ACCELERATED MATH IMPLEMENTATION AND ELEMENTARY STUDENT ACHIEVEMENT AND ATTITUDES

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ABSTRACT

The purpose of this evaluation is to show how Accelerated Math implementation affects student achievement and attitudes towards mathematics. Accelerated Math is a computer based curriculum management program. The program provides both the teacher and student with a database of math practice, testing, and intervention. This study looked at teacher and student attitudes in relation to student achievement, with respect to math success in students. It also looks closely at effective levels of proper implementation through professional development of the program and those effects on student achievement. Surveys were taken and End of Grade standardized test results of third and fourth grade students were compared in order to determine the impact of the program on student achievement. It was found that students in the group who spent much more time using the program scored lower on standardized tests, as students in another group who used the program as a less significant compliment to their instructional program scored higher. Teachers in both groups had a similar lack of training and information about the program during it original implementation in their school. Student attitudes were positive about math ability and achievement during the use of Accelerated Math.

DEDICATION

This thesis is dedicated my husband who has been endlessly supportive and understanding during my graduate school experience. I also would like to thank my parents who were my first and most influential educators in my life. Without them my graduate career would have never begun.

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INTRODUCTION

The purpose of this program evaluation is to show how the various levels of implementation and fidelity to Accelerated Math affect student achievement and student attitudes towards mathematics. Accelerated Math is a computer based curriculum management program. Its success is determined by teacher training, a required amount of computer equipment, and also technology support after implementation. The program provides both the teacher and student with a database of math practice, testing, and intervention. The pace of the learning and mastery is determined by the student's own ability and speed.

The Accelerated Math Program was an idea that developed from the historical issues that surround poor academic math achievement in the United States. Several studies were conducted and those studies produced Evidence Based Instructional Practices that were noted to have a higher probability of encouraging student success (Advantage Learning Systems, 1998). Accelerated Math by Renaissance Learning was developed with these standards and practices in mind in 1998. This program was developed with intentions of incorporating many of the successful strategies promoted in the Evidence Based Instructional Practices as platforms for success (Advantage Learning Systems, 1998). It was first piloted in a handful of schools to determine success. These schools reported that teachers agreed that their students are more confident, they progress through topics quicker, and that they are more motivated to work (Accelerated Math Pilot Schools Report, 2000).

Accelerated Math is a computer-based program designed to pinpoint the individual skills and goals students must achieve. It allows students to work at their own

individual pace and track their own progress through the program. Accelerated Math (AM) is a curriculum based instructional management system that is intended to enhance math achievement, not teach math curriculum. It allows students to tailor their current AM assignments to their own goals with unlimited practice assignments. Then the program gives the student instant feedback once the assignment has been completed and helps students correct their mistakes. While doing this for the students, the program helps the educator follow the mastery of goals of his/her students through reports generated in the management system.

This program requires teacher training and support for both implementation and use of the computer equipment. Since it is computer driven the program also requires sound technology support in order for it to be successful on a daily basis. This involves both the classroom teacher and who ever supports technology within a school.

There are three main goals of Accelerated Math, as stated in Renaissance Learning's Accelerated Math Workshop Manual (Advantage Learning Systems, Inc. (1998). The goals are to motivate every student to succeed, to make teaching more effective, and to improve standardized test scores. These goals are met by objectives that are centered around generating unlimited practice assignments, giving immediate and individualized feedback to the students, letting educators know which objectives are being mastered, automatically scoring student assignments, and allowing students to move at their own pace.

The essential elements of the program, as described by Renaissance Learning are appropriate math practice, learning information systems, math motivation system, and to motivate, instruct, monitor, and intervene. Through implementing these essential

elements several results are intended to occur. The Accelerated Math Program results include printouts of individualized practice assignments and tests for each student. It scores practice assignments and tests automatically. AM prints individual and class reports that help educators plan, monitor, and follow a prescribed six-step classroom process that includes individual student conferences with the teacher.

In education today, proving student growth and progress is becoming more important because initiatives such as No Child Left Behind and more emphasis on testing and accountability. The purpose of this evaluation is to determine the relationship between the implementation levels and fidelity of this data base math management program and the growth and achievement of elementary school students who are exposed to the program.

In the evaluation of Accelerated Math both quantitative and qualitative research sources are utilized. Specifically the qualitative resources include direct observations, open-ended survey questions, and both student and teacher attitude scales, and follow up questionnaires that were responsive to the research. These particular qualitative resources are used in order to allow for fiscally responsible research. The quantitative data research was conducted by using Likert Scale type surveys and End of Grade Test results. These sources provided data and numbers so that Accelerated Math's potential in testing and long-term scores could be evaluated. Specifically students who scored well on Standardized End of Grade tests were compared to students who did not score as well, all groups used Accelerated Math. Comparing them quantitatively with these available means identified the trends in test scores for both groups. The researcher created the

Likert Scale questions the other testing information while keeping the identity of the students confidential.

In chapter 2 of this study a review of the available literature is presented. Literature pertaining to The Accelerated Math program, data based management programs, implementation of professional development with new curriculum, and best practices are present. The literature shows that there is a gap in the research that has been completed in regards the implementation of Accelerated Math and teacher fidelity to the program. In chapter 3 the methodology is explained more thoroughly. Specific examples of qualitative and quantitative data are presented, as is specific information in regards to the comparison groups. More information about these instruments is found in chapter 4, which shows specific results and findings from the action research that is included for review. Chapter 5 includes the analysis and a discussion of the results for curriculum, instruction, and school leadership as well as possible implications on the field of Curriculum Instruction and Supervision.

REVIEW OF LITERATURE

Overview

The constantly changing world of education is facing a new challenge in the current age of technological advances. Education supervisors and administrators must determine how to balance the cost of large computerized learning information systems for their schools with the costs of implementation of these systems appropriately in the classroom. This balance must be achieved in order to provide for proper student outcomes through proper implementation and professional development (Electronic Education Report, 2003).

The literature review was created in a broad sense from the conceptual use of technology in education and then technology inclusion in regards to student learning. From the introduction of technology comes research about implementation. Following this, broad standards of staff development are laid out and examined. These standards pave the way for research regarding the proper application of staff development in schools. This research leads to a look at the impact of staff development on progressive schools and failing schools. Examples are shown through a case study highlighting where staff development brings an entire school system through a successful change process.

Introduction to Accelerated Math

The adaptation of computer technology into elementary classrooms is changing the face of elementary education dramatically. School systems are spending large amounts of capital on Learning Information Systems (LIS). One company dominates

these LIS systems at present, Renaissance Learning. This company holds over 34% of the shares in the LIS market in 2003 (Electronic Education Report, 2003). Renaissance Learning's prevalent math software system is Accelerated Math.

There are three main goals of Accelerated Math, as stated in Renaissance Learning's Workshop Manual. The goals are to stimulate every student to succeed, to make teaching more effective, and to improve standardized test scores. These goals are met by objectives that are centered around generating unlimited practice assignments, giving immediate and individualized feedback to the students, letting educators know which objectives are being mastered, automatically scoring student assignments, and allowing students to move at their own rate (Advantage Learning Systems, Inc. (1998).

Technology and Accelerated Math in Student Learning

The Accelerated Math Program was an idea that developed from the historical issues that surround poor academic math achievement in the United States. Several studies were conducted and those studies produced Evidence Based Instructional Practices that were noted to have a higher probability of encouraging student success (Forbash, 2001). However, the parent company and producer, Renaissance Learning, did most of the research that promotes AM. Accelerated Math by Renaissance Learning was developed with these standards and practices in mind in 1998 (Anomourlis, 2001). This program was developed with intentions of incorporating many of the successful strategies promoted in the Evidence Based Instructional Practices as platforms for success (Accelerated Math Pilot Schools Report, 2000). It was piloted first in a handful of schools. These schools reported that teachers agreed that their students are more

confident, they progressed through mathematical topics quicker, and that they are more motivated to work (Accelerated Math Pilot Schools Report, 2000).

Technology and Student Learning

Literature is divided and scarce in regards to the correlation between technology and student learning increases or decreases. Lemke and Sweeney (1999), in their research report on Wenglinksy's Educational Testing Service Study found that when computers replace activities that teach and reinforce low order thinking skills, such as those replacing traditional paper and pencil worksheets, student achievement drops. However the same study found that the use of computers to teach higher order thinking skills is positively related to student math achievement in eighth grade mathematics. However the question seems to be rarely asked if there is a correlation between achievement using electronic learning systems and the staff development of it during implementation.

Several studies have been completed as to the success of these LIS at various levels in math education. Positive changes in attitude and achievement have been noted (Tardrew, Yessedkyke, 2002; Gaeddert, 2001) without closely tracking implementation or training by the teachers implementing Accelerated Math.

Caperton and Papert (cited in Lemke and Sweeney, 1999, p.20) have posed this possibility:

> "The conversation about technology in schools is trapped in the wrong subject… The question should not be: Does the technology work as a fix for the old? It ought to be: How can we develop and choose visions that will use this immensely powerful technology to create and support powerful new forms of learning?"

Standards of Staff Development

Here the question is raised about how new strategies should be adopted in schools. In a program implementation requiring a great deal of capital to employ, is the money well spent on the technology and physical resources or on the implementation of staff development to support the resources and students? Furthermore, should implementation be based on the rate of the staff development success, rather than the installation of the software and hardware for the program? The NSDC Standards for Staff Development, revised in 2001, outline the context standards, process standards, and content standards for staff development. These are essential in adopting new teaching strategies in the classroom, whether computer based, or not. These standards were developed by the National Staff Development Council in collaboration with many national associations of school leadership and administration, representatives from higher education foundations, and school district staff members from across the country. The main focus of all of this that staff development improves the learning of all students (NSDC, 2005). In the three categories of standards, each has an intended result. Context standards are in place to address the organization, system, and culture in which the new learning will occur and be implemented. Process standards refer to the design and delivery of staff development. They describe the processes used to acquire new knowledge and skills. Content standards refer to the actual skills and knowledge that effective educators need to possess to produce higher levels of student learning.

