

the correct calculations when solving word problems as our state's adequate yearly progress (AYP) (NSBE, 2000).

Researchers stated many positives from their studies of problem solving in their classrooms such as: using problem solving to teach traditional algebra topics such as graphing, exponents, slope; and introduction to variables to help improve our students' attitudes toward Beginning Algebra. The most important to most teachers is not hearing the question of "Why do I need this?" by the students (Hofmann & Hunter, 2003). Students focus on finding an answer rather than trying to understand the mathematical processes and ideas that are needed in problem solving and by using more complex and real-life problems that would enhance their mathematical reasoning (Hekimoglu, 2004).

Many researchers discuss the positive results of having collaborative problem-solving groups. The use of collaborative problem solving, within daily curriculum, affects individual mathematical problem-solving abilities by reminding group members of errors, rethinking processes and discussing about reasonable solutions (Wu, 2000). The use of collaborative problem-solving activities within the classroom setting can also help students understand the importance of how people can solve a problem using a variety of methods and strategies (Coy, 2001). Students' preference for working in pairs or triads to discuss the problem to be solved between themselves and with the teacher was another finding (Ursini, Orendain, Sanchez, & Butto, 2001).

One group of researchers stated that the use of technology within their curriculum not only enhanced the learning, but increased student involvement in the problem. The use of technology allowed their students to be more creative in their process, to defend their thinking, and to be willing to look for other ways to solve a problem (Ursini, Orendain, Sanchez, & Butto,

2001). Technology also brings the information and topics into real-life situations that students will be experiencing themselves. Students today are surrounded by technology. Schools need to reflect what is happening outside of their walls. The more technology and problems that the students can connect to their own lives and background knowledge will then translate into a new knowledge base for them to solve future problems (Coy 2001).

Hekimoglu (2004) stressed that to determine a student's learning and thinking process, the researcher must implement well-developed teaching experiments to allow students to explain their responses and mathematical thinking. At the end of their research, all the researchers stated changes that would have helped determine their students' learning and thinking process better. These are all things that must be thought of and carefully planned before starting a teaching experience so that the information needed to determine the influence on the students' learning and thinking process can be collected.

## Research Design/Methodology

This is qualitative research on a class of students at George Middle School. My responsibilities will be to plan, study and implement problem-solving strategies and the use of technology in the seventh grade classroom. I will be conducting the research but I will also be designing and implementing the problem solving and technology as the teacher.

### Plan to Gather Information

Some of the fifth and sixth grade teachers from the George district will be interviewed. Interviews will focus on their perceptions of areas of student weaknesses in math, math content they focus on at their grade levels, and what they want students to already know before entering their grade levels. The interviews will be audiotaped for purposes of data collection. All students will complete a mathematics attitude and self-assessment survey during math class in

February and April, taking approximately 10 minutes each time. A weekly journal will be keep to document the observations of the learning and attitudes of students during lessons involving technology, problem solving, test preparation and test taking skills from February 1, 2006, until April 1, 2006. The class will be videotaped approximately four times during the research period. The videotapes will not be shown publicly. STARS standards reported data for this current class would be collected and compared to the previous two years' classes. Data will be viewed in aggregate form (percentages of students ranked as proficient for each state standard). The students chosen as research participants are those in the 7th grade math class and the 8th grade regular math class because these are students of average and below average math ability who typically have little exposure to problem-solving experiences that enhance their abilities to think and communicate mathematically; they also have poor test taking skills. They are students who we, as their teachers, perceive to be most at risk when taking formal standardized assessments with problem-solving questions or sections.

In February, records of types of technology that were used and a journal of thoughts in selecting lessons and activities using technology were recorded. A student survey was administered about their feelings regarding problem solving. A student survey/questionnaire about technology in the classroom was administered. Lessons were videotaped involving technology and problem-solving activities.

In March, records of types of technology used and a journal of thoughts in selecting lessons and activities using technology were recorded. Lessons were videotaped involving technology and problem-solving activities.

In April, records of types of technology used and a journal of thoughts in selecting lessons and activities using technology were recorded. A student survey was administered about

the students' feelings regarding problem solving. A student survey/questionnaire about technology in the classroom was administered. Lessons were videotaped involving technology and problem-solving activities. The standards test 8.2.2 (AYP) about problem solving was also administered.

