Educational Technology and Teacher Perceptions: How does the technology fare in the wild?

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ABSTRACT

MathWorlds is a piece of educational software that allows students to explore a variety of topics related to the mathematics of change and proportionality, utilizing dynamic graphs and animated "worlds". SimCalc is the package of MathWorlds software plus curriculum and teacher professional development, and has a history of significant success in single classroom studies. According to Simonsen and Kensing (1998), "users will not change the way they work to adapt to a computer system if the benefits are not significant and obvious." While researchers know SimCalc has a significant impact on student outcomes, is this obvious to the teachers? One powerful source of information about this question is the corpus of extensive phone interviews that my colleagues and I conducted with teachers after they completed the SimCalc curriculum.

Many of our teachers recognized SimCalc as something that could be beneficial for their students. Besides raising test scores, teachers using SimCalc introduce more complex mathematical ideas to their students, which have ordinarily been considered outside a normal 7th grade math lesson. This was reflected in the phone interviews when treatment teachers mentioned more complex mathematical ideas than the control teachers. However, some treatment teachers struggled with using SimCalc because it was so different from their current teaching methods. In this case, SimCalc was not compatible with their current teaching methods. Also, for some teachers, using technology such as MathWorlds is a complex process with many hurdles to overcome. Future research must investigate ways to bridge the gaps in teaching methods and encourage more support for teachers using technology. By doing this researchers can make SimCalc more compatible for teachers with different teaching methods and reduce the number of obstacles teachers face when using technology in the classroom. With continued effort, research and support, we can look forward to the diffusion of more educational innovations such as SimCalc.

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1 Overview

Since the invention of the home or desktop computer, the number of computers found and used within K-12 schools has increased enormously. In 1983, there was one computer for every 125 students in American K-12 schools, but by 1998 there was one computer for every six (Smerdon et al., 2000). It is a widely held, though not uncontroversial, belief that technology should be used and taught in K-12 education. Lumpe and Chambers (2001) stated, "In order for our society to have computer-literate and functional citizens, we need to ensure that our children are obtaining the necessary modeling and training from the educators in their lives." However, technology can be used in the classroom to not only teach children to be computer literate citizens, but also help students succeed beyond traditional chalk and blackboard methods.

The National Council of Teachers of Mathematics, the Mathematical Association of America, and the National Research Council have all published reports in which they convey the importance of students developing deep and interconnected understandings of mathematical concepts. Furthermore, international studies of math performance show that American students are behind their international peers in math achievement beginning in middle school, and are less likely to master more complex and conceptually difficult mathematics (Schmidt et al., 2001; Suter, 2002, as stated in Tatar et al. 2007, in press). Math classes should introduce more conceptually difficult topics and encourage students to engage in the process of mathematical thinking. According to Kaput (1994), classrooms must be communities in which mathematical sense-making of the kind we hope to have students develop is practiced. To facilitate the growth of students' mathematical understanding, activities must be designed and used that expose students to meaningful tasks that are difficult yet encourage the exploration of mathematical ideas. Designing these activities is a challenge that can be addressed by well-developed educational software and curriculum. Educational programs hold the promise of helping teachers scaffold complex math concepts for their students.

MathWorlds is such a piece of educational software. It was developed by researchers at UMass Dartmouth, with the mission "to enable all children to learn the mathematics of change beginning in early grades" (Roschelle & Kaput, 1996). They developed the software and curriculum with the idea that students can come to understand graphs of motion pictorially before they need to master algebraic representations. MathWorlds allows students to explore a variety of topics related to the mathematics of change and proportionality, utilizing dynamic graphs and animated "worlds" or simulations. MathWorlds had a history of significant success in single classroom studies (see Hegedus et al. 2004, 2005; Nickerson et al.2000; Roschelle et al. 1996; Stroup 2004, Vahey et al. 2004). Evidence for its efficacy was still weak, because it had primarily been used in remedial circumstances, with close researcher contact with teachers and students, and with enthusiastic teachers. In short, SimCalc MathWorlds had yet to prove its viability "in the wild". The Scaling Up SimCalc study, attempted to address this by creating a controlled, randomized experiment investigating the hypothesis that the students of a wide variety of teachers could benefit from the package of MathWorlds plus curriculum and teacher professional development more than those who were given an alternative, highly rated teaching option. Researchers from SRI developed a three-week replacement unit curriculum for teaching rate and proportionality to 7th grade students employing the MathWorlds software. The first year

of the study has been completed with 95 math teachers and 1621 students in 7th grade math classes in Texas. The study followed a pre and post-test design, in which the students in both conditions were given identical tests on rate and proportionality. Researchers found that students who used SimCalc (as illustrated in Table 1) performed better on the post-test than those in the control group.

Table 1. The SimCalc intervention package

SimCalc	Software	The MathWorlds software package, with simulation files corresponding to the curriculum activities.
	Curriculum	A 3-week replacement unit on rate and proportionality, including teacher manuals and student workbooks.
	Teacher Professional Development	A 5-day summer workshop on teaching function-based proportionality and with the curriculum materials.

While this result demonstrates the successful use of technology in a variety of class settings, a number of questions still remain. One of which is, "how does teacher understanding, attitudes, and subject experience mediate the classroom implementation and the overall impact of the intervention?" This question can be addressed by a variety of data gathering and analysis mechanisms. However, one powerful source of information is the corpus of extensive phone interviews that my colleagues and I conducted with teachers after they completed the unit. These allow us to ask, "How do teachers experience the classroom events around using SimCalc and to what do they attribute the events that they notice?" Thus, this paper is about the teachers' self-reports on using SimCalc and the concerns raised by using a technology regularly in their practice.

1.1 Research Questions

In the Scaling Up SimCalc project, as with all scaling studies, the driving research question is, "how does the treatment perform when taken to scale?" (McDonald et al., 2006). Or in other words, what is the viability of the intervention. Researchers want to investigate the use of SimCalc in a variety of "real world" settings and assess the intervention's ability to endure over time. To do this, we must examine the variety of situations, settings, and opinions that teachers experience surrounding the technology and the intervention as a whole. From the corpus of phone interviews we can examine the opinions and thoughts given to us by the teachers, as well as the teachers' perceptions of the technology and curriculum. Specifically I am asking the following three questions:

RQ1) What is the variety of attitudes in our teacher population?
RQ2) What decisions and tradeoffs are teachers faced with when teaching with technology and how do these decisions affect the students' access to materials and potential knowledge?
RQ3) How do the teachers' responses to the phone interview questions predict or affect our study in terms of students' scores and participant retention?

To summarize the thrust of these questions, I would like to explore the differences and similarities between teachers who did use our intervention (treatment condition) as well as the teachers who did not (control condition). In examining the teachers' descriptions of classroom phenomena, I hope to illuminate the tradeoffs and decisions teachers are faced with in their practice. These themes could have implications for the viability of technologies and interventions such as SimCalc MathWorlds.

1.2 Approach

Once each interview was conducted, they were transcribed and coded for general themes. A complete list and description of these codes can be found in Appendix B. After the phone interview transcripts had gone through the initial coding phase, I wanted to take the codes pertaining to the three research questions described in Section 1.1 and analyze them further. To identify the codes I wanted to further analyze, I summarized the three research questions into main ideas and tried to map these ideas to potential codes. The main idea behind RQ1 is the teachers' attitudes, which directly maps the to data in the *Philosophy code*. The Philosophy code was used for whenever a teacher stated an opinion or philosophy about their practice. For RQ2, I needed to examine the teachers' opinions of technology, and classify all of the technological problems they encountered, which is contained in the *Technology code*. The main ideas behind RQ3, student scores and participant retention, did not map directly to a code as easily as the ideas behind RQ 1 and 2 did. However, one could conceive that the math topics discussed by the teachers would be an indicator of the math topics discussed in their classrooms, which would influence the student scores. Also, I believed that the administrative support in the school could influence a teacher's decision to continue with the study. Therefore I further analyzed the *Math Topics* and *Administration* codes for RQ3.

Table 2. Codes pertaining to main ideas behind research questions

	Idea	**Code Mapping**
RQ1	Teachers' attitudes	Philosophy
RQ2	Technology tradeoffs and difficulties	Technology
RQ3	Student learning gains	Math Topics
	Participant retention	Administration

1.3 Scope of this Project

As stated by Eugene Judson (2006, p.583), "when establishing any classroom innovation, it is the teacher who is the key determinant of implementation." In other words, the success of any educational intervention hinges on the teachers themselves. With respect to educational technologies, teacher beliefs in self-efficacy and the school context can affect their implementation and use of technology (Judson, 2006). Therefore it is important in studies such as Scaling-Up SimCalc to have our participants not only teach a specified curriculum with the software provided, but also participate in professional development workshops, fill out surveys on their teaching philosophy, and complete exit interviews.