Staff Development standards provide directions for implementing staff development but do not dictate how or when teachers and schools will achieve the level

of implementation, they are available to help ensure success. The standards were deemed necessary because too many schools and systems were implementing professional development that was not beneficial for their staff or students (Mizell, 2001). The staff development model presented by NSDC helps districts and schools have a clear and direct model, that is not regulatory, to implement sound professional development. The prerequisites of content, context, and process result in higher levels of learning for students, which is the overall goal of all educators. The new standards, written and released in 2001, focus on the standards that are most crucial and beneficial to providing high quality staff development that ultimately increases student learning (Mizell, 2001).

NSDC Standards for Staff Development describes a comprehensive system of professional development. This system involves sustained and consistent efforts of everyone in the organization from the school staff upwards through the hierarchy of school leadership (Roy, 2004). The standards assume that the school is a body of change and is the center of a push for change. A model for meaningful and sustained changed must include a collaborative, joint effort between administration, classroom teachers, and all involved in between (Roy, 2004). This joint collaborative efforts described in the standards is difficult to attain, but is worth attempts at emulation, especially in cases such as this where no staff development was implemented from the top or bottom of the administrative chain. Margaret Honey, director of the Center for Children and Technology in New York City. "Unless there is a concerted effort at the district level or building level so technology is used to support the local community's objectives, the use of technology will remain occasional" (Zehr, 1999).

Examination of Effective Technology Staff Development

One important piece of research looks at the importance of student-teacher relationships in regards to student motivation (Morgan, 2001). The researcher closely examines the gender differences in these relationships and how they influence differences in classroom attitudes and socialization. Only one other study has looked at gender differences in motivation. The sample in the Morgan study consisted of 54 male and 73 female 5th grade students, and 50 female and 50 male 6th grade students. Students were given different forms of feedback, related to similar assignments, and then asked to complete an interview, rather than a survey, to accommodate for variance in reading skills. The findings indicate that the feedback provided by the teacher created a difference in the students, based on their gender. Thus linking the needed for proper implementation through professional development in another realm of the classroom (Morgan, 2001).

From the research done in this case study it is apparent that the lack of staff development is evident in the teacher responses to the survey and follow up questions. There was no implementation of any staff development prior to implementation of the Accelerated Math program, certainly none following National Professional Development Standards. No teachers were formally trained in how to use Accelerated Math, thus contradicting the necessity of appropriate staff development during implementation of a new curriculum or program. The fact remains that most school policy makers do not know that a new vision for staff development, that is more hands on and useful was implemented in 2001. (Mizell, 2001) The standards for professional development must

be presented to systems, and then addressed for implementation in order for situations, like the one in this case study, to stop adversely affecting students.

One catalyst for thinking about the evolution of a successful district's effort in technology and staff development, in the fourth largest city in Washington State, Bellevue (Rockman, 1994). The school system has long had a history of working at the cutting edge of mainstream educational change. Bellevue has been recognized for 30 years as a district among the leaders of those creating the vision of dynamic, innovative schools. There are 28 schools in the Bellevue District with a teaching staff of about 850. About half of the size of the current school district where Accelerated Math is being implemented in this particular case study (Rockman, 1994).

The Bellevue school system has implemented a joint effort to improve technology use and professional development in their school system. In 1982 the School Board adopted a set of objectives for computer education, which was a huge step towards acceptance and implementation of technology at this point in history. During the advent of computer technology in the district, during the early 1980's, students used computers in many ways. Adoption of technology in the classroom and school computer labs was voluntary and training was provided for those teachers who sought it. In 1987 the school district funded a proposal to develop, model, and integrate technology rich classrooms in two elementary schools, as opposed to sending students out to a computer lab setting. The focus had an emphasis on site based planning, implementation of technology, and staff development. The goal was to shift from teaching of technology skills, not the learning of them by the staff. The outcome of this strong integration plan is that the district and its staff have created an effective and powerful model of implementing

technology through teacher learning. Bellevue adopted certain elements of their strong program. They are consistent philosophies shared by the educational community and supported from by the strong district leadership as well as the teachers on the implementation end of the spectrum. They are site-based staff development, evolution-not revolution, and flexibility by encouraging experimentation and sharing, planning through participation across schools in the district (Rockman, 1994).

Connections Between Staff Development and Implementation

Staff development is the bridge between the teacher and successful education change (Guskey, 1998). Strong professional development takes teachers from where they are now to where they need to be to meet the challenging call of guiding students to higher levels of learning and development. Both pre-service and in-service staff development requires a partnership among schools, higher education, curriculum providers, learning information system companies, and other appropriate groups who impact the learning and achievement of students (Guskey, 1998). The key here is strong, quality staff development that creates change. Educators can no longer operate under the assumption that all staff development is good and that more is better (Guskey, 1998). However, some research indicates that despite futile efforts to provide staff development that the isolation of the teacher is the key inhibitor to improving education. Sagor (1992) says that when teachers are involved in the preliminary research that equates to staff development they move out of isolation and into collegial relationships with their fellow teachers.

The evaluations of effectiveness of professional development and technology application are coexistent in schools where connections are made soundly. Coley, Cradler, and Engel (1999, P.2)) state, “evaluations of educational technology are really evaluations of instruction enabled by technology, and the outcomes are highly dependent on the implementation of the instructional design”. Thus leading this research to the connection between professional development and implementation. In a featured case study presented by the NSDC titled “Evaluation Professional Development” (Brown, etal. 2004), there is an illustration of how well designed professional development, that is delivered appropriately, contributes to improvement in both teacher and students. The value of professional development is examined for its significance in impacting skill, knowledge, and attitudes for the in service participants and the students they serve. The following table shows the balance and efficacy to used gauge sound professional development. This table demonstrates the cross reference between teacher and student impact in relation to learning, attitudinal, and resource impacts in regards to their interrelationship. This table (Brown, 2004) shows the evaluation of professional development must be two-dimensional in order to determine true impact. This table is a means to show connectivity between teacher and student impact through sound staff development.

Table 1 Teacher and Student Impact Through Staff Development

		Impacts	
Levels of Impacts	Learning	Attitudinal	Resource
Teacher Impact			
Student Impact			

The study examines both levels of impact thoroughly through tangible data of learning, attitude, and resources by using information gathered from both teachers and students. Thus, truly gauging the impact of proper and consistent professional development. Most states in the United States have adopted the Professional Development Standards of the NSDC. For instance, both South Carolina and Kentucky have adopted the Context, Process, and Content standards and published them on their state websites for consumption by the districts (Roy, 2003). South Carolina takes the standards further for their educators by including sample indicators of proficiency in implementation. Therefore districts and educators have access to guidelines for strong, thoughtful, and research based staff development (SCOPD, 2005).

The essential elements of the program, as described by Renaissance Learning are appropriate math practice, learning information systems, math motivation system, and to motivate, instruct, monitor, and intervene (Advantage Learning System, 1998). Through implementing these essential elements several results are intended to occur. The Accelerated Math Program results include printouts of individualized practice assignments and tests for each student. It scores practice assignments and tests automatically. AM prints individual and class reports that help educators plan, monitor, and follow a prescribed six step classroom process that includes individual student conferences with the teacher. This system is a specialized student data reporting system that provides for storage, tracking, and assessment of students by instructional objective and learning category (Electronic Education Report, 2003).

With large investments being made into these systems and their likenesses it is imperative to determine if the implementation of the systems alone are worth the costs or

if staff development and fidelity to implementation by teachers plays a role in the success.

Summary

An extensive look at research regarding Accelerated Math is impossible at this date because of its widespread adoption, which is one of the catalysts for this study. Limited research is available that was not completed or funded by the Renaissance Learning Company at present. This was taken into account when determining the topic of this study. The goal of this study is to add to the available research and to determine the results of implementation of Accelerated Math in an unbiased forum. One Action Research Project has however, research unaffiliated with Renaissance Learning in regards to elementary school student outcomes with Accelerated Math is difficult to attain.

The final outcome for all educators is the implementation of the best practices for teachers and students. This allows educators have standards for best practices in the classroom then professional development providers too should have a guide for best practices for implementation of staff development. The NSDC and the US Department of Education's Professional Development Team have defined these.

METHODOLOGY

Chapter three outlines the participants, instrumentation, and the design and procedure of the research that was conducted. The case study of this particular school is a learning tool for administrators and school leaders regarding the way many schools implement new programs, through pressure from their district. This school has a high population of students from poverty-stricken households with the overall free and reduced lunch population at 71%. This poverty risk increased before the research concluded. The student participants averaged 76% free lunch at the time of the End of Grade (EOG) Test Administration.

Implementation at of the Accelerated Math Program, by Renaissance Learning, at this school is the focus of this case study. The intended result is that this study will serve as a catalyst for an examination of the need for implementation of sound professional development in schools moving towards change. This school was given Accelerated Math by the school district to use in an Extension of Year program, implemented as a traditional summer school model. The teachers at the school did not originally use the program and were not required to work the summer school program, so the program was installed in their absence during the summer break. The software and hardware were originally installed in fifth grade classrooms and was subsequently implemented down through the grade levels the year after the summer school program in 2000.

The fifth grade teachers were provided no professional development as how to use the software and hardware that had been installed in their classrooms while they were gone over the summer. Those teachers, at the direction of their administration, went to observe another teacher in their same grade level who was using the program in his

classroom, in another school. This was the only training or professional development provided to the fifth grade teachers to implement the program and teachers were required to implement the program on their own. Subsequently, as the program worked its way into implementation in fourth and third, and then several years later, second grade classrooms the teachers who had experience with the program trained the others and shared the program manuals that accompanied the original software. As indicated earlier in previous chapters, no formal professional development was designed or presented at any grade level, in any year, to implement the program. Teachers relied on each other, support from outside resources, and their interpretation of the manuals to implement the program.