In May, the surveys were tabulated. Interview data was reviewed and index cards were formulated from the data. Videotaped lessons involving technology and problem-solving activities were reviewed and index cards were formulated from the data. All information gathered was analyzed and sorted by overlying themes or comments that are common between all informants and data collected.

## Plan to Analyze Information

As the data I obtained about problem-solving techniques and technology uses in the classroom was analyzed, I looked for themes that appeared throughout the informants. I looked for the following trends by: (a) students responses on green index cards, (b) comments from teachers on yellow index cards, (c) data from videotapes of lessons on blue index cards, (d) records of types of technology used in selecting lessons and activities using technology on pink index cards, and (e) journal of teacher thoughts in selecting lessons and activities using technology on white index cards. The index cards were then sorted by overlying themes or comments that are common between all informants and data collected. After classifying and sorting comments, I concluded that technology integration in the mathematics curriculum does lead to improved academic achievement; students can become better problem solvers by working collaboratively and use self-assessment to determine if they have chosen effective problem-solving strategies.

## Analysis

As I have been doing more PowerPoint presentations during class for notes and review of sections, I have been able to walk around to see what the students are writing. I have also been able to give some students one-on-one help with problems. I had one student who had been gone the day before and while the others were at the board working out the problem I could click up the next step for them while I was able to talk to this student and work through questions they had about what we were doing. The other students were still involved because I could click up the next step without leaving the student I was helping or making the other students wait for me to finish talking with that student to go to the board to write out the next step. This has been the biggest benefit for me as a teacher - being able to walk around to see how students are working out the problems and helping each student individually. I believe that I am being a better teacher by having that ability. Blank nods that students understood what we were discussing in class was the only clue I could get if they did not understand, unless they asked me a question. Now, I can see what they are doing and help them understand, not just have them erase what they did and copy what I have.

I also believe I have everyone involved in the learning. When I am at the board writing things down the whole time, I think that students are not as involved in the lesson. When I am walking around and checking to see how they are working the problems as I click up the next step, then students have a little higher stake in their learning. This will allow me along with the Special Education teacher in my room this class period, to help each student, which includes my English Language Learners and Special Education students, with the problems. This also helps keep all students focused on their learning.

In the measurement, perimeter and area unit, we did not do a lot with any technology. We were using rulers most of the time; the state standards tests require these students to be able

to measure in tenths of a centimeter and eights of an inch. My wireless mouse has also quit working. I have tried ordering a presenter mouse. The district has said that I have to wait until next year's budget to buy a new presenter. The effectiveness of my PowerPoint presentations in class has decreased significantly, since I am no longer able to continuously walk around the classroom while the students are working the problems out. I have to walk back to the table by my computer to click the next step to show up on the screen. Up until this point, the PowerPoint presentations have been a very effective tool for me as a teacher to individually work with each student in my classroom this year. I have never felt so involved and connected to what and how the students are actually working problems out in my classroom. I am looking forward to having this tool back for next school year.

About 80% of the students reported (Appendix E and F) that they liked having technology used in their math classroom and they feel more confident when problem solving in math with the use of technology.

I have been working to make students discuss a problem with their neighbor before I have them explain it to everyone. There are some very high ability students in this class and some students who really need some extra time to think through the process. Making the students share their ideas has helped with both ends. The high ability students (and one in particular), will sometimes shout out the answers before everyone has had the time to think about the problem. This student is always getting into trouble for shouting out answers, but when the student is given a time to share those ideas with a neighbor, there are not as many shout outs. Whom he sits by is very important, I have found. I thought that I would sit him by a lower ability student and he would explain how to solve it to them – not so! I had to sit him by another high ability student so that they could discuss/argue which process would be better. When he

was sitting by the lower ability student, he would just tell him the answer and not explain why. The lower ability student would just write the answer down, no questions asked.

We worked on some story problems about measurement and using proportions in groups. I really had to require them not to rush through the problems. When I first had them start I heard some groups start saying I will do the evens and you do the odds. I had to stop the whole group again. I put up the answers to all the problems on the board. I told them their goal was to work each problem together and show how they could get the correct answer that is on the board. The goal is how and to show the work they did to get there! This was a real issue with them. I also told them that it was not due that day and they got started again. This time when I walked around they were doing a lot better job of working together, asking each other what they think they should do, rethinking what they should do because what they did, did not give them the correct answer that was on the board.