However, the teacher's self report on their philosophy can often times differ from their classrooms in practice (Judson, 2006). Developers using a participatory design approach have also identified this phenomenon as the 'say-do' problem or the difference between 'ideal' and 'manifest' (Simonsen & Kensing, 1998). This suggests that we cannot rely solely on interviews to understand the relationship between teacher beliefs and practices. We must also go to the classroom and conduct field studies from which we will develop rich case studies.

Thus, I present my research in two phases:
Phase 1: Classification and Analysis of the teacher interviews
Phase 2: Thick description of unit implementation in the form of case studies.

Phase 1 is the subject of my Masters Thesis, while Phase two will be the subject of my Doctoral Dissertation.

2 Background and Related Work

This chapter of my thesis explains the opportunities and values that motivate the current work. First I place this work and approach in the larger world of debates and trends in thought about pedagogy, math pedagogy and technology. Then I describe the MathWorlds software and previous research in single classroom instances. Finally, I illustrate how this intellectual milieu has lead to the questions addressed by the current Scaling-Up SimCalc study as a whole and to the portion addressed by the phone interviews in particular.

2.1 Math Pedagogy and Technology

The math of change and variation (MCV) can be conceptualized as a strand of math learning that runs from kindergarten onwards, culminating for most children in today's American schools in Algebra and continuing for some into Calculus and beyond. In 1994, James Kaput introduced a vision in which more sophisticated ideas about MCV could be taught and learned by using interactive technologies to allow students to link measurable events and experiences to formal mathematical representations. Grounding student understanding more firmly in motion and rate phenomena and focusing on the information captured in different representations, such as graphs and tables as well as algebraic expressions, would have, he claimed the twin benefits of teaching students more and teaching more students better. That is, the strongest students would have their understanding strengthened while the weakest students would have the gap reduced between their performance and the performance of the top students. Thus, this approach would *democratize* access to advanced mathematics.

To fully understand the math of change and variation, students must be able to establish a connection between real-world phenomena and their algebraic and graphical representations. A student's ability to solve a math problem with real-world relevance, or "situatedness", relies on both the student's linguistic understanding of the problem and consciousness of the underlying mathematical structure (Weber-Russell & LeBlanc, 2004). Also, students who lack previous experience with reflection are ill prepared to engage in the reflection that is required in solving more complex problems (von Glasersfeld, 1989). Students in this situation rely on the hasty application of rules without an understanding of the underlying relations to solve problems asked

of them in math class. To expand a student's ability to represent and manipulate mathematical concepts, their education must help them move from a procedural memorization to a conceptual understanding. The implication then for learning tools is to "facilitate children's reflection on and exploration of whole structures and relationships in mathematically relevant contexts" (Weber-Russell & LeBlanc, 2004). James Kaput and his colleagues sought to do just that when they were developing their own learning tool for MCV. The developers wanted to "begin with students' intuitive experience with velocity" and "minimize computational complexity" so that a young and diverse population of students could conceptualize and understand the math of change and variation (Kaput, 1994). This resulted in the development of the MathWorlds software, which linked graphical representations to a "world" that could simulate real-world phenomena.

2.2 MathWorlds

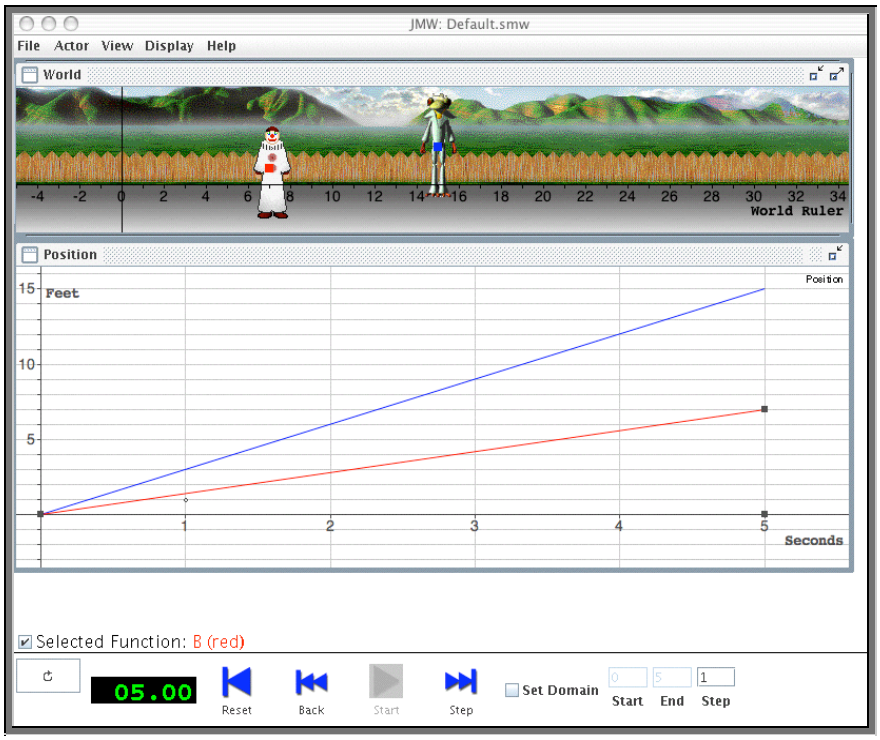

Figure 1. SimCalc MathWorlds running on MacOSX platform

The MathWorlds software supports dynamic graph creation and manipulation, in which graphical representations are tightly coupled with representations in a simulation "world". Students can step through the motion graph, observe characters in the world, and examine tables with corresponding values. The graphs can be directly edited with the mouse, and the simulation world and tables will immediately reflect these edits. In the image above (Figure 1) the red line represents a character known as "Clown", and the blue line represents the character known as "Dude". With this particular SimCalc graph and simulation, the two characters would start at position zero, and when the student presses play the characters will move in correspondence with the graph, arriving at their final position of 7 for the Clown and 15 for the Dude after 5 seconds. There are several worlds the students can interact with, such as elevators in motion, ducks

swimming across a pond, and clowns marching across the screen. The designers of SimCalc decided to implement five key innovations into the software: definition and direct manipulation of graphically editable functions, hot links between graphically editable functions and their derivatives or integrals, connections between representations and simulations, ability to import physical motion, and the use of physical/cybernetic devices (Hegedus, 2004).