Participants

The data for this study was collected in a variety of ways. First, student test scores at a low wealth, Title 1 School were scrutinized for significant differences across grade levels. At the school 3rd and 4th grades were the two grade levels that had the greatest discrepancy in End Of Grade Test Scores. The students in these two grade levels were chosen as test groups because they did have the greatest variance in test scores, along with the most similar demographic information. This variance in test scores was the greatest in the school and this made looking at effects of the program more evident. Another consideration when choosing test groups was to pick grade levels that had similar demographics, such as race, gender, and socioeconomic variables. These two groups were similar demographically and the sizes of the groups were comparable.

Third grade math proficiency was rated at 85.9% while 4th grade math proficiency was at 100%. All levels of proficiency reported were determined by the Accountability Office of the North Carolina Department of Public Instruction and are based on mastery of concepts on the North Carolina End of Grade Test in Mathematics. A group with 100% proficient was significant because it was obvious that the students across the grade level had a firm grasp of the math concepts taught that school year, even if there was a slight margin of error in test score validity (which none has been reported). Both groups had an average of 76% free lunch. Third grade was comprised of three Hispanic students; 26 black students, 41 white students, and one multiracial student for a total of 71 students. Fourth grade was comprised of four Hispanic students; 27 black students, 31 white students, and one multiracial student for a total of 63 students. Thus, making the groups demographically similar and also comparable in size, with only a difference of 8 students in the size of the two groups. Finding two groups with the exact same demographics, within this same school was not possible for the purposes of our study. The following table shows the specific gender and racial breakdown of the two grade levels studied.

Table 2 Gender and Racial Breakdown of Third and Fourth Grade Students

	Hispanic Male	Hispanic Female	Black Male	Black Female	White Male	White Female	Mult Female	Total Male	Total Female	Total Students
3rd Graders	2	1	10	16	24	17	1	36	35	71
4th graders	2	2	20	7	17	14	1	39	24	63

Teachers in both 3rd and 4th grade were given a survey as well. Their survey also had attitudinal questions and information about training and implementation of the program. The same methods were used for administering the survey to the staff. Because of discrepancies in the survey answers across the grade level, which later was determined to be due to teacher error, a follow up questionnaire was administered to all 3rd and 4th grade teachers as a response to the discrepancies.

Instrumentation

The materials necessary for this study were the hardware and software necessary to implement Accelerated Math, The NC End of Grade Test in Mathematics for both 3rd and 4th grade, End of Grade Test Score Reports as provided by the NC Department of Public Instruction, Testing and Accountability Department, and student Lickert scale and teacher Lickert scale. The Lickert survey was composed of demographic information, implementation levels, and attitudinal questions. Follow up research was done using a questionnaire to help clarify the discrepancies reported in the original survey results. The appendices include copies of the surveys administered to teachers and students, in Appendix A and B, as well as a copy of the interview questions, in Appendix C.

Surveys given to both 3rd and 4th grade students were identical. The survey was one page and read aloud to all students when it was administered and the researcher gave the surveys to the students. The students were in a regular classroom with the researcher and main instructor monitored the classroom. Survey directions and questions were identical for all students in both grade levels. Most significantly, surveys and directions

were read aloud in order to maintain the comprehension level of the survey questions. This insured that students were able to answer the questions about the Accelerated Math program and were not concerned or hindered with reading and comprehending the survey questions. Demographic information was included such as grade level and use of the Accelerated Math program. Implementation perception was also included where students reported the number of times a week they used Accelerated Math and how they used it. All of these questions were multiple choice and students circled the answer themselves during administration. There were six attitudinal questions with a choice of five response levels: *Strongly Agree, Agree, Do Not Know, Disagree*, and *Strongly Disagree*. Five was representative of *Strongly Agree* and one was representative of Strongly *Disagree* with the rating going in descending order through the response levels stated above.

The End of Grade Test in Mathematics assesses student achievement in the four strands of the North Carolina Math Curriculum: (1) Number Sense, Numeration, and Numerical Operations; (2) Spatial Sense, Measurement, and Geometry; (3) Patters, Relationships, and Functions; and (4) Data, Probability, and Statistics. The 80-item test is administered in two parts where one part calculator use is allowed by the student and for 56 questions and another part where a calculator is not allowed for 24 questions. Students were given graph paper and rulers during the test, as well as extra paper to work out problems. Test directions are read aloud from a script that is standard across the state, and prepared by the state-testing department. Testing security and high standards for maintaining test validity are hallmarks of the End of Grade Test program. This allowed for a viable tool for recording information for this research. Both parts of the

test require students to interpret information from problems in context in order to generate appropriate responses (NCDPI, Division of Accountability Services, 2004).

Design and Procedure

This study utilized a comparison design to determine the differences in attitudes about math, math achievement, and implementation of the program of two groups of different levels of mathematical success. The NC End of Grade (EOG) Test in Mathematics was given to all students in both groups at the end of the 2003-2004 school year. Just following the reporting of EOG test results students were administered an attitudinal survey. Teachers of grade levels, 3rd and 4th were given an attitudinal survey as well. In addition to similar information in the student survey, teacher surveys also included questions that determined the amount of professional development each teacher had received and the implementation levels of the program in each classroom. These surveys were grouped by grade level to determine the mean of answers.

The survey given to the teachers in 3rd and 4th grade had an identical format with demographic and implementation information at the top, presented in a multiple choice format and five attitudinal questions in Lickert scale format. The same response levels were used as in the teacher survey as were used in the student survey: *Strongly Agree, Agree, Do Not Know, Disagree*, and *Strongly Disagree*. Five was representative of *Strongly Agree* and one was representative of *Strongly Disagree* with the rating going in descending order through the response levels stated above. A copy of all surveys administered is included in appendix A and B.

Teachers were also given a follow up questionnaire in response to the survey answers. Several of the questions showed discrepancies across the grade levels and schools so a follow up questionnaire was used to delve deeper into understanding the original research.

This study has several limitations that cannot be eliminated. Teacher effect may be a reasonable variable in math scores, as well as maturity level of math concepts between two different grade levels. It is uncertain that there are other variables that may play a role in the gains or losses in achievement that these students experienced due to their regular classroom experiences.

Another limitation of the study is the limited student groups examined. The total student population examined is 134 students in all. The study was also carried out at one school, where further study could be done across different schools with various student populations. The information was gathered from a low-wealth school without a broad range of student populations, so that is also a limitation to the research. Students from other socio-economic backgrounds may yield different outcomes to a similar design of research. The teacher population is a large limitation to the study. Because of the small number of teachers in the sample the effect of a single teacher response is great when averaging responses.

Another limitation of the survey is centered on the measurement instruments. Though the measurement determined by the End of Grade Test has been field tested and proven reliable, researchers were not allowed access to the actual problems on the tests to see if there were congruent to the problem bank offered by Accelerate Math. The contact with test materials was limited because of rules governing test administration that did not

permit outside people to view actual test questions. However, current publicly released practice questions were review to determine the type of questions students would be asked to respond to during EOG test administration. It was found that both the EOG and Accelerated Math had similar, objective, multiple-choice questions.

Another limitation to the survey was time, as there was a small window of time to administer the student and teacher surveys after students took the End of Grade test and before school was released for summer vacation. This limitation is why students were given the survey in large class-size groups and not smaller groups or in individual interview form, as was considered during the original design of the research.

RESULTS

Student Survey

The return rate of the survey was sizeable. Sixty-four out of 71 students in third grade, or 90% of the group, returned survey data. Fifty-six out of 63 students in fourth grade, 89% of the students, returned surveys and demographic data. Lack of returns on student surveys were due to student absences and student withdrawals from the schools' enrollment between the time the scores from the End of Grade test results were returned and the administration of the survey. Teacher surveys had a 100% return rate, however the subject group was limited to six teachers, three from 3rd grade and three from 4th grade.

Student answers and teacher answers to survey questions and items were tallied and Likert scale questions were given a numerical value and averaged to find the mean of the answers. Statistical and demographic information was tallied and averaged to determine the mean for the two populations surveyed. Demographic items on the survey included information about grade level, frequency of use of Accelerated Math, implementation of Accelerated Math, and the difficulty level of program implementation from the student perspective. Responses to demographic and implementation questions for fourth grade students are listed in Table 2.

Table 3 Fourth Grade Student Perception Data

Demographic Questions						
What is your grade level?	***3***	***4***	***5***			
		100%				
	Yes	***No***				
Do you use Accelerated Math?	44%	56%				
Does your teacher meet in small groups to work on difficult problems when you use Accelerated Math?	18%	82%				
Is Accelerated Math easy to use?	73%	17%				
How many times a week do you use Accelerated Math?	***0***	***1***	***2***	***3***	***4***	***5 or more***
	56%	4%	13%	2%	4%	29%
	some students gave mulitple answers to questions					

Table 4 Third Grade Student Perception Data.

Demographic Questions						
What is your grade level?	***3***	***4***	***5***			
	100%					
	Yes	***No***				
Do you use Accelerated Math?	100%	0%				
Does your teacher meet in small groups to work on difficult problems when you use Accelerated Math?	42%	58%				
Is Accelerated Math easy to use?	67%	33%				
How many times a week do you use Accelerated Math?	***0***	***1***	***2***	***3***	***4***	***5 or more***
	0%	0%	5%	19%	21%	55%
	some students gave multiple answers to questions					

The comparison between the demographic indicators is apparent. Table 3 shows the information from 100% third grade students, while Table 2 gives information from 100% of fourth grade students. There is a significant variance in the answer to the question as students report on their use of Accelerated Math. Every single third grade student reports to have used the program, reporting at 100% use. The fourth grade group has very different results. Less than half (44%), a significant difference from Table 3, reports using Accelerated Math. This question provides for the huge variance between grade levels in response to the following three perception information questions.