I really think that giving them the answers was a good idea. My other classes had started the day before and I didn't give them the answers on the first day. On the second day for them and the first for my study group, they seemed to be thinking and rethinking how to solve the problems more since they knew where they needed to go. If they didn't get there, they were more willing to go back and rethink the problems. This is something I have done before. I really think that this is a worthy strategy for building problem-solving skills and to build confidence in their problem-solving abilities. This activity ended up being very productive and should probably be moved to the beginning of the year so they understand how best to work in groups and show their thinking on paper, not just find correct answers.

Students have taken four different standards tests involving lots of different types of story problems during this study time. Comparing the STARs data for this grade level compared to

last year's, the percentage of students mastering each standard had increased an average of 20% (Appendix B). From the surveys, I found that the percentage of students who said they are good at solving math problems dropped about 14% from the first survey to the second survey (Appendix G and H). I am not sure why this dropped, other than the level of difficulty of the problems they were solving toward the end of the year increased significantly. There was also a 10% increase to 70% of the students who liked working in groups on math problems; their choice of whom to ask for help if they got stuck was now the same for a friend and the teacher (Appendix G and H). It was great to see that they felt comfortable asking both the teacher and a friend for help and not be self-conscious about others knowing they didn't understand a problem. That was a huge hurdle for me to cross in my own learning too.

The most rewarding result I got from the students was that when asked if they felt good about themselves when they solved a math problem went from 36% to 70% of the students; the percentage that stated they liked math went from 60% to 74% of the students (Appendix E and F). Wow! This is a huge hurdle that teachers even recognize we have to overcome with our students. During the teacher interviews, this was stated by each teacher: an area of weakness is the students' attitudes about math and their confidence levels of their mathematical abilities were very low. The teachers gave some thoughts about why this is: those students did not see the application to their lives; the curriculum being an inch deep and a mile wide; and, ability grouping with "low groups." The teachers all expressed the thought that ability grouping should be just on grade level groups with maybe one high ability group for every grade level. They all stated that inconsistency between teachers at each grade level adds to this confusion as the students then move grade levels and mix into different groups of students.

## Interpretation

This study has shown me that problem solving is very important to helping students see the application of mathematics to their own lives and to help prepare them for their future. A focus on learning the basic facts and then applying them gave students an understanding of how to use math and of the importance of learning the math concepts. After interviewing the teachers, it is very apparent that we need to have more discussions about how best to present problem solving and skills or tools that students can use to solve them within our own district. We need to go into each other's classrooms to see how each of us teaches the math concepts and how students are best learning those concepts.

The use of technology with in our classroom is very important with letting the students see where math can take them, while also using it to teach them mathematical concepts. The one drawback is always the reliability of the technology. This will not stop me from finding another way to get those experiences to my students.

This next year, with our new curriculum, I am going to start the year off with teaching and directing the students to see the benefits of working in groups to solve problems while looking for other ways to solve that same problem. These steps will hopefully lead to better learning and understanding of mathematics.