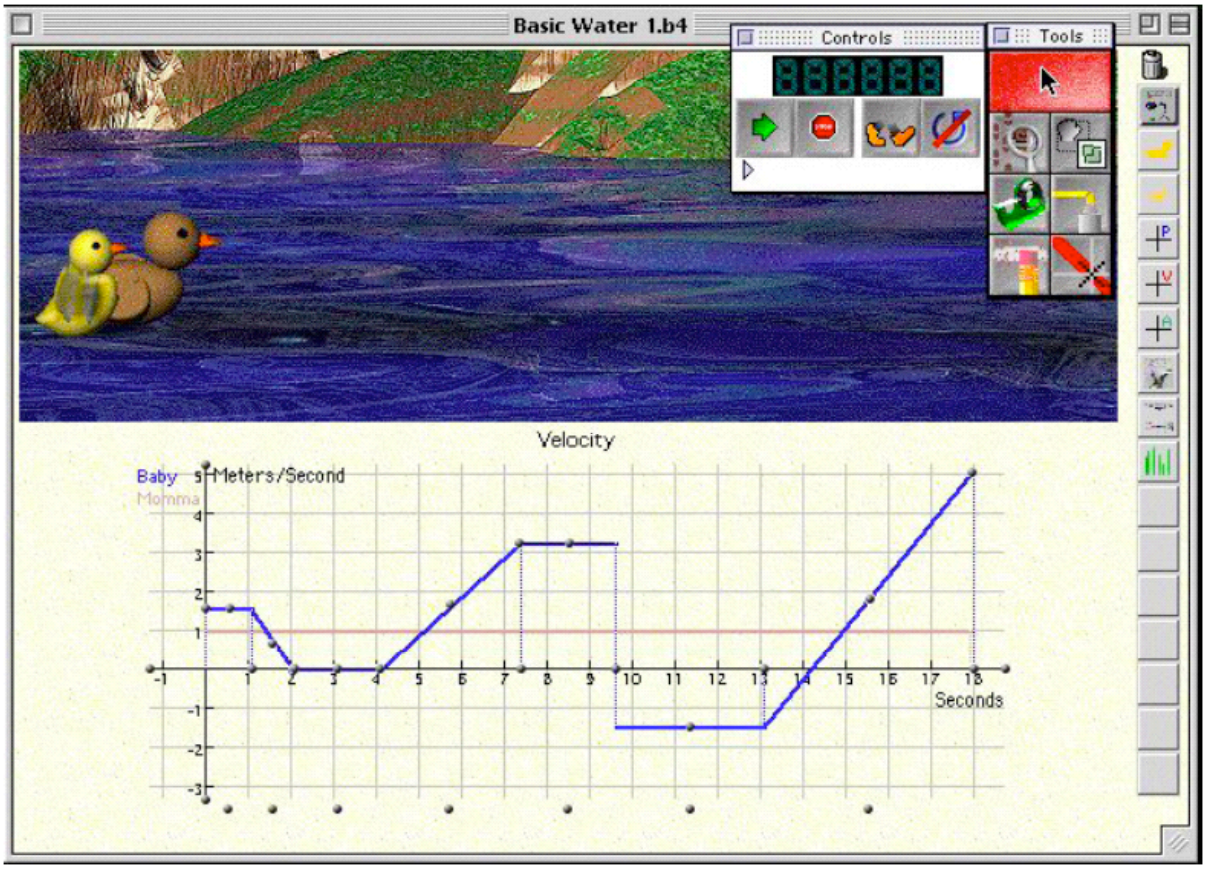

Figure 2. SimCalc - Ducks swimming across the pond

The SimCalc MathWorlds approach presents Calculus ideas graphically rather than algebraically, which allows for the student to first understand the concepts pictorially and then move to numeric and algebraic functions later. Students can play the simulation to watch the characters move in correspondence to the position graph they created, therefore experiencing the mathematical constructs of algebra and calculus as dynamic, motion based events. The developers wanted MathWorlds to be available on as many platforms as possible, so they decided to write the software as a Java application. MathWorlds is available on PCs and Macs, as well as hand held devices such as TI-83 calculators and Palms.

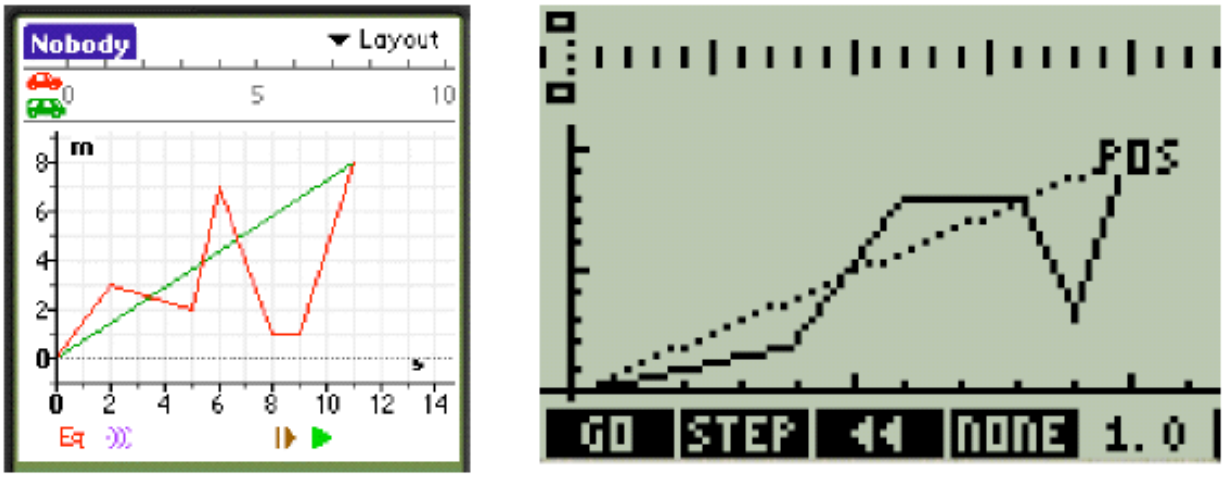

Figure 3. SimCalc/NetCalc running on a Palm (right) and a TI83 (left)

The creators of MathWorlds understood that "software re-use, integration, and activity authoring" were critical aspects that any educational program must embody if it has any hope of widespread success (Roschelle & Kaput, 1996). For this reason, they developed MathWorlds to have drag and drop capabilities, so that teachers and students could easily author and layout their own activities. They also made use of AppleScript and AppleGuide innovations on the MacOS platforms to integrate MathWorlds with Eudora email and MacMotion software, as well as allow teachers to author guides to suit their students.

2.3 SimCalc MathWorlds Use in Individual Classrooms

One reason that students are hindered in their ability to master advanced math ideas is that a number of assumptions are made about math pedagogy. As Stroup (2004) puts it:

> "We assume in our curricula and in our teaching that calculus is a subject to be studied well after the basics are mastered and only after a long series of prerequisite coursework has been taken. As a result, most of our students do not progress as far as calculus." (p. 180)

Teachers are often told to address raised standards of learning without much support and no time to address advanced math concepts in an already crammed schedule. To combat this problem, Dr. Stroup suggests that advanced mathematics concepts can be introduced simultaneously with the basics when using a powerful simulation environment. He presents examples of 6th grade students completing activities with the MathWorlds software. In all of the activities the students engage in calculus reasoning while developing their basic skills to complete the problem. Dr. Stroup concludes that, "using mathematical contexts closely associated with the study of calculus can be helpful, in very practical ways, in supporting our students' developing understandings of what we often refer to as 'basics'." With the help of simulation software such as MathWorlds, math skills like subtraction, addition, multiplication, and division can be used and mastered while developing advanced mathematics reasoning.

Susan Nickerson, Cherie Nydam, and Janet Bowers from San Diego State University also studied the possible use of MathWorlds in classroom settings. They saw that the MathWorlds software focused on graphing instead of algebraic equations, and felt this was advantageous for students because it allowed them to connect the character's motion with a graphical representation without first having to master algebraic equations. The researchers developed a curriculum for MathWorlds with three main themes: "1) graphing in the coordinate plane, 2) writing and evaluating algebraic expressions, and 3) understanding rate and change" (Nickerson et al. 2000, p. 2). They then observed the teacher and students while they worked with the curriculum and software. The researchers found that from the students' point of view, "the use of technology enhanced the appeal of doing mathematics for a reason", and from the teacher's point of view, "the technology provided a context in which to ground abstract algebraic concepts". They also found from a post-test administered to the students, that "students gained in understanding a number of pre-algebra concepts". However, the authors recognized that there were some pragmatic difficulties in teaching with technology. The teacher had a difficult time attending to over 30 students in the computer lab setting, and it was "daunting" to create an entire instructional sequence (Nickerson et al., 2000).

The researchers at SRI had a vision that computers would be used frequently and integrally in K-12 classrooms. One reason that this vision has not yet been realized is that teachers often encounter difficulty in scheduling and using school computer labs (Tatar et al., 2003). However, there is one piece of technology that is frequently and easily used throughout American schools: the graphing calculator. Around 40 percent of high school math classes use graphing calculator, while only 11 percent use computers (Becker et al., 1999). Researchers at SRI sought to leverage the widespread use and acceptance of graphing calculators and handheld devices when they developed NetCalc, a version of SimCalc MathWorlds for Palms. NetCalc was co-developed with researchers, software developers, and two teachers. Developers did not want NetCalc to just be a scaled down version of SimCalc, but a separate tool that leveraged the small screen size and beaming capabilities of handhelds. Their efforts resulted in a design with four separate activities: Exciting Sack Race, Match My Graph, Slot Machine, and Aggregation. The researchers then evaluated the use of NetCalc in an advanced 8^{th} grade math classroom located in the San Francisco Bay Area. The students performed significantly better on the post-test evaluation than on the pre-test. Furthermore, students using NetCalc outperformed high school students taking the AP calculus exam. This study demonstrated the potential impact of using the SimCalc innovation on small, affordable, and easily accessible handheld devices (Vahey et al. 2004).

Over the past decade, researchers have gathered evidence that supports the relative advantage of the SimCalc innovation. First, the researchers were able to show ordinary students learning more complex mathematics. They could also articulate the potential advantage of using new representational capabilities to draw upon learner's strengths and the need to change curriculum in schools to be more learnable. Shifting to controlled design experiments with carefully defined outcome measures, the team was able to show a causal relationship between SimCalc and enhanced student learning (Tatar et al., 2007, in press). In these experiments they found that elementary, middle school, high school, and remedial college students could use SimCalc to understand key concepts in Calculus (Roschelle & Kaput, 1996). But are these studies evidence enough to prove the capability and viability of SimCalc? While the results are promising, the

research team still needed to show that SimCalc could be used by a wide variety of teachers and students in a wide variety of settings.

2.4 The Scaling Up SimCalc Project

Currently in our country, every state administers some form of mandated statewide testing to their students. The teachers, principals, and district superintendents are expected to explain the results of these tests and seek ways to improve their students' scores. Teachers also have a constrained amount of time to spend with their students, which pressures them to teach as quickly and effectively as possible. Educators do not have the time, resources, or support to try new educational innovations unless they can be sure that they will work. Educational researchers are charged with the task of creating and identifying curricula, pedagogy, and professional development activities that result in improvements across a broad range of settings. They must also demonstrate and explain the results of such advancements to teachers seeking new methods. This means that researchers must develop interventions that work not only in single classroom instances, but that work "at scale" (McDonald et al., 2006).