In response to the question, "Does your teacher meet in small groups to work on difficult problems when you use Accelerated Math?" 18% of the 4th grade students reported a yes, or positive response. Congruently, 42% of the third grade students responded positively to this question. Though the percentage is higher for the third grade students, so was the level of implementation. Fifty-eight percent of the third grade students, 100% of which reported to have taken part in the program, did not meet in small groups, as reported by the students. The work in small groups is a tenant of the Accelerated Math program outlined in their publications and workshops. The results indicate that 27 third graders out of 64 students did recall meeting in small groups while using the program, while only 5 fourth graders, out 56 reported having the same experience when using the Accelerated Math program. That is a huge variance of implementation in a very similar population using the same program and software.

The next question students were asked was, "Is Accelerated Math easy to use?" and there were similar student perceptions and responses regardless of the level of implementation by grade levels. Seventy-three percent of fourth graders reported the

program easy to use, from a student perspective. Relatively similar, 67% of third graders reported the program easy to use. Thus, making the overall conclusion of the students positive in regards to ease of using the program.

The follow up reporting in the question "How many times a week do you use Accelerated Math" is striking as well. In the third grade group, represented in Table 3, 95% of all the students reported using the AM program at least three times a week. Fifty-five percent reported using it five or more times a week, equaling use of at least once a school day. The fourth grade group, represented in Table 2, shows that 76% of the student respondents reported using the program two or less times a week which is the opposite of the level of use in third grade. All third graders reported using the program a minimum of two times a week up to a maximum of five times per week. Sixty percent of fourth grade students reported the use to be much lower, this percentage said that they used it one or less times a week. Of that number 56% of the 60% of students reporting negative responses they said they never used it all by reporting zero. Accordingly, there is a largely marked difference between the uses of the Accelerated Math program across these two grade levels at the school. The reliability of this information by the students is also evident in their responses, as 56% of the students surveyed also reported not using Accelerated Math in the question "Do you use Accelerated Math?" in an earlier survey question. This is the same percentage that reported zero usage in a week of math class.

Specific attitudinal responses that were presented in a Likert Scale format include the following items for both grade levels, 3rd and 4th. These were written in a simple format, at an elementary reading level, for ease of understanding by the students to make sure that language would not be a barrier when indicating correct responses to the

questions being asked. Though items were read aloud to students, ease of understanding was still taken into account to insure understandability by the audience. The items used with both third and fourth grade students are as follows:

1. I am good at math.
2. I learn more when I use Accelerated Math.
3. I have a better chance on paper and pencil tests if I use Accelerated Math.
4. I make good grades in math.
5. My math test scores will be higher than last year.
6. Math is less difficult for me when I use Accelerated Math.

Survey responses were weighted with Lickert Scale numerical indicators in order to calculate the responses effectively. Answers were tabulated averaging the numerical answer provided by the student subjects and then presented. Answer scales provided to the student were stated as following: *5 equals strongly agree, 4 equals agree, 3 equals do not know, 2 equals disagree, 1 equals strongly disagree*. The average mean of item responses for each item on the fourth grade attitudinal section is listed in Table 5. The mean of item responses from third grade is shown in Table 6.

Table 5 Fourth Grade Attitude Response Data

	Strongly Disagree	***Disagree***	***Do Not Know***	***Agree***	***Strongly Agree***	***No Answer***
Attitudinal Questions						
I am good at math.	5%	4%	9%	31%	51%	
I learn more when I use Accelerated Math.	27%	8%	16%	33%	16%	
I have a better chance on paper pencil tests when I use Accelerated Math.	18%	5%	13%	27%	37%	
I make good grades in math.	5%	4%	11%	36%	40%	4%
My math test scores will be higher this year than last year.	5%	0%	15%	22%	58%	
Math is less difficult for me when I use Accelerated Math.	27%	5%	16%	27%	20%	5%

Table 6 Third Grade Attitude Response Data

	Strongly Disagree	***Disagree***	***Do Not Know***	***Agree***	***Strongly Agree***
Attitudinal Questions					
I am good at math.	5%	3%	11%	32%	50%
I learn more when I use Accelerated Math.	3%	0%	34%	29%	34%
I have a better chance on paper pencil tests when I use Accelerated Math.	5%	8%	34%	13%	40%
I make good grades in math.	3%	8%	13%	18%	58%
My math test scores will be higher this year than last year.	0%	0%	13%	18%	69%
Math is less difficult for me when I use Accelerated Math.	11%	3%	26%	29%	31%

Analysis of the information collected in the student surveys shows that students in the 4th grade group had generally similar attitudes to students in the 3rd grade group. For instance, the same percentage of students in both grade levels had a positive response of *agree* or *strongly agree* when asked if they were good at math. Both groups reported an 82% total of positive response of *agree* or *strongly agree,* a high rate of positive attitudes about math ability among the third and fourth grade students.

To arrive at a second attitudinal indicator students were asked to respond to the statement "I learn more when I used Accelerated Math." In response to this statement 35% of fourth graders had negative responses of *disagree* or *strongly disagree* while 3% of third graders responded negatively to the same statement. Forty-nine percent of fourth graders responded positively to this statement, where 63% of third graders responded positively by choosing *agree* or *strongly agree*. There were a significant number of students who did not measure their learning when using Accelerated Math but selecting *do not know* as their response. Of the students that responded neither positively nor negatively 16% were fourth graders and 34% were third graders. Almost one third of students familiar with the program did not know if it helped them learn more math. However, there was a higher yield of positive responses from third graders indicating the program was helpful in learning more. Again this data must take into account that 56% of fourth graders reported not using the program, while 100% of third graders reported using it at least two times a week.

Students responded to "I have a better chance on paper and pencil tests when I use Accelerated Math" on the survey. This question yielded a lower rate of positive responses by actual users of the program. Sixty-four percent of fourth graders and 53 %

of third graders responded positively to this statement by answering *agree* or *strongly agree*. The group that showed 100% use of the program showed a less positive reaction to doing well on paper and pencil tests, even though Accelerated Math is generally paper and pencil based. What is also interesting is the higher level of uncertainty along with the negative response rate. Thirteen percent of 4th graders surveyed stated they did not know if they would do better on paper and pencil tests, where as 35% of third graders responded with *do not know*. This statistic combined with the negative responses makes for an interesting attitudinal reaction by students to the Accelerated Math program. The fourth grade numbers must be read with some caution, as only 44% of the students reported using the program. However, third grade students all reported using the program, but responded less favorably to the statement.

There was another exact match, of 76%, in positive responses to "I make good grades in math." The data from the two grade levels shows a positive attitudinal response by both groups that used Accelerated Math, no matter the implementation level or level of professional development. The main difference in the information collected from the 3rd and 4th grade students was in the *Do Not Know* column of student responses. Many more 4th graders responded *Do Not Know* than 3rd graders. This is reasonable considering the level of implementation in 3rd grade was at 100%, when in 4th grade the level of implementation was much lower at 44%. In summary, no matter the grade level or achievement level of the student groups, the outcome was identical.

In response to the statement "My math scores will be higher this year than last year" the negative and positive responses were similar once again, as they were in the "I am good at math" and "I make good grades in math" attitudinal statements. For this

statement 55% of the fourth graders had negative responses while none of the third grade participants reported negative responses. The number for students who were unsure and responded *do not know* was similar as well. Fifteen percent of fourth graders and 13% of third graders responded in this manner when asked. The positive responses were overwhelmingly strong in this instance. The fourth graders reported 80% positive responses, have agree and strongly agree, while 87% of the third graders reported the same. The statistical similarities were similar in regards to student perception of test scores in the future. The statements that have similar levels of attitudinal responses were all based on factors in classroom learning and achievement that were unrelated the Accelerated Math. This raises awareness of the attitudinal effects of the program on elementary students.

The final attitudinal statement that students were asked to rate their agreement or disagreement with was "Math is less difficult for me when I use Accelerated Math". There was slightly higher rate of uncertainty among the high use group of third graders. That is apparent in the following response rates. Thirty-three percent of fourth graders and 14% of third graders *disagreed* with this statement. Forty-seven percent of fourth graders responded positively while, 60% of the third graders responded positively with *agree* or *strongly agree* to this statement. The fourth grade group, which reported that only 56% of the participants had used Accelerated Math reported *do not know* to this statement, while the third graders who all reported using Accelerated Math reported that 26% of that group *did not know* when asked to respond to "Math is less difficult for me when I use Accelerated Math".

From the demographic and attitude questions it is apparent that implementation of the program was very different across the two grade levels examined. There are overall higher rates of uncertainty of success for those students who had a higher exposure rate to the program. Comparison with teacher data and information is important at this point to determine the use of program from the teachers' perspectives.

Teacher Survey Data

Answers to teacher survey questions and items were tallied and Likert scale questions were given a numerical value and averaged to find the mean of the answers. Statistical and demographic information was tallied and averaged to determine the averages and norms for the two populations surveyed. Demographic items on the teacher survey included determination of training, implementation of training, use of Accelerated Math, the number of times a week a teachers uses Accelerated Math, ease of using the program, and frequency of mathematics teaching by the individual teachers. Results from the demographic information collected from Fourth grade teachers are presented in Table 6. Information reported by third grade teachers is reported in Table 7.