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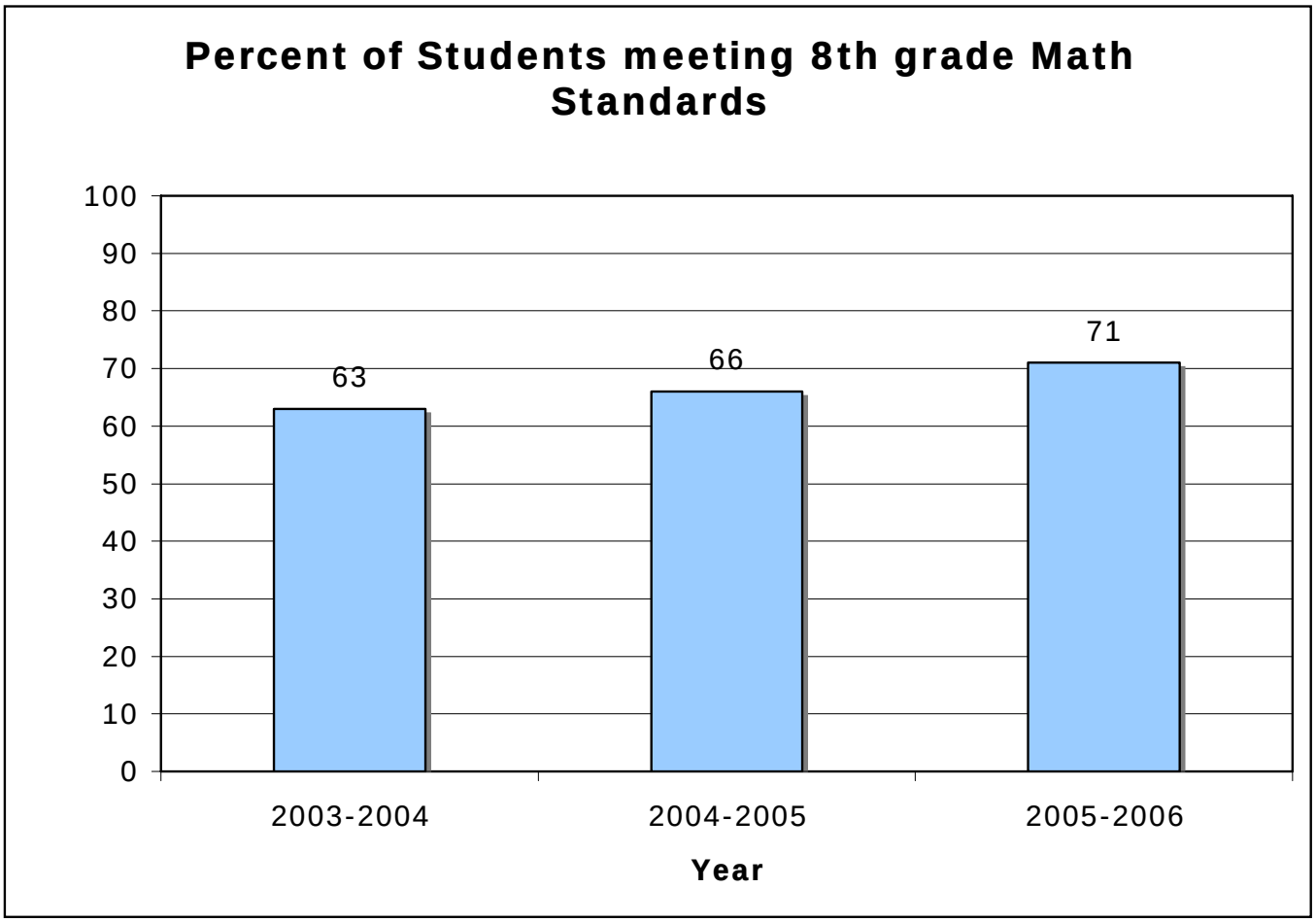
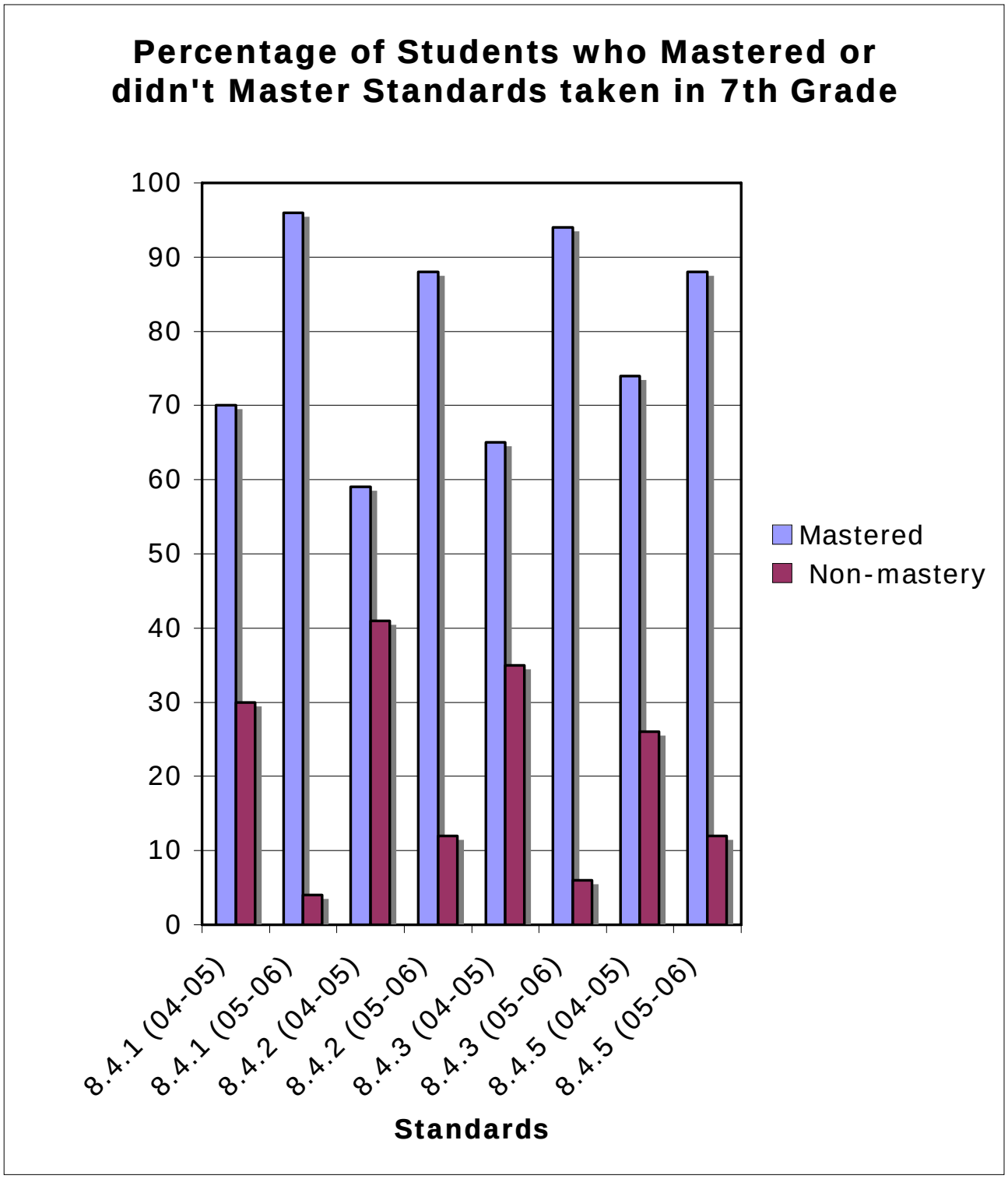
# Appendix