2.4.1 Study Rationale

As illustrated in the Section 2.3, over the past decade SimCalc MathWorlds has been evaluated in numerous small-scale studies showing positive and promising results. Because MathWorlds showed such promise and potential in the smaller studies, the SimCalc researchers believed they should "spread the word" about SimCalc to a larger number of teachers in hopes that it would be adopted for widespread use. In order to do this, the researchers needed to assess how their technology and curriculum would fare in the wild, where there is a large amount of variability in the teacher levels and school settings (Tatar et al. 2007, in press). This led to the development of the Scaling Up SimCalc study, with the hypothesis that a wide variety of students from a wide variety of settings can benefit from the use of SimCalc MathWorlds.

2.4.2 Study Design

The researchers chose a delayed treatment design with two conditions to test their hypothesis. The experimental, or treatment group, was assigned to use SimCalc during year one, while the delayed treatment, or control group, was assigned to use SimCalc during year two. Students from both conditions were given a pre-test before their unit on rate and proportionality, as well as an identical post-test once the unit was completed. The study design is illustrated in the diagram below (Table 3).

Table 3. Experimental Design

	Year 1			Year 2		
Treatment	O_1	X	O_2	O_3	X	O_4
Control	O_1		O_2	O_3	X	O_4

The researchers understood that whatever location they chose to base their study would have implications on how the study would be conducted, as well as the generalizability of their results.

They wanted a place that would welcome involvement in a study such as theirs but was also diverse in teachers, students, and settings. The researchers chose to base the Scaling Up SimCalc study in Texas for three reasons:

1.) The SimCalc researchers partnered with The Charles A. Dana center, which oversees math and science teacher professional development in Texas, and has a good relationship with teachers and schools.
2.) The State of Texas gathers comprehensive yearly data about schools and teachers that helped characterize our sample.
3.) State standards and testing have been in place in Texas for longer than other states, and are more stable and mature.

Although the researchers wanted to choose a grade level that focused on rate and proportionality, like 8th grade algebra, they did not want to choose a "high-stakes" class. This is because teachers of high-stakes classes might feel anxious and less inclined to try a new, experimental teaching method. Since proportionality is a central topic of 7th grade, yet not considered high-stakes, 7th grade math classes and teachers were chosen to be participants in the study (Tatar et al., 2007, in press).

7th grade math classrooms in Texas typically focus on a formula-base approach to rate and proportionality (a/b = c/d). A formula-based approach requires the student to solve for a single unknown value when given three numbers in a proportional relationship. A more advanced approach to rate and proportionality is function based (y=kx). A function-based approach requires students to find a multiplicative constant that maps a set of inputs to a set of outputs. The researchers felt that in order to show that the intervention was successful, they would need to show that students with the intervention (1) learned standard mathematics to the same degree or better than their peers and (2) learned mathematics beyond what is normally taught (Tatar et al., 2007, in press). This required that the pre and post-tests would evaluate the students on standards for their grade level, as well as more advanced topics. To develop the pre and post-tests, the researchers used questions from the "TAKS", or Texas standards exam, to evaluate requirement number one. The TAKS (Texas Assessment of Knowledge and Skills) mathematics exam for 7th grade focuses on formula-based questions. To test requirement number two, the researchers developed additional function-based questions on rate and proportionality.

However, the researchers wanted to make sure that teachers in both the control and treatment conditions were exposed to the idea of teaching function-based proportionality. Therefore, all teachers attended a 16-hour TEXTEAMS workshop. TEXTEAMS is a teacher professional development workshop developed by the Dana Center in Texas. It was chosen for the study because it is "highly regarded and represents the state of the art in teacher professional development around the topic of rate and proportionality" (Tatar et al. 2007, p. 21, in press). The following diagram summarizes the sequence of events for year one that the teachers experienced while participating in the study (Figure 4).

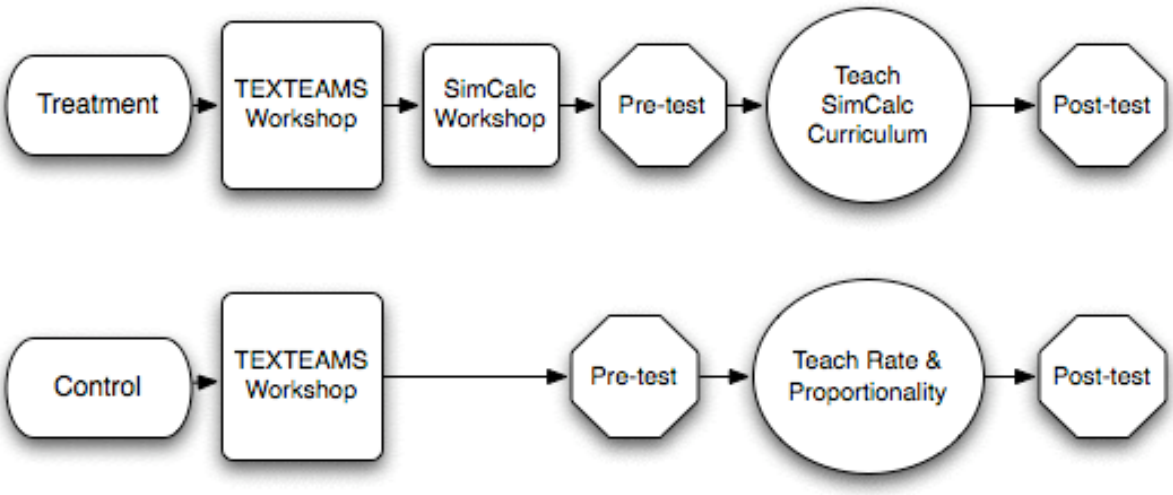

Figure 4. Participant timeline for year one

2.4.3 Pilot Study

As can be imagined, scaling studies can be large, and potentially expensive undertakings. Once a scaling study has been started with a large number of participants, any errors can become costly to fix. To mitigate the chance of such errors arising, the researchers decided to run a pilot study. 25 teachers applied to participate, and they were randomly assigned to the treatment or control condition. The students of control teachers started with slightly higher pre-test scores than the students of treatment teachers. But despite the initial advantage, students of treatment teachers had significantly higher learning gains, learning gain being the difference of the student's post-test score from their pre-test score.

2.4.4 Year one Study Results

Year one of the study has been completed with 95 teachers and 1621 students in 7th grade math classes throughout Texas. Students in the treatment condition had a significantly higher mean difference score, or gain score, compared to their peers in the control condition. This indicates that students from the treatment group learned more than students in the control group. Furthermore, students in the treatment condition did even better than students in the control condition on the complex, or function-based, portion of the test.

2.5 Role of Phone Interviews

It is important for educational software and curriculum developers to pay attention to the difficulties that teachers face with raised standards of learning, busy schedules, and state mandated testing. With the "No Child Left Behind Act" enforced on the federal level and other statewide testing, teachers feel pressured to teach as effectively as possible within a very short time period so that their students "pass" requirements outside their own classrooms. Here is how two of the teachers in our study put it:

> "The problem was the state of Texas gives what you call a TAKS. It's a lot of pressure." - Teacher in the Treatment Condition

> "If it takes one semester to get kids to understand fractions, then I believe that one semester ought to be spent on that until every child can comprehend what a fraction is, what it does. The same thing about rate, proportion - all the basics. With the new TAKS, with the "No Child Left Behind", it is - [we] are teaching to the test." - Teacher in the Control Condition

According to Simonsen and Kensing (1998), "users will not change the way they work to adapt to a computer system if the benefits are not significant and obvious." While researchers know SimCalc has a significant impact on student outcomes, is this obvious to the teachers? If the positive results of using SimCalc are not obvious to teachers, who are already pressured to teach their students a broad range of topics within a short period of time, what motivation would they have to continue using SimCalc beyond their involvement in our study? As we will see later in this document, many of the teachers in our study had students in their classrooms that struggled with "the basics." While Dr. Stroup asserts that teaching calculus concepts can also help students learn the basics of math, is this apparent to our teachers? The answer to these questions could seriously impact the widespread use of any educational software or intervention.

Besides examining the struggles and pressures teachers face in their practice, we must examine how they feel about technology in education specifically. As stated by Berkowitz and Donnerstein, "The meaning that the subjects assign to the situation they are in and the behavior they are carrying out plays a greater part in determining the generalizability of an experiment's outcome than does the sample's demographic representativeness or the setting's surface realism" (Berkowitz & Donnerstein, 1982). Many teachers have an opinion or meaning that they assign to the role technology can/should play in the classroom that will influence their instructional decisions and acceptance to a new technology. One of our control teachers from the study expressed their opinion of educational technologies they tried before:

> "I haven't found – a lot of computer programs just seem like they're so expensive for what you get out of them. I would like one that would be really advantageous for students, but not just 'something to do when we don't have anything else to do' type program." – Quote from a Control teacher.