Table 7 Perception Data From Fourth Grade Teachers

	Yes	No				
Have you been trained in Accelerated Math during a formal w orkshop or professional development activity?	33%	66%				
If you have been trained in AM do you feel you implement the training consistently w hen using the program?	33%	66%				
Do you use AM in your classes?	100%	0%				
Do you meet in small groups w ith your students to w ork on difficult problems given by the Accelerated Math program?	66%	33%				
Is AM easy to use?	66%	33%				
	daily	**weekly**	**2-3 days a week**	**other**		
How often do you teach math?	100%	0%	0%	0%		
	0	**1**	**2**	**3**	**4**	**5 or more**
How many times a w eek do you use AM in class?	0%	33%	0%	33%	0%	33%

Table 8 Perception Data from Third Grade Teachers

	Yes	No				
Have you been trained in Accelerated Math during a formal workshop or professional development activity?	33%	66%				
If you have been trained in AM do you feel you implement the training consistently when using the program?	66%	33%				
Do you use AM in your classes?	100%	0%				
Do you meet in small groups with your students to work on difficult problems given by the Accelerated Math program?	100%	0%				
Is AM easy to use?	100%	0%				
	daily	**weekly**	**2-3 days a week**	**other**		
How often do you teach math?	100%	0%	0%	0%		
	0	**1**	**2**	**3**	**4**	**5 or more**
How many times a week do you use AM in class?	0%	0%	0%	33%	0%	66%

One third of the teachers reported to have had training in Accelerated Math in a formal workshop. The research later indicated that this was false and teachers were counting the times they had met with other teachers informally as formal professional development inaccurately. Contrary to the student results 100% of all teachers in both grade levels reported using Accelerated Math in their classrooms. This is a statistically significant difference from the students' perception, where 56% of the fourth graders reported never having used the program at all. However, from the follow up questionnaire we learned that the mode of delivery was different in the classrooms, thus confusing the students as to whether they were using Accelerated Math practice sheets or teacher-generated sheets.

Only 66% of fourth grade teachers reported using small groups instruction to work on difficult problems. One hundred percent of the third grade teachers reported using small group instruction on problems generated by AM. Thirty-three percent of fourth grade teachers reported not using small group instruction when using Accelerated Math. Third grade teachers responded that they all used small group instruction during program implementation. Small group instruction is a hallmark of the Accelerated Math program, as a means for results, so this information needed to be addressed (Advantage Learning Systems, Inc. 1998). The follow-up questionnaire of the teachers indicates this was a result of lack of resources and manpower during Accelerated Math time. Teachers reported needing two adults in the rooms to implement the program effectively and the fourth teachers had no assistance or teacher aids during the time the program was used in their classrooms, whereas third grade classes are assigned teacher assistants to their classrooms for instructional use. Fewer fourth grade teachers found AM easy to use.

The numbers were reported that the majority, 66% of fourth grade teachers thought the program was difficult to use and all third grade teachers said it was easy to use. Again it was determined later that this was a result of the lack of manpower and also computer malfunction issues which were reported as a barrier to the ease of implementation of the program by both grade levels. The high rate of use in third grade versus fourth grade matches the student responses in the teacher portion as well. The students in third grade reported using the program much more often, as did their teachers. The teachers in fourth grade reported using the program an average of three times a week, lower than third grade. This is congruent with teacher responses on the previous tables, as the 4th grade students also reported a much lower implementation of the program as well.

The results from the fourth grade teacher demographics and the third grade teacher demographics did not match the information presented by the teachers verbally, through conversation during the research so the surveys, after tabulation and comparison to the student information, showed a need for a more responsive research tool. Therefore, the surveys were followed up with a questionnaire of the teachers in both grade levels. Some of the questions were used to help explain the inconsistency in the data in tables 6 and 7 as explained above. The questions used were as follows

1. Tell me when you remember Accelerated Math becoming part of the school's curriculum. If you do not know or remember when did you begin working here?
2. Tell me when you began using Accelerated Math in your classroom.
3. How much time a week did you spend last school year using Accelerated Math? How much time during each day/lesson did you spend using Accelerated Math?
4. Out of 100% of your teaching time each week how much time did you spend using Accelerated Math? How much time did you spend assessing? How much time did you spend using traditional teaching tools such as the overhead and worksheets? How much time did you spend using hands on manipulatives, again out 100%?

5. What role does/did AM play in your teaching of the math curriculum?
6. What are advantages of AM?
7. What are disadvantages or barriers to use and implementation of AM?
8. How many students were in your math class(es) last year?

Like student surveys, teacher survey responses were also weighted with Likert Scale numerical indicators in order to calculate the responses effectively. Answers were tabulated averaging the numerical answer provided by the teachers and then presented. Specific attitudinal responses that were presented in a Likert Scale format include the following items for teachers in both grade levels, third and fourth:

1. Math is less difficult when I use Accelerated Math in my classroom.
2. My test scores will improve in math this year partly due to Accelerated Math.
3. I feel my students have significant practice in each skill/objective when they take a math test.
4. I am a successful math teacher.
5. My students seem to like math class.
6. My students like using the Accelerated Math program
7. My students seem to have success using Accelerated Math.
8. My students seem to achieve higher on tested skills that were mastered in Accelerated Math.
9. My students perform better when they use Accelerated Math.
10. My students like to use the computer.
11. My students have a positive attitude about math.
12. My training/professional development in Accelerated Math is important to student success.

Answer scales provided to the teachers were stated as following: *5 equals strongly agree, 4 equals agree, 3 equals do not know, 2 equals disagree, 1 equals strongly disagree.* The mean of item responses for fourth grade teachers is listed in Table 8.

Table 9 Fourth Grade Teacher Survey Responses

	Strongly Disagree	Disagree	Do Not Know	Agree	Strongly Agree
Math is less difficult for my students when I use AM in my classroom.	0%	33%	33%	33%	0%
My test scores will improve in math this year due to AM.	0%	0%	66%	33%	0%
I feel my students have signifcant practice in each skill/objective when they take a math test.	0%	0%	0%	100%	0%
I am a successful math teacher.	0%	0%	0%	66%	33%
My students seem to like math class.	0%	0%	0%	66%	33%
My students like using the AM program.	0%	33%	0%	66%	0%
My students seem to have success using AM.	33%	0%	0%	66%	0%
My students seem to achieve higher on tested skills that were mastered in AM.	0%	0%	66%	33%	0%
My students perform better when they use AM.	0%	33%	33%	33%	0%
My students like to use the computer.	0%	0%	0%	0%	100%
My students have a positive attidue about math.	0%	0%	0%	66%	33%
My training/professional develoment in AM is important to student success.	0%	66%	0%	0%	33%

Table 8 shows the information reported by the fourth grade teachers who were administered the survey. Teachers, like their students generally had a positive attitude about the use of Accelerated Math. Warranting caution is the lack of professional development that preceded the implementation of the program as reported by the teachers regularly through out the research. For instance 100% of the fourth grade teachers believed that their students test scores would go up this school year, while 66% of the third grade teachers believed they would. Therefore one out of six teachers surveyed believed their students would achieve more this year. One hundred percent of fourth grade teachers felt their students received significant amounts of practice in each skill they take on a math test and 66% of the third grade teacher agreed. The other 33% did not know, but did not have negative responses. There was a negative response to Accelerated Math by one of the fourth grade teachers; the teacher did not believe their student performed better when using Accelerated Math. There were no negative responses in this category for 3rd grade respondents. Third grade teachers did report less positive attitudes from their students about math than did fourth grade teachers. This is also evident in the student responses reported earlier in the results chapter. Fourth grade teachers also saw training and professional development in Accelerated Math as less important to student success. This is reasonable when you take into consideration that they used it less and obtained higher levels of proficiency on the End of Grade state tests. Table 8 and Table 9 show the reactions to the statements by the teachers in fourth and third grade teachers at the school, respectively.

Table 10 Third Grade Teacher Survey Reponses

	Strongly Disagree	Disagree	Do Not Know	Agree	Strongly Agree
Math is less difficult for my students when I use AM in my classroom.	0%	33%	33%	33%	0%
My test scores will improve in math this year due to AM.	0%	33%	66%	0%	0%
I feel my students have signifcant practice in each skill/objective when they take a math test.	0%	0%	33%	33%	33%
I am a successful math teacher.	0%	33%	0%	0%	66%
My students seem to like math class.	0%	33%	0%	33%	33%
My students like using the AM program.	0%	33%	0%	66%	0%
My students seem to have success using AM.	0%	33%	0%	66%	0%
My students seem to achieve higher on tested skills that were mastered in AM.	0%	0%	33%	66%	0%
My students perform better when they use AM.	0%	0%	33%	66%	0%
My students like to use the computer.	33%	0%	0%	0%	66%
My students have a positive attidue about math.	0%	33%	0%	33%	33%
My training/professional develoment in AM is important to student success.	0%	33%	33%	0%	33%

The statistical significance of the teacher surveys warrants caution. The small group of teacher responses can easily change the average mean of the answers. Teacher perception of student attitudes is evident in many of these responses represented in Table 8 and Table 9. The first statement about math being less difficult for students when AM is used in the classroom gleaned identical responses from teachers in both grade levels. Thirty-three percent of both sets of teachers disagreed with the statement, 33% did not know, while 33% agreed with the statement. This is a wide variance of responses among teachers using the same program in their classrooms.

Teachers were also asked to predict if their test scores would improve due to the use of Accelerated Math in their classrooms. In fourth grade, where the proficiency level of students was 100% on the End of Grade Tests 66% of the teachers reported they did not know, while 33% of the fourth grade teachers agreed Accelerated Math would have a positive impact. In the third grade teacher group, the numbers were different, where as 33% of the teachers disagreed that their scores would improve due to AM use, and 66% of the teachers did not know. No teachers in third grade reported they agreed with the statement, which is powerful considering the large amount of implementation of the program. These responses are relevant to the actual scores and outcomes of the North Carolina End of Grade Test results. Teachers who used the program with more fidelity value the programs effects on test scores less.

Teachers were also asked to rate their beliefs as to where their students have significant practice in each skill/objective when they take a math test. The fourth grade teachers reported 100% agreement with the statement through positive answers. The

third grade teachers had much more varied responses to the statement. Thirty-three percent of the teachers in their grade reported they did not know if their students had received significant practice, while 66% responded positively to the statement by answer agree or strongly agree. Again these teacher responses were reflected in the actual proficiency of the grade levels on the testing instrument, where 100% of the fourth grade students were proficient and a lower number of third graders showed proficiency.