## Appendix A


Percent of Students meeting 8th grade Math Standards
100
90
80
70
60
50
40
30
20
10
0
63
66
71
2003-2004
2004-2005
2005-2006
Year

Appendix B

## Appendix C



# Math Attitudes Survey

DO NOT put your name on this survey. Please answer each question by putting an X in the box that best describes you.

SA – Strongly Agree
A – Agree
N – No Opinion
D – Disagree
SD – Strongly Disagree

| | Strongly Agree | Agree | No Opinion | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| I like math. | | | | | |
| I am good at math. | | | | | |
| I like working math problems on the board. | | | | | |
| I like working in groups on math problems. | | | | | |
| I like working by myself on math problems. | | | | | |
| I like having technology used in math class. | | | | | |
| I am more confident when solving problems in math with the use of technology. | | | | | |
| I study the night before for a quiz and test in math for about: | 30+ minutes | 21 – 30 minutes | 11 – 20 minutes | 1 - 10 minutes | None |
| When I get stuck working a math problem, I ask for help from: | Friend | Class-mate | Family member | Teacher | No One |

Appendix D

# Self Assessment Survey

DO NOT put your name on this survey. Please answer each question by putting an X in the box that best describes you.

SA – Strongly Agree
A – Agree
N – No Opinion
D – Disagree
SD – Strongly Disagree

| | SA | A | N | D | SD |
|---|---|---|---|---|---|
| I know how and where to start when I am solving math problems. | | | | | |
| Solving math problems is fun. | | | | | |
| Solving math problem is important. | | | | | |
| My goal when solving math problems is to get the correct answer. | | | | | |
| I feel good when I solving a math problem. | | | | | |
| Solving math problems helps me understand why I have learned certain math concepts. | | | | | |
| I am good at solving math problems. | | | | | |
| On average, how much time do you spend on math homework each day? | 30+ minutes | 21 – 30 minutes | 11 – 20 minutes | 1 - 10 minutes | None, I get it done at School |
| It is easier to solving math problems in my head or on paper. | Only in my head | Mostly in my head | Not sure or both equally | Mostly on paper | Only on paper |