It appears that this teacher has only found technology useful when there is "nothing else to do" and not as a viable tool to use regularly. Other teachers find technology difficult to use within a classroom because they lack experience or the management overhead associated with using the computer lab in their school is too great. This is expressed succinctly by one of our treatment teachers:

> "We're constantly told about technology and we need to use technology and we're like, 'it's fine if it's working.' And when it doesn't work, you just lose a lot of time." – Quote from a Treatment Teacher

In both cases we could see that the teacher's understanding and perception of technology would influence their use of SimCalc or any other technology in the future. Also, by conducting phone interviews we can categorize and examine unexpected problems and circumstances that surround our intervention. This is why I am analyzing the interviews of teachers in the Scaling-Up SimCalc study, to identify and categorize teachers' perceptions of the software and intervention.

3 Methods

3.1 Phone Interview Protocol

3.1.1 Scheduling

A researcher first contacted the teachers to verify that they were approaching the end of their unit and to inform them who would be conducting their post-unit interview. Then the assigned interviewer would contact the teacher by email, and by phone if necessary, to schedule the interview. The interviews were scheduled within 10 days of the teacher's completion date. Once the interview time was scheduled, the interviewer would enter this information onto a password-protected wiki that only interviewers and other members of the research team had access to. When the interview was complete, the interviewer would save the file as the date the interview was conducted on.

3.1.2 Script

We used a semi-structured interview. The questions were divided into the following six topics: Teaching Experience, Math, Technology, Students, Collaboration, Support, and Research. There were also additional "wrap-up" questions at the end of the interview. The interview script can be found at the end of this document as Appendix 1.

3.2 Data

An outside corporation transcribed all of the interviews. Then the interviewer would check the transcripts for errors and correct any that they found. Each interview transcript was then loaded into NVivo. I used NVivo for coding the interviews.

3.3 Phone Interview Statistics

My two colleagues and I conducted 95 interviews in total, which amounted to 5163 minutes. 48 of those interviews were with control teachers for a total of 2399 minutes, while the remaining 47 were with treatment teachers for a total of 2764 minutes. The average control interview lasted 50 minutes, with the shortest being 21 minutes and the longest lasting 1 hours and 55 minutes. The average treatment interview lasted 59 minutes, with the shortest being 29 minutes and the longest lasting 2 hours and 7 minutes.

3.4 Teacher Demographics

During the interview, each teacher was asked their age and ethnicity, as well as if they had any other careers besides teaching before. There were 46 treatment teachers and 47 control teachers who answered these questions. The average age of the control teachers was 41, with the youngest teacher being 26 and the oldest 58.The average age of the treatment teachers was 42, with the youngest being 24 and the oldest 62. The following table illustrates the ethnicities of the teachers in both groups.

Table 4. Teacher demographics

Ethnicity	Treatment	Control
Caucasian	34	32
Hispanic	11	13
African American	1	0
Asian	0	2

20 of our treatment teachers and 21 of our control teachers had had other careers before teaching. Of the treatment teachers, 3 worked in Sales or Retail, 4 were Engineers, and 3 had been in the military. The rest of the treatment teachers said they had worked as accountants, social workers, tutors, and bankers. Of the control teachers, 2 worked in Sales or Retail, 4 were Engineers, and 2 had been in the military. The rest of the control teachers said they had worked as accountants, restaurant managers, secretaries, nurses' aids, or at rehabilitation clinics.

4 Analysis

An important question to ask before beginning the analysis of our data is what exactly can our data tell us? Specifically to this research, what data is there and isn't there in teacher phone interviews? As mentioned earlier, it has been recorded that a teacher's self report of their teaching pedagogy can differ greatly than from what they do in practice. Clifford Geertz described culture, and the subject of anthropological inquiry, as "stories people tell themselves about themselves." It is fitting then that I should describe the subject of my qualitative study, teacher phone interviews, as stories teachers told me about themselves. These stories tell me what happened in the classroom through the teachers' eyes, as well as the teachers' opinions on the classroom events and setting. To collect and categorize the teachers' stories, I developed a set of categories that were used to code the interview transcripts. These codes served as a means to collect similar opinions expressed by a variety of teachers.

The coding scheme was developed from the goals and reasoning in conducting the interviews, and from questions directly asked in phone interview protocol. The coding scheme evolved over time as the interview transcripts were analyzed and themes began to emerge. In particular, the Class Management, Philosophy, and School Description codes were developed after analysis of the phone interviews began, because I found that many of the teachers would describe class management issues, their particular school settings, and their opinions of what could or should be done in schools. Below is a list of the codes and their descriptions (Table 5):

Table 5. Over-arching coding scheme

Code	Description
Class Management	Descriptions of the class, materials, and instruction that reflected choices the teacher made.
Philosophy	Any opinions the teacher expressed.
School Description	Description of the school/community/district or policy that is outside the teacher's control.
Materials	Any discussion about materials used in teaching the unit.
Teacher Classification of Students	Description of the students the teacher has in the target class.
Technology	Any description of technology used at their school, including problems encountered, set-up, frequency of use, student and teacher comfort levels, and technologies beyond what the project provided.
Math Topics	Discussion of mathematics topics taught within the unit.
Administration	Description of the school administration and their support of the teacher/project.
Other Teachers	Description of other colleagues the teacher may have worked with.
Project Perceptions	Discussion about participating in the research project itself.

Once all of the phone interview transcripts had gone through the initial coding phase, each code was brought to light and broken down further into smaller subcategories for analysis. A list of all of the codes, their subcategories, and descriptions can be found in Appendix B. For this document, I focused on the Philosophy, Technology, Math Topics, and Administration codes. In the following sections I will illustrate the analysis and results that came from these codes.

5 Results

5.1 Summary of Phone Interviews

During the phone interviews, teachers enumerated on all of the things that went well or were difficult while they were teaching. Many teachers started describing what went well or poorly at the very start of the interview, when we asked, "Overall, how did teaching rate and proportionality go this year?" In the following table, I describe the topics treatment and control teachers described as going well.

Table 6. Discussion of what went well while teaching rate and proportionality

Topic	Description
Technology	The treatment teachers would often describe the SimCalc MathWorlds software as a useful resource for their students.

Materials/Curriculum	Treatment teachers would discuss the SimCalc curriculum and workbooks, and control teachers would discuss TEXTEAMS materials or other textbooks.
Teaching	Both control and treatment teachers mentioned that they enjoyed teaching rate and proportionality this year.
Math	Both control and treatment teachers would mention specific math topics that went well for their students.
Real-World	Treatment teachers would say that the "real-world" settings presented in the SimCalc curriculum were beneficial for their students.
Test	Both control and treatment teachers said their students did well on assessments, and felt that their students' success on these assessments was an indictor of the students' understanding of rate and proportionality.
Students	Both control and treatment teachers mentioned how they enjoyed the group of students they worked with this year.

Overall, there were a wide variety of topics discussed that went poorly for teachers over the year. The discussion ranged from dealing with students who had behavior problems to coping with loss in the family while continuing to teach. In the following table I describe the topics that went poorly for teachers.

Table 7. Discussion of what went poorly while teaching rate and proportionality

Topic	**Description**
Time	Both treatment and control teachers mentioned that they didn't have enough time in the class period to teach effectively. Also, many treatment teachers thought that the SimCalc unit was too long.
Technology	Many of the treatment teachers said that it was difficult to teach in a computer lab or they experienced technical problems.
Students	Both treatment and control teachers described having students that were low in ability, spoke English as a second language, frequently missed class, wouldn't turn in homework, or had behavior problems.
Math	Both treatment and control teachers described math topics that their students struggled with.
Materials/Curriculum	Both treatment and control teachers would describe problems they had with the SimCalc unit, TEXTEAMS materials, or other materials provided by their school district.
School Interruptions	Many of the teachers had difficulty dealing with school and class time interruptions.
Teaching	A few of the treatment and control teachers felt apprehensive or nervous teaching new curriculum.
Test	A few treatment and control teachers felt that their students did not do well on assessments.
Co-worker	A few teachers mentioned that they had difficulty with co-workers.
Outside Stress	A small number of teachers described tragedies that had happened in their lives while they were teaching.