The next two statements can be grouped together. First teachers were asked to rate whether they are successful math teachers, followed by asking teachers to rate if their students like math class. The positive and negative percentages of answers were identical. In fourth grade teacher responses, 100% of the teachers gave positive responses to both questions. For both questions the third grade teacher group reported 33% negative answers and 66% positive answers to both statements as well. Again, lower perception of teacher ability and student perception were mirrored in these two sets of responses. A statement found later on the survey can also be likened to the two discussed in this paragraph. This statement asks teacher to rate if their students have a positive attitude about math. Here the fourth grad teachers reported that 100% of their students have a positive attitude about math, where in third grade 33% of the teachers reported they disagreed with this statement, and 66% of the teachers reported positive attitudes about math by their students. These three statements are grouped together as they have similar student outcomes and intentions.

Because of statistical likeness of the next two questions they two have also been grouped together for presentation. Teachers in both grade levels were asked to rate “My students like using the AM program” and “My students seem to have success using AM”

Thirty-three percent of both teacher groups reported negative responses either *disagree* or *strongly disagree*, while 66% reported positive responses of *agree* or *strongly agree* to this statement. No teachers surveyed reported *do not know* to either of these statements.

The next statement teachers in grades three and four were asked to rate their agreement to related to student performance and achievement when using the Accelerated Math program. Teachers were asked to respond to the statement "My students seem to achieve higher on tested skills that were mastered in Accelerated Math". The fourth grade teachers had a higher rate of uncertainly when answering this than third grade teachers did. Fourth grade teachers reported at 66% *did not know* if this was true, while 33% agreed with the statement. The third grade teachers only reported that 33% of the group was unsure, while 66% if the teacher group agreed and gave positive reports to this statement. The next question, similar in nature elicited slightly different responses by the teacher participants. The statement asked teachers to determine if their students perform better when they use AM. In the fourth grade responses, 33% if teacher *disagreed*, while, 33% *did not know*, and 33% reported to *agre*e. The third grade teachers reported no negative answers, 33% of them *did not know* and 66% of the teachers *agreed*. The results of this statement were contrary to the actual test result levels, where third grade students performed at 85.9% math proficiency and 4th grade students had a 100% math proficiency level.

Following the statements about testing and proficiency teachers were asked to if their students like to use the computer. Students who used Accelerated Math more, in third grade had a lower teacher report of liking the computer, at 66%. In the 4th grade

group 100% of teacher responses indicated positive student reactions to using the computer.

One of the most significant statements, which is important to the current research being done asks teachers to rate their agreement to this statement " My training/professional development in Accelerated Math is important to student success". The fourth grade responses were much more negative than those of the third grade teachers. The fourth grade teachers had 66% negative response rate, all being *disagree* and a 33% *strongly agree* response. The third grade teacher group reported 33% *disagree*, 33% *do not know*, and then 33% positive responses of *strongly agree*.

NC End of Grade Test Data

Statistical results for the North Carolina End of Grade Test indicated that the group of 4th graders showed the highest level of proficiency. Fourth grade students were rated at 100% proficient in all strands of mathematics. Third grade students showed a large number of proficient students, yet there was a significant statistical difference in proficiency. Third grade students were rated at 85.9% proficient in all areas of 3rd grade math (NCDPI, 2004).

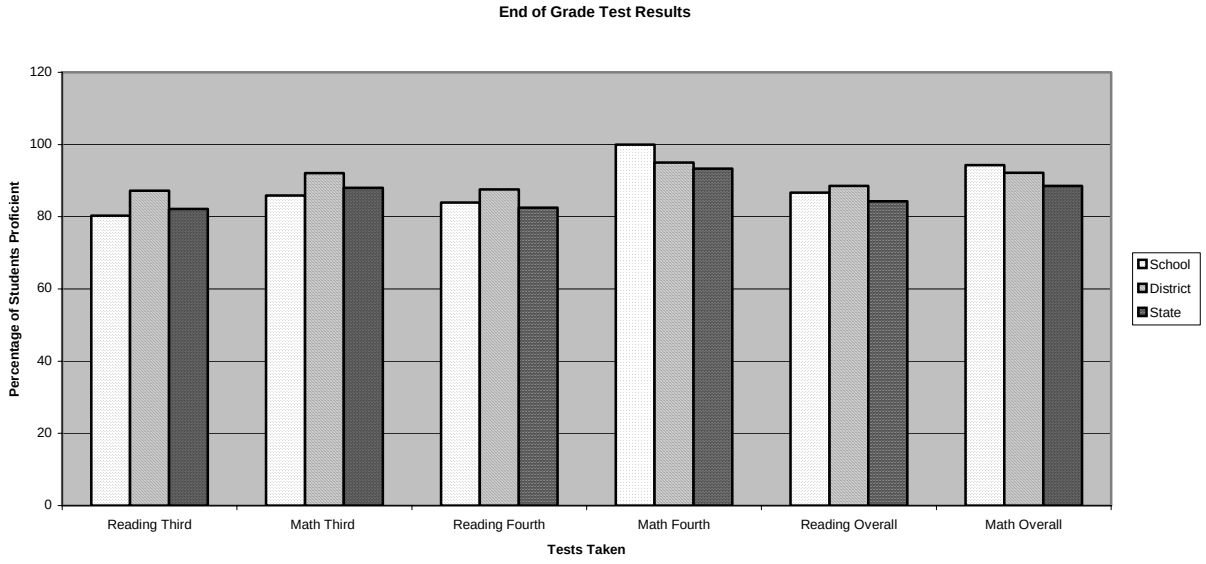
The results in Table 10 and Figure 1 deserve close examination, as the third grade scores, the group with the higher level of implementation of Accelerated Math were not only below the fourth grade group of scores, but also fell significantly below their math district average of 92.1% of proficiency and 88% of proficiency of math on the state level. The fourth grade math proficiency is at 100%, higher than the district and state averages of 95% and 93.3 % respectively though they had a much lower level of

implementation reported by both students and teachers. The comparison in Figure 1 shows how each grade level did in relation to each other and the school as a whole, on both the local, district, and state levels.

Table 10 End of Grade Test Results

	Reading Third	Math Third	Reading Fourth	Math Fourth	Reading Overall	Math Overall
School	80.3	85.9	83.9	100	86.7	94.3
Number of Tests Taken	71	71	62	62	211	211
District	87.2	92.1	87.6	>95	88.5	92.2
State	82.2	88	82.5	93.3	84.3	88.5

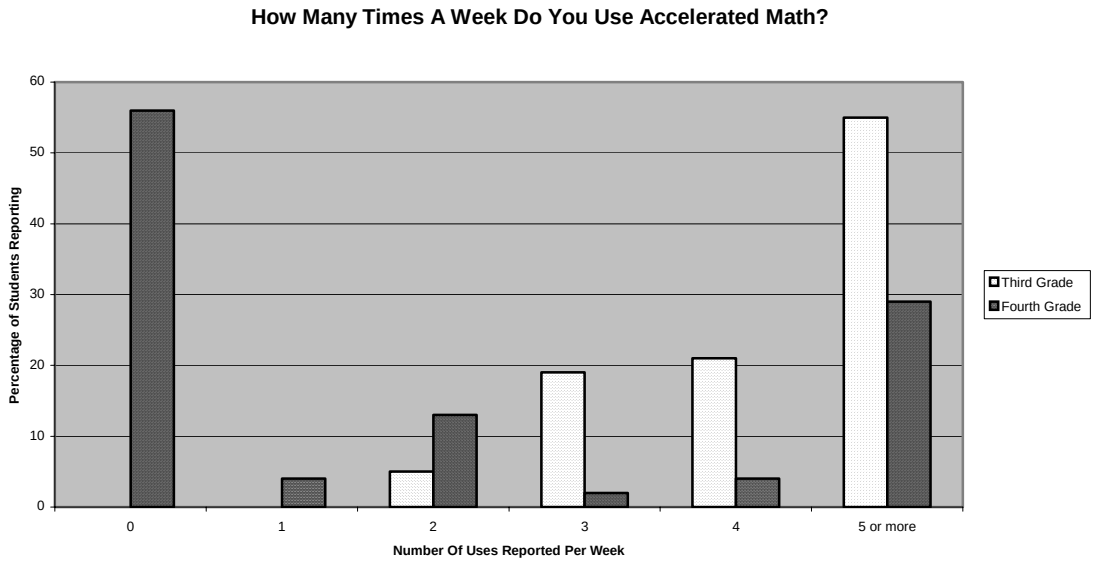
Figure 1 Comparison of End of Grade Test Results



Summary

This compilation of data brings forward the question as to whether the higher level of implementation of this math program, with no significant professional development attached to it, was a reasonable use of math instructional time and resources. This question has merit since the fourth grade reported 100% proficiency, which was above both the district and state levels of proficiency yet had a much smaller implementation of the program in its classrooms. This result was much higher than that of third grade End of Grade test scores, which were, reported at 85.9% proficiency with a greater use of Accelerated Math in the classroom. Data reflecting student responses about the weekly use of Accelerated Math are presented in Figure 2.

Figure 2 Student Information on Accelerated Math Use



A response to the original research was also completed to take into account the variance in teacher responses. A follow up was appropriate for the students however, the population had changed so dramatically since the original survey, because of the school's transient population, that a follow up for students was not possible. It is apparent from achievement levels reported on the state mandated testing that achievement levels certainly were not in correlation with the amount of time spent using Accelerated Math in the classroom. However, the study did show that these students in this particular case study were certainly encouraged positively about math, as they reported very favorable attitudinal responses about their math instruction and abilities at both third and fourth grade levels studied. Therefore Accelerated Math may have a bearing on their attitudes about math, since all students responded positively. It certainly can be ascertained that student attitudes were not hindered in a negative manner by using the computer based learning program, as most reported a liking for using the computer and the Accelerated Math program, no matter how much or little it was used.