5.2 Philosophy

During the interviews, teachers would sometimes give their opinions or philosophy about certain aspects of their careers. All of these statements were captured in a "philosophy" code. I chose to call the code "philosophy" because a few of the teachers would start a sentence with "my philosophy on the mater is…." Also, the teachers were directly asked if they usually participated in studies such as Scaling-Up SimCalc, and whether they liked trying new things in the classroom. All of the statements in the philosophy code were broken down into subcategories that can be seen in the following table:

Table 8. Break-down of the Philosophy code

Philosophy Code Subcategories	Description
Participating in Studies • Routine • New	The teachers were asked if they usually participated in studies, to which they either said it was routine in their lives or a new experience.
Try Something New • Cautious • Will try them	The teachers were asked if they liked trying new things in the classroom, to which they either said they were relatively cautious or that they did try new things regularly.
Type of Teacher	Interviewees would sometimes describe themselves with reference to their teaching style and learning style.
Students • Ability • Pride	Interviewees would describe their students in terms of ability and pride.
Teaching Methods • Method presented (SimCalc/TEXTEAMS) is something new • Method presented (SimCalc/TEXTEAMS) is like what they usually do • Making mistakes/Struggling with math is seen as a good thing • Making mistakes/Struggling with math is seen as a bad thing	The teachers would characterize their teaching methods as either the same or different from the method presented by SimCalc. Also they would say whether they felt that students struggling with math topics could be seen as a good thing or not.
Policy	Teachers would describe the current school policies and what they felt about the policies.

5.2.1 Trying new things and participating in studies

During the interviews, the teachers were asked two questions: (1) Is participating in studies like SimCalc new for you or pretty much the way you do things? (2) Do you like to try new things in the classroom or are you pretty cautious? The responses to these questions were put in the philosophy code, and out of the 95 teachers interviewed 92 of them responded to the question. The results of these questions can be seen in the table below, for both treatment and control conditions.

Table 9. Treatment and control teacher comments on trying new things and participating in studies

All Teachers	Routine to be in studies	New to be in studies	Totals
Cautious	6	15	21
Likes to try new things	53	18	71
Totals	59	33	92

You can see that most of our teachers like to try new things in the classroom (71 out of 92) and participate in studies like this routinely (53 out of 92). By performing a Chi-square analysis on the table you get $\chi^2(1) = 14.96$ ($p < 0.001$). This means that those teachers who claim to routinely participate in studies such as ours also claim to enjoy trying new things in the classroom. Nonetheless, there are a substantial number of study participants in both treatment and control groups who claim to be cautious, and around a third do *not* routinely participate in studies.

5.2.2 Type of Teacher

During the phone interviews, some teachers would make comments about the type of teacher they are. Out of the 47 treatment teachers, 10 of them made 13 comments like this. And out of the 48 control teachers 9 of them made statements like this. While reviewing these comments there were a few themes that developed:

Table 10. Type of teacher themes

- How teachers felt about using review/repetition in teacher their students.
- Whether the teacher believed in giving homework to their students.
- How they felt their own confidence affected their students.
- How they felt their teaching style is different than that of co-workers or peers.
- How they let their students play the role of teacher.

5.2.2.1 Review/Repetition

There were 3 treatment teachers and 1 control teacher that stated an opinion on the use of review/repetition in their practice. The three treatment teachers all felt that repetition was useful in the classroom and reinforced their students' learning.

Table 11. Treatment teachers viewing review/repetition as helpful

○ "Throughout the year I'm one I always teach something and I bring it back again and again and again. That's just the way I do it."
○ "When they finally see it the third time, they're going to rock the boat. They are going to blow it out of this world because it's there. You know, like I said, repetition is the only way to learn."
○ "Because sometimes, if you say one more time, these guys are going to get it. And the other ones, sometimes, maybe the third time you explain it, they get it."

However, the one control teacher who stated their opinion about repetition did not like to use drill and practice in the class, and felt that using the TEXTEAMS materials in class enforced that technique.

Table 12. Control teacher did not like review/repetition

○ "I'm not real big into the whole drill and practice thing and that's what it turned into."

5.2.2.2 Believing in Homework

Two treatment teachers stated their opinion about assigning homework to their students. One of the teachers felt positively about it while the other did not believe in assigning homework.

Table 13. Treatment teacher beliefs on homework

○ "I am a big believer in homework."
○ "I'm not a real strong believer in homework because from prior years I found if it's in my classroom I have total control on who's doing what."

5.2.2.3 Teacher Confidence

Two of our teachers made comments about how their own confidence affected their students. One of the teachers was in the treatment condition, while the other was control. The treatment teacher felt that his/her students knew when (s)he was or wasn't comfortable and that passed onto their students.

Table 14. Treatment teacher commenting on teacher comfort

○ "If a teacher feels more comfortable with it, I think that feeling of comfort passes onto the student. If I'm uneasy about it or unsure, then I'm not going as smoothly as I need to and that passes on to the students. And I think the ones - the sections that we're more comfortable with - they become more comfortable with it because - does that make sense?"

The control teacher felt that when (s)he was confident in his/her teaching, his/her students would do better.

Table 15. Control teacher commenting on teacher comfort

○ "I really thought that they would do better because I was more confident myself in the way I was teaching it and I think that helps them."

5.2.2.4 Teaching Style different from Co-workers or peers

There were 6 teachers who felt their teaching style was different from the co-workers or peers, 3 of them were treatment and 3 of them were control. One of the treatment teachers felt that their style of teaching was different from their co-worker's, and that prevented them from collaborating together. The other two treatment teachers commented how their style of teaching was different from the other teachers they met at the summer workshops.

Table 16. Treatment teacher's teaching style differs from co-worker

○ "I would say that I'm more of a direct tell-the-students-what-they-need, give them some kind of problem to work out, to learn something and then have them practice and work on it. Her style is more kind of here's-how-you-do-it, here's a problem to work, I'll explain - we'll go through those problems, I'll show you how to do those problems, we'll talk about the vocabulary, she does a lot of projects, and then we'll do this project to build on what we learn."
○ "It was funny because I was curious if they would notice that because I remember at the teacher workshop, some of the teachers - I was a little bit of a contrarian - some of them said, 'that's not modeling real life. We really shouldn't have a bus that goes over 50 miles an hour.' 'Well, no, I think it's kind of cool.' Because nobody's going to get killed and the kids loved that when the bus goes so fast. And the more timid ones say, 'did I make a mistake? It says the bus is going this fast. Can I make the bus go fast?' So, I think that kind of irreverent stuff is really good. You don't want it so far out because you want them to reality check their answers but I think a certain amount of irreverence is good. I would probably put more in there but I know from the workshop that some teachers aren't as comfortable with this as I am. You've got to appeal to the masses."
○ "Oh, I loved the SimCalc training. I thought it was good and I felt somewhat different from the average participant there. Most of the participants in my group didn't seem as comfortable. I know that, when we did the training, not only the unit but it continued on into how you could use this to bridge to calculus, and I was really surprised. I just don't have much exposure that middle school math teachers really don't have as much math training or exposure on beyond the level where they're teaching. A lot of middle school math teachers were more of a K-8 sort of side. Many of them said they had never taken calculus, which I'm a believer that you really need to be lot a whole lot of levels ahead of your kids to know where you're headed. So, that's probably my strength is that I know what other math is coming up."

One of the control teachers also felt that his/her teaching style was different from a co-worker's, and that this prevented them from working together. Another teacher said they didn't see the benefit in changing their teaching style to what was presented in the TEXTEAMS workshop like

the other teachers did. The last control teacher felt that other middle school teachers did not appreciate the use of manipulatives in the classroom even though they are helpful for students.

Table 17. Control teacher's teaching style differs from co-worker

○ "They - well, the other eighth grade teacher in our campus, she's very different. We have different philosophies. Yes, unfortunately. I believe in practicing and I believe in the students doing it themselves. I believe in guiding the students, but she doesn't - we don't, no we don't plan together or things like that." ○ "I don't like using something else somebody's done and if I look at it and I don't say, 'What's the benefit of this? What's this accomplishing?' I don't see it. Some of the things I see, I don't see it. Some of the TEXTEAMS things, I don't think they have any benefit. I really don't." ○ INTERVIEWEE: I did a lot of visual. INTERVIEWER: Now, when you say "visual," what do you mean? INTERVIEWEE: Visual and manipulatives. INTERVIEWER: Like some examples? INTERVIEWEE: Exactly the way she did it in the unit, the training we did this summer was the kind of stuff I did with my kids on a regular basis, all the time. And I know, and I think, that some junior high teachers get away from that, get away from doing - they go to the training and they sit through all the physical, the kinesetic stuff, the manipulatives and all that kind of stuff. But, I don't really think that they use it in their classroom. I don't think they take it back and use it.

5.2.2.5 Students as teachers

Two teachers felt that students could play the role of teacher in the classroom; one of them was a treatment teacher while the other was control. The treatment teacher described a time that a student helped when (s)he got confused herself.

Table 18. Treatment teacher describes students as teachers

○ INTERVIEWEE: One of the times, I was giving directions and I was telling them what to do as I walked around and one of the kids said, 'no, no, no. that's not the right way. Why don't you do it this way instead?' and I was like, 'no.' and it got to the point where I was very confused. I didn't know what to do and finally she takes over. 'let me tell you what we're going to do.' And I was, 'okay.' 'This is what's going to happen' and she starts telling everyone, 'now follow this and follow that' and I'm sitting going, 'oh, I see it now.' INTERVIEWER: And little role reversal, huh? INTERVIEWEE: Right. I don't mind if that happens and like I tell them, 'you all are my teachers, too. I learn a lot from you guys.' They all think it's funny and they giggle about it. But, that's how I feel. I do get a lot of out of them.

The control teacher said that after (s)he taught a topic (s)he would often ask the students to teach it again to the rest of the class.

Table 19. Control teacher describes students as teachers

○ INTERVIEWEE: I've been teaching the way that I always teach which is okay; I'm

going to introduce this lesson. I have the students practice the lesson and then I have them work in groups. Once they understand what they've been learning, I have them teach it…
INTERVIEWER: Uh huh.
INTERVIEWEE: …to the rest of the class. Okay, now you're going to teach it to me. You know?
INTERVIEWER: Uh huh.
INTERVIEWEE: And I like to do that because that reinforces their learning.

5.2.2.6 Using Technology with Teaching

When asked if they had ever used technology in the classroom before, two control teachers gave their opinions about how effective or useful technology could be in educational settings.

Table 20. Control teacher comments on using technology

- "I do it some. It's really hard to bring in much technology in addition to trying to teach everything that I need to teach in order for the kids to succeed on the TAKS test. I realize of course, if I incorporated it really well, they might do better but I can't always count on technology to teach directly what the kids need to know. I can count on it to reinforce and, when I have time, it's good for them to investigate and do a little discovery. But, until there's some program that can teach it better than I do in the time frame in which I have to work, I don't use technology much for direct instruction."
- "I would love to. I would love to be able to incorporate technology because I think it's very important. Everything nowadays is computer and our students need to know how to incorporate that in their learning. I've had some training, but yet not enough that I feel comfortable in saying, "Okay, kids this is what we're going to do. We're going to go to the computer lab and do this." I wish I did"

5.2.2.7 Singular Opinions on Teaching Style

The rest of the comments made about teaching style were singular instances with specific teachers. One treatment teacher felt that they needed to teach to the high students in their class.

Table 21. Treatment teacher comment on teaching to high students

- "I'm going to teach to the high because they're going to - and the other one's still catch up and they will catch on."

A different treatment teacher felt that, while using SimCalc, it was important for the teacher to act as a facilitator as opposed to a lecturer.

Table 22. Treatment teacher comments on being a facilitator with SimCalc

- "This has got to be a very much a facilitating. You have to be facilitator, not a lecturer. I don't think it would work if you stood up there and just lectured. Just be the facilitator because the program will - it will initiate the discussion."

One treatment teacher described their own learning style, and how it is different than his/her students and that causes difficulties while teaching.

Table 23. Treatment teacher comments on his/her learning style

○ "They were very excited about being able to move the line on the graph and being able to move the runners and so I thought that was a very good visual for them. Because a lot of them are visual learners. I'm not but…so that was the hard part for me. I'm not a visual learner but teaching them…Because I see with numbers, I guess because I'm a math teacher, I see with numbers. I'm not used to using pictures."

One control teacher had a specific method for moderating his/her students' behavior, that (s)he called "capturing kids' hearts".

Table 24. Control teacher comments on moderating student behavior

○ **"**I also am applying - I went to a - it's not really concepts-based but it's behavioral based. It's capturing kids hearts and so my - the way that I govern my classroom has completely changed based on that. We built social contracts. The students basically came up with the guidelines in the class and so they buy into the system for social contracts. They all sign it and then they help each other out. It's basically a team atmosphere in the classroom. They can't discourage each other. If they put someone down, we call them fouls. If they put someone down or make a rude comment, they have to give two put-ups or two positive comments to them because of that. So, it builds a conducive environment for kids to actually learn so they are not scared to ask questions and things like that."

5.2.3 Teaching Methods

5.2.3.1 Method presented (SimCalc/TEXTEAMS) is something new

Some of the teachers commented on the teaching method presented, either in the SimCalc or TEXTEAMS workshop, as being a new approach for them. Out of the 47 treatment teachers, 6 of them made a comment like this.

Table 25. Treatment teachers comment SimCalc teaching method different from their own

○ "I didn't give them much credit as first and, like I said, it was really hard to me to stand back and let them put it together and a few times I just blurted it out because it's frustrating to sit there and give them the wait time like you should. But, later on, they were really getting better at it. ○ "First off, I was a little apprehensive teaching it because it was very different. The style would be very different from what I'm used to. With the technology. Also, I've been so used to lecturing, I'm from the old school, I guess - lecture and then we do discuss whatever we have covered, but usually I'll end up with a hand out where they can demonstrate to me that they have understood what they've done. With the computer, I did not get as much feedback from the student as far as paper and pencil work. It was

like together. I really wasn't sure if the individual students were getting as much as it seemed like they were."

- "Yes. There were times when I felt like, if I could have maybe shown examples and maybe that just goes back to my old style of teaching - that's the old teacher in me. I just want to show examples."
- "There was a lot more student involvement and maybe it makes me look at my teaching a little bit, too, but I'm not a horrible teacher or anything like that. But, I'm saying that I saw the light in their eyes. They liked it. They enjoyed it. Not that they don't enjoy my class, of course they may tell you different."
- "Well, it has been quite a different experience for me, a different way of teaching rate and proportionality than I had ever taught it before. I think it's the way to go. I really do. Like I was saying before, there's so much more that the kids understand about ratios and proportionality and rates that they got from this that they ever got from me teaching from the book and supplemental workbooks and all that kind of stuff. Of course, I understand more about it also."
- INTERVIEWER: I was taking some notes as you were speaking before and I hope I have captured adequately what you were saying but, basically, you were saying that, because you were in a different district, the 7th grade curriculum was weak and at first you really embraced this project and then you were moved to a different district which has a stronger 7th grade curriculum? Is that correct?
  INTERVIEWEE: That's right. And I still embrace it. It was like, sure, I'll have three weeks, four weeks, whatever because I've got these things that we're not doing anything that seems that worthwhile and then I came to a district that was very tight as far as we get in all the Texas Essential Knowledge and Skills and it's a much richer curriculum. There's probably that many weeks of this kind of thing in there, a little less on the actual slope, linear equation - that's a little advanced - but the idea of all the proportionality is there. We just don't have that big a block. We just cover it and then we kind of weave it into other things. So, I still totally embrace the curriculum, I still love it. It was just harder to find an uninterrupted block to put it in.

Out of the 48 control teachers, 6 made a statement about the teaching style presented by TEXTEAMS being different than their normal teaching method.

Table 26. Control teachers comment TEXTEAMS teaching style different from their own

- "It's very different the way I've taught it before in the sense that I guess I'm not a facilitator. I'm not the one bringing forth in the information. I'm getting it from the kids as they go through the lesson, which is basically what we're being pushed for now. So, in the beginning, I felt like, 'okay, am I getting through to the kids?' because I'm so used to being the one transferring the information. So now, they are trying to discover the information and I feel like some days, 'am I getting through? Are the kids really getting it?' And so, that's what my experience for this year has been."
- "I would say this is pretty new for me to teach it in this way. I think sometimes, in trying to cover a certain amount of material that you feel compelled to complete with your students over the course of the year, that you can fall out of the teaching to maybe some of the students needs and strengths and maybe you fall into trying to teach the material -

cover the material, so to speak - and I think this teaching style is a good one. "
- "I think the - I think me going to the summer sessions kind of opened my eyes because I was so used to teaching it one way and I think this year I was able to teach it multiple ways."
- "I mean, we used that a lot as far as percents and everything and when then I kind of felt like, because this method was different for me - where we actually were trying to focus on the process - and I did kind of approach this - it was just trickier for me because I hadn't done it before and I expected that it was going to be a little awkward and it was a little bit just trying - the more I did it, the more I got comfortable with it and therefore was able to take the kids better."
- "Well, definitely, it's different because like I said before, whenever we would talk about proportions, it was spread out from several lessons from the textbook. But, we have not made reference to the textbook in weeks or months. I would say just right after Christmas time, only because we're preparing for the upcoming TAKS test. But, definitely, it's different because we grouped everything that has to do with proportionality together."
- INTERVIEWER: Now, when you say you "taught it the way it should be taught?" What are you meaning?
  INTERVIEWEE: Well, it's because I've never really been able to get them to understand that concept before.
  INTERVIEWER: The pattern and the rate?
  INTERVIEWEE: Right. I've always just, 'look at it and see a pattern.'

5.2.3.2 Method presented (SimCalc/TEXTEAMS) is like what they usually do

Some of the teachers commented on the teaching method presented, either in the SimCalc or TEXTEAMS workshop, as being the same teaching method they had always used. Out of the 47 treatment teachers, 2 of them made a comment like this.

Table 27. Treatment teacher comments SimCalc teaching method same as their own

- "As far as from the teaching standpoint, this is a lot of the way I normally teach anyway."
- "But math kids, that we can develop, we just love the manipulatives so that's why the software was so good because we use a lot of manipulatives."