Figure 3 Student Attitudes About Math Ability

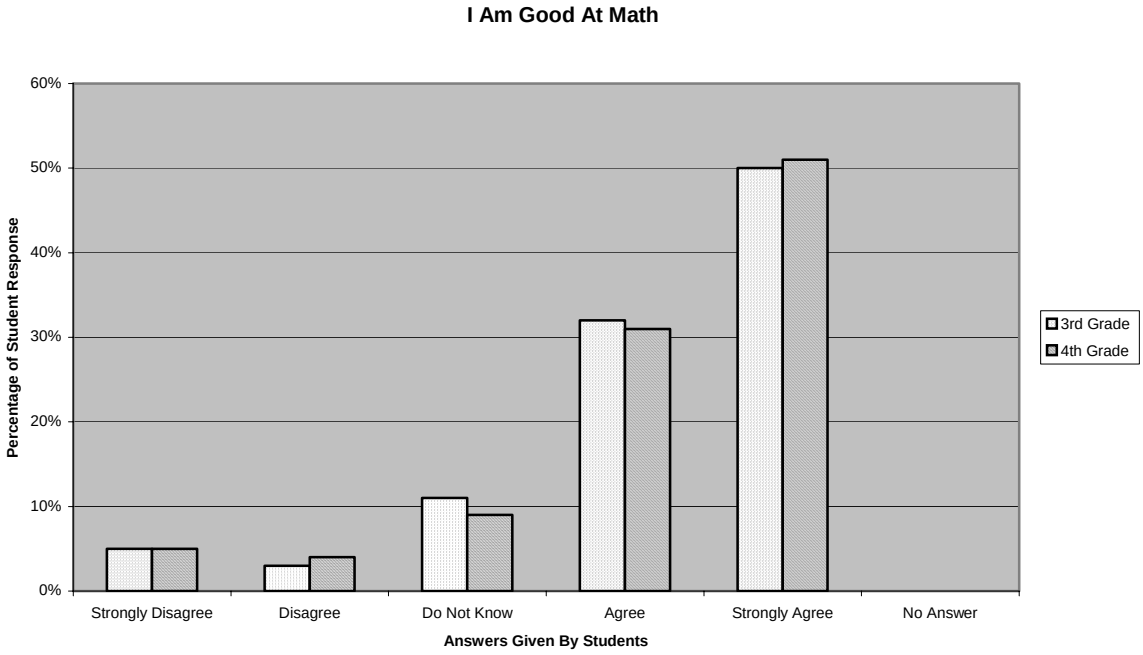
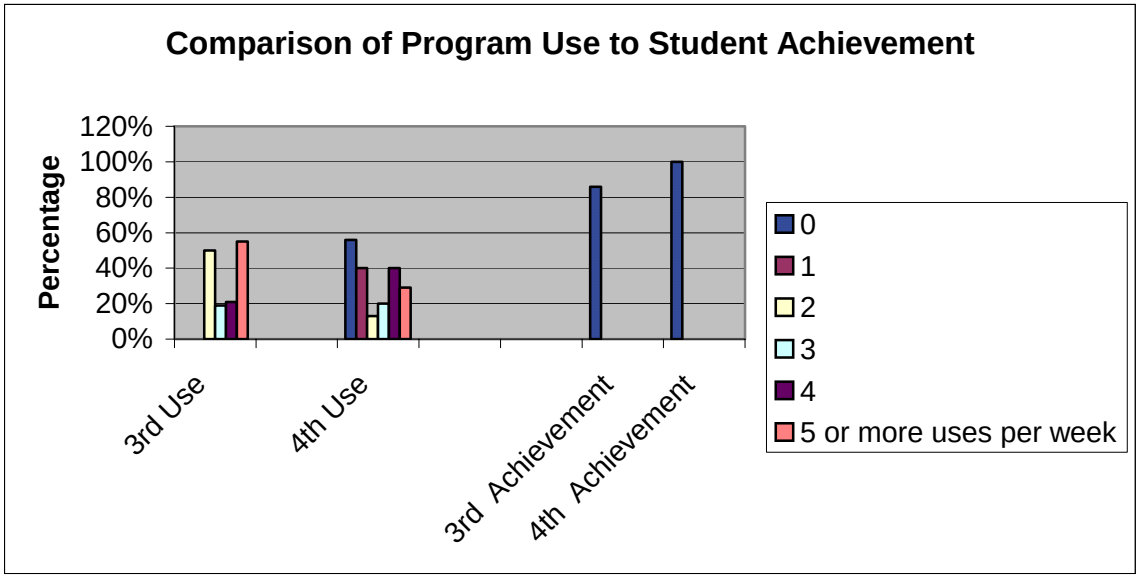


Figure three shows the comparison between the use of the Accelerated Math program and the student achievement levels. Student groups were able to report zero, one, two, three, fourth and five or more uses on their survey. This graph shows the percentage of students who chose each level of use in relation to their achievement level on the End of Grade Test. Students with the lowest level of use had the highest level of achievement, while students that reported the highest level of use had lower levels of achievement. This comparison is very telling and the focus of the outcome of this research. It is important to reflect on these findings when determining usefulness of staff development when implementing programs in schools. This discourse in implementation, use, and professional development opportunities in regards to the program is certainly means for discussion in the following chapters and in the field of education supervision and curriculum implementation

Figure 4 Comparison of Program Use to Student Achievement



CONCLUSIONS AND IMPLICATIONS

The study presented was completed to evaluate the relationship between the use Accelerated Math and elementary student achievement. The case study was done taking heavily into account teacher professional development and fidelity to implementation of the program as important factors. Student and teacher perceptions regarding mathematics and the Accelerated Math program were specifically addressed through attitudinal measures and follow up interviews for the teachers. The information in this survey and the interview reflects the benefit and shortcomings of Accelerated Math at the upper elementary level, more specifically in third and fourth grade.

Most studies published show strong gains and increased proficiency levels in students who use Accelerated Math. However, most studies that are published are also done so by the parent company, which causes some conflict of interest. The current case study presented here shows the contrary. The group, third grade, in which students and teachers reported the spending the most time implementing the program, had significantly lower levels of proficiency than its comparison group. The group, 4th grade, that reported the highest level of proficiency reported a lower level of time spent on the program with a large negative variance in implementation from the comparison group in 3rd grade. In fact in 3rd grade 100% of all students reported using the program and in 4th grade only 44% of students reported even being aware they were using the program. Other studies take into account gains, development scores, and percentile rank. This study looks at proficiency, which is important in order for schools to meet Adequate Yearly Progress, as defined by federal No Child Left Behind laws.

More importantly the level of professional development provided to support the program and the use in classrooms is an important part of this study. Neither group reported any significant amount of formal or informal professional development during the phase prior to implementation, during implementation or up to the point of data collection.

This study is beneficial because it compares groups with a high level of Accelerated Math implementation with a group that has a low level of implementation and the differences in achievement and proficiency for those groups. Class time was used differently among the teachers and students in the two grade levels examined. Third grade reported to use a great deal of class time implementing Accelerated math with no professional development. Fourth grade reported to use much less class time on the program with a higher yield of proficiency on standardized tests. There was also a greater uncertainty amongst third grade students, the lower performing group, as to attitudes about Accelerated Math and mathematics in general. It is difficult to ascertain with certainty that this a reflection of the use of Accelerated Math or other factors such as class climate, exposure to the math content, or teacher experience.

However, attitudes about school and anticipated math grades are very similar across the two grade levels. Both groups felt success in math and believed they would have higher test scores in the future. Though, when students were asked to respond to statements about Accelerated Math in their math program and success, the level of uncertainty amongst the students went up dramatically. Accelerated Math was the variable in each question on the student survey that elicited the most *do not know* responses. In both groups the students had a positive outlook about math, learning, and

achievement regardless of the outcome they experienced in standardized testing. This indicates that other factors are contributors to the student success. Clarity about what those factors are is not provided in this study.

The results of the surveys and test scores examined in this study show that this particular computer based management learning system did not have a positive effect on proficiency and math scores across similar populations. It is interesting to note that the highest level of implementation in the two grade levels promoted the lowest proficiency. Teachers at both grade levels reported no formal training once all research, surveys, and interviews were completed. Other factors of course could be taken into consideration when considering the level of proficiency such as teacher mastery, teacher experience, and effectiveness of other components of the overall math curriculum. All of these were addressed in the follow up interview but provided no specific differences worthy of study for the purpose of the current research.

Some questions showed differences in attitude within the data and were fairly striking considering the considerable difference in levels of use by the students. On the teacher survey, teachers were asked to rate if their students were successful using Accelerated Math and if their students liked using the program. This question yielded identical positive and negative responses amongst both groups. The difference in implementation was great, since 3rd grade used the program consistently and 4th grade reported a much lower use rate of the program during the school day. Most of the students seemed to like math at a high level whether they had used Accelerated Math in a sustained, correct fashion or not. This may be a reflection of the school climate or again factors outside the realm of this study. The 3rd grade teachers surveyed reported to be

unsure of the strength of the program even though they reported using it much more than the 4th grade group. This again insights questions about the importance of professional development in implementation. Teachers would know what the strengths of the program were if they were more familiar with its tenants and how it is supposed to be successful in the classroom.

A similarity that warrants further study is the third grade teacher's responses to several questions. The teacher perception of his/her own success seemed relevant to the actual success of the students of that grade level. One teacher reported to *disagree* with the statement that he/she was a successful math teacher. The students in third grade were less successful than the fourth grade group where all teachers agreed they were successful math teachers. Along those same lines, teachers who used the Accelerated Math program more, the third grade teachers, valued the program less as an instrument to improve student test scores. With the teacher responses are important a closer look at student responses is important. The third grade teachers reported less positive attitudes from students about math, as did the students. They did not seem to have as positive of an outlook about learning math as their fourth grade counterparts. The fourth grade teachers also showed a much more positive attitude about teaching math. Though third grade used the program a great deal more than fourth grade they showed a low value for its ability to raise standardized test scores. This is interesting to note due to the high level of implementation in third grade level. A following look at teacher attitudes affecting student achievement would be a good next step in this line of research. So it is interesting to note the affect of the program use on teacher and student attitudes and how that manifests into student achievement.

The integrity of the survey process, application and collection was maintained in a closed setting and completed by the researcher in the same manner each time. Static rules for giving and collecting student's surveys were adhered to throughout the research process. The sample that should be examined with great caution is the teacher sample, as it was fairly insignificant for data collection purposes. There were only 3 teachers from each of the two grade levels surveyed, so one answer made large difference in the statistical reporting of answers. The teacher surveys were imperative and useful in determining the level of training and implementation associated with the implementation of this program however the attitudinal responses should be considered with great prudence.

One consideration of this look at Accelerated Math is the lack of the recommended STAR Math assessment. This component is recommended by the parent company of Accelerated Math, however the cost of program has been prohibitive for this school. The lack of success of the implemented portions may also be taken into considerations when determining the use of funds to purchase this program. This is taken into consideration as a missing component of the program at this particular school. The lack of this program component could be considered significant when results are scrutinized by the parent company however other means of viable assessment and tracking student progress were used that were consistent throughout the samples, such as the surveys and End of Grade Test scores.

As cited in the literature review, the outcome of research about technology and student achievement varies greatly. Wenglinksky's Educational Testing Service Study determined that when a computer replaced activities that teach and reinforce low order

thinking skills, such as traditional paper and pencil worksheets, student achievement dropped. In the same study it was also found that the use of computers to teacher higher order thinking skills was related to student math achievement among eighth graders. That of course is a much different age group than we are studying here, but the previous research is thought provoking in relation to the current study of Accelerated Math shared here.

Perhaps some of the most telling information in the current study is in regards to the lack of implementation and warrants comparison with the past research about professional development done in Bellevue, Washington. The success of the Bellevue case showcased a joint effort to improve technology in the schools along with the use of professional development to pave the way. The school system, using technology and professional development in concert was able to yield successful gains for both students and teachers. Their goal as a system was to shift to the teaching of technology skills to the students, rather than just teaching the staff how to use the technology themselves. Strong district leadership, sound professional development standards and implementation, as well as teacher input into implementation created an effective and powerful mode of the application of technology, through teacher learning.

One purpose of this study is to determine whether or not student achievement increases and attitudes change based on proper implementation of Accelerated Math. Proper implementation was not carried out, as there was no formal training of the teachers in the use of the technology or the merits, or hallmarks of the program. Teachers were simply doing what they had been asked to do with no resources other than the technology and each other.

There are three standards of staff development, which include context standards, which are in place to address the system and culture into which the new programs will be implemented and presented. There are process standards that refer to design and delivery of sound, important staff development. Then there are content standards that refer to the knowledge and skills that educators should know to produce higher levels of student achievement and learning. These standards have been researched and implemented by the National Staff Development Council and have been adopted broadly across many school districts in the country (NSDC, 2001). From the research done in this case the lack of staff development, following any standards including the three outlined above, is very apparent. There was no reported staff development or training provided prior to using Accelerated Math in the classrooms.

The results of this study show that using the Accelerated Math learning system may provide attitudinal benefits for students in upper elementary grades. The research does not support achievement benefits of the program through standardized test results, without proper teacher training and implementation. Upon a close look at the overall results it is evident that the students who used Accelerated Math the most regularly showed less significant levels of success than those that used it in moderation. Conversely, students who used Accelerated Math more had positive attitudes regarding mathematics classroom instruction even though their test scores may or not be high.

Further study is suggested in regards to teacher implementation and also in regards to elementary student achievement. Sample size for this study was restricted to one school with only 133 student participants and 6 teacher participants. Further studies could include students across an entire district and of course a much greater sample of

teachers with and without Accelerated Math training. A greater variance in student population is also recommended for future studies as well. The lack of achievement gains may indicate that the use of the Accelerated Math program is beneficial for positive students perception of math instruction, but not mastery of skills. Both grade levels reported high levels of positive attitudes without taking into account proficiency.

The results of this study are important to the elementary learning community as well as anyone involved in school or curriculum supervision or leadership. The study indicates that staff development; that most importantly includes strong implementation and precise research based staff training can play a role in student success using learning information and other computer-based systems. However, strong staff development is not self-implementing, it must be based on standards, such as those from NSDC or the US Department of Education and supported by on-site and district administration. The standards for staff development must be presented and made available to school systems, and then addressed in order for situations, like the one in this case study, to stop adversely affecting students and teachers. Just as in this case, incidents like this will continue without the initiative of individual teachers, administrators, and central office staff. Will a teacher, like myself who strives to attain new information and knowledge, bring the need for staff development standards to the attention of his or her principal? Would a principal dare suggest to district leaders or central office staff that there appears to be a disconnect on certain levels between the standards we all should be adhering to and the staff development practices adopted by the system? Will this information make it up the line to school board leaders and legislators through the urging of colleagues? Those questions remain to be answered in every school that is in need of change. It

deems necessary that a thorough response in every school where teachers feel the professional development they undertake is largely a time filler instead of a true learning experience that benefits students and the professionals that teach them. It also deserves a thorough review in any school where administrators do not thoroughly investigate staff development needs in the schools they supervise.

The implications of a study like this are an excellent tool for study in the field of Curriculum Instruction and Supervision, as well as any school leadership role. Based on an image of a school as a community where the needs of learners are paramount, where learning is cherished, diversity celebrated, vision shared, and leadership toward worthy and common goals is drawn from all members, a study like this could be examined as a springboard for growth in a school. To be effective school and district level curriculum and instructional leaders, or any personnel who play a supervisory role in the professional development of others, it is important to see studies where the professional development system has failed its students and its teachers and learn from those mistakes in the context of the current climate within schools. As a decision-maker and reflective practitioner, curriculum leaders and supervisors could view this case study as a way of addressing the needs within their own schools and for decision-making in professional development practices.

Staff development and professional growth of teachers can be an avenue for great positive change in a school or it can be the very thing that can make a school and school district less successful. This is evident in the comparisons presented in this study. Teachers and educational leaders play the most critical roles in education reform, as they are on the front lines and must implement or create change. High quality, well thought-

out professional development reflects a positive and lasting effect on teaching and learning.

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APPENDICES

Appendix A

Student Questionnaire

Please circle the answer to the following questions:

What is your grade level?
3 4 5

Do you use Accelerated Math in your classes?
yes no

How many times a week do you use Accelerated Math in class?
0 1 2 3 4 5 or more

Does your teacher meet in small groups with you to work on difficult problems given by the Accelerated Math program.
yes no

Is Accelerated Math easy to use?
yes no

Answer the following questions using the scale of 1-5.
5 means strongly agree, 4 means agree, 3 means do not know, 2 means disagree, 1 means strongly disagree

I am good at math.
1 2 3 4 5

I learn more when I use Accelerated Math.
1 2 3 4 5

I have a better chance on the regular paper and pencil tests if I use Accelerated Math to practice.
1 2 3 4 5

I make good grades in math.
1 2 3 4 5

My math test scores will be higher this year than last year.
1 2 3 4 5

Math is less difficult for me when I use Accelerated Math in class.
1 2 3 4 5

Appendix B

Teacher Questionnaire

Please circle the answer to the following questions:

What grade level do you currently teach?
3 4 5 all 3

Have you been trained in Accelerated Math during a formal workshop or professional development?
yes no

If you have been trained in Accelerated Math do you feel you implement the training consistently when using the program?
yes no

Do you use Accelerated Math in your classes?
yes no

How many times a week do you use Accelerated Math in class?
0 1 2 3 4 5 or more

Do you meet in small groups with you to work on difficult problems given by the Accelerated Math program?
yes no

Is Accelerated Math easy to use?
yes no

How often do you teach mathematics?
daily weekly 2-3 days a week other

Rate the following statements from 1 to 5.
5 means strongly agree, 4 means agree, 3 means do not know, 2 means disagree, 1 means strongly disagree

Math is less difficult for my students when I use Accelerated Math in my classroom.
1 2 3 4 5

My test scores will improve in math this year partly due to Accelerated Math.
1 2 3 4 5

I feel my students have significant practice in each skill/objective when they take a math test.
1 2 3 4 5

I am a successful math teacher.
1 2 3 4 5
My students seem to like math class.
1 2 3 4 5

My students like using the Accelerated Math program.
1 2 3 4 5

My students seem to have success using Accelerated Math.
1 2 3 4 5

My students seem to achieve higher on tested skills that were mastered in Accelerated Math.
1 2 3 4 5

My students perform better when they use Accelerated Math.
1 2 3 4 5

My students like to use the computer.
1 2 3 4 5

My students have a positive attitude about math.
1 2 3 4 5

My training/professional development in Accelerated Math is important to student success.
1 2 3 4 5

Appendix C

Accelerated Math Post-Survey Questions

Prepared by Elizabeth Metcalf

Name of Respondent _____

Date of Response_____

1. Tell me when you remember Accelerated Math becoming part of the school's curriculum. If you do not know or remember when did you begin working here?

2. Tell me when you began using Accelerated Math in your classroom.

3. How much time a week did you spend last school year using Accelerated Math? How much time during each day/lesson did you spend using Accelerated Math?

4. Out of 100% of your teaching time each week how much time did you spend using Accelerated Math? How much time did you spend assessing? How much time did you spend using traditional teaching tools such as the overhead and worksheets? How much time did you spend using hands on manipulatives, again out 100%?

5. What role does/did AM play in your teaching of the math curriculum?

6. What are advantages of AM?

7. What are disadvantages or barriers to use and implementation of AM?

8. How many students were in your math class (es) last year?