Out of the 48 control teachers, 2 made a statement about the teaching style presented by TEXTEAMS being the same as their normal teaching method. One teacher said that the TEXTEAMS material fit with their usual teaching method, while the other used TEXTEAMS materials already.

Table 28. Control teacher comments TEXTEAMS teaching method same as their own

- "You know, I would say probably most of the unit went well just because it was a case of it was fun stuff they enjoyed doing and I didn't have to - this really isn't my style anyway, but I didn't just have to stand up in front of the class and tell them things."
- "And, it's one of those - I'm a real firm believer in the TEXTEAMS materials."

5.2.3.3 Making mistakes/Struggling with math is seen as a good thing

Many of the teachers commented on their students making mistakes or struggling with the math topics presented. Some of these teachers expressed the opinion that making mistakes, or discovery, is an important part of the learning process. Out of the 47 treatment teachers, 5 of them made comments like this.

Table 29. Treatment comments on making mistakes/struggling as beneficial

- "You know, students need to be given a chance to look at what they did, to analyze how they got it incorrectly and to go on from there. And, because I've worked with teachers before when they're stopping a student and I say, 'Why are you doing that?' He goes, 'They're going to make a mistake.' And I said, 'Well, that's part of the learning process.'"
- "Like I say, this one is - you've got to be the facilitator and not the lecturer. Make them figure things out. I think that's what makes it so meaningful."
- "The kids really liked the software because they could see it happening and it built the idea of rate and slope much easier when they could see those graphs taking shape. I really liked that and I just loved the investigation part of it where the kids discovered on their own some of the things that were happening. I would much rather do that because kids learn faster when they do that."
- "Yeah, but the things that they think they have discovered, that's what they remember. Me telling them it's this way, they don't remember that."
- "I talk to friends who are math teachers and I said, 'I now think I was taught to just be a machine. Here's a problem. Do these steps. Spit out the answers.' And I was very good at that. But, as far as understanding what proportions are, how they work, what that proportionality means, I learned a lot this summer."

Out of the 48 control teachers, 5 of them stated that the felt making mistakes, struggling, or discovery was an important part of the learning process for their students.

Table 30. Control teacher comments on making mistakes/struggling as beneficial

- "They are discovering by measuring and then they're trying - okay, they are going to reduce it. They are going to reduce it by what? And so, in other words, they're figuring it out as we go along the lesson and before I would - in other words, I would walk them through everything and I think that's very different because now I'm really getting where the kids are coming from. There's a lot of confusion at the beginning because the kids - they are doing the group work - the kids did not really know how to - they were all waiting for me because they are so used to that kind approach. They have to wait for me to tell them what to do and then I'm telling them, 'okay, you are going to work as a group.'"
- "They would - "We've never been through this before, we don't know what to do, nobody showed us this." And I just kind of had to back off and say, -you know - I wanted them to discover it. I didn't want to just tell them, "write this.""
- "I think that - sometimes failure is what causes us to remember something. So, once we do it, we make sure that next time we don't do it wrong. Sometimes, saying, 'well that's

wrong' is okay."

- "Well, that's what some of the teachers are afraid of - is that if I don't tell them exactly what this means or if I don't tell them exactly how to do this, they are going to miss out on the whole purpose. I'll admit - the first year I tried doing something like that, I was the same way. But, with time, it does work out."
- "Sometimes, I feel the kids were - because it was kind of an investigative, open-ended discovery kind of thing - I had some students that were like, 'just give me a worksheet to do' which I don't usually do anyway but because they had had a lot of subs this year, they had that. And I actually had some kids frustrated with the investigative method and that was okay. I let them be frustrated with it.

5.2.3.4 Making mistakes/Struggling with math is seen as a bad thing

Only one of the participating teachers, in the control condition, stated that they didn't think letting the students make mistakes was a good thing. (S)he described how (s)he let her students make mistakes, thinking that they would learn from the experience, but that it was a bad decision in retrospect.

Table 31. Control teacher comment on making mistakes/struggling as not beneficial

- "And you know, I didn't know if I should - when I saw they were getting wrong answers at first I started to stop them and just say no, this is not right, let's back up and look again. But I thought no, I'm just going to let them go because I think when they see that they're wrong, I think it will be more clear of what they did wrong to get it right, but for a lot of them, it wasn't. So, if I had it to do over again, I would probably stop them instead of letting them continue and doing it wrong."

5.2.4 Students

5.2.4.1 Ability

Several of our teachers expressed opinions about their students' ability, and how that effected how the teacher could teach. There were 10 treatment teachers who had opinions about their student's ability.

Table 32. Treatment teacher comments on students' ability

- "In 7th grade. Because they are doing those linear equations and you might as well. I mean, you are doing unit rate - you might as well. So, it gave me a new experience as to whether they had the ability to do slope or not and, although we didn't go over it a lot, you know, I had to, you know, do one or two of the problems and then go on to the next thing. It did let me see that they could/would be able to slope in 7th grade."
- "I always have low groups of students. I mean this is traditional. You can go check our statistics or whatever and by the time I get through with them in 7th grade, we're up to over ¾ of them passing and the one's that don't pass just miss the questions by a few questions."
- "And it's just - it's something I've always experienced between teaching regular class and AP classes is that their mathematical abilities are so much stronger. They have some

inbred number sense that comes to them that some of the other kids don't have. Now, usually it's because of exposure. If they've been in a family that's traveled a lot, their parents have gone to college, those kinds of things, they're usually much better on mathematical skills. If they've had parents that haven't done those kinds of things, a lot of time, they're much weaker on their mathematical skills. So the environment they are raised in makes a big difference."

- "Yeah, at the beginning, I just told my GT class, 'you know what? You need to learn this over and try to figure it out.' And sometimes, these guys, they didn't like, 'okay, sir. I know how to do this. I know how to do that.' So they were like on their own. They were learning everything. And in my regular class, no, you need to go step-by-step, this is how you move a line, this is how you change the scale and this and that, and these guys, the GT guys, I don't know, maybe because it's in their genes to know everything. So, I was impressed with that. The only problem like kind of with the discipline because of too many people. I don't know, maybe next time, next year we're continuing right?"
- "Yes, because sometimes, for example, I was just starting to explain something and my top students, 'oh, okay. We got it.' And the other ones, they were having a little problems and sometimes they were making fun like, 'hey it's very easy. So, come on - how come you cannot do it?' So, I told them, 'okay, you already understand it. Just be quiet and let me explain one more time.' Because sometimes, if you say one more time, these guys are going to get it. And the other ones, sometimes, maybe the third time you explain it, they get it."
- "For my students, that's just my opinion. I felt like it was a little difficult for them. Especially, not knowing - they've been so conditioned to choose these multiple choice questions that when they're faced with something that shows them to think and to give an answer themselves, it was a little complicated. I would venture to say, if they were to have math maybe like this for maybe two years consecutively, you'd see a big change."
- "The more advanced kids are the ones that are like that. They want to do better. They want to do more, even though everybody says, 'well, they come from a better family.' Some of my kids that are in that class do not come from better families."
- " I saw the whole unit as being pretty pre-algebra unit, not a pre pre-algebra unit. It struck me as a regular 8th grade, advanced 7th grade type curriculum, even towards the beginning part. And, I feel pretty good that we're teaching aligned with what the Essential Knowledge and Skills are for the 7th grade, as far as 7th graders. But, I love the stretch. I don't want to say I don't want to do that. It's just that I might do the more required earlier because we've got to make sure their solid in all their standard skills first."
- "Yeah. Neither I nor my teammate, we didn't try this with any of our regular classes. And she said, I wouldn't even try it with a regular class. Now, next year, I'm not going to have 7th pre-AP, I'm going to have 6th pre-AP and 7th regular, so I'll be doing it with a regular class but I will be doing it differently. To the extent that resource doesn't exist, I'll be trying to think of a way - because if a regular kid misses a day of this - the most likely ones to miss are the ones that are most likely to get a huge hole that they won't be engaged and then they'll be totally off track."
- "That's what they were saying at the beginning that it was too hard. But, like I told you, those type of students I had are slow learners, they're ESL students, and what happened - they got some of the resource students out of resource and just threw in middle school

without any knowledge of math skills. That really hurt but then I had the other students open them up."

There were six control teachers who commented on their students' ability. In one case, the teacher was surprised by their student's ability. The other 5 teachers commented on their students not being very talented, or able, in understanding math.

Table 33. Control teacher comments on students' ability

- "I think you will see it in my - that I was really satisfied with the way I taught it and with how the kids reacted towards it. Because, see, I thought doing it as group work, the kids are not going to be focused but they were focused. Yeah, because I thought the kids would not be able to get it."
- "Because they get bored easily since they don't have the basic skills and they forget their multiplication tables and a lot of Math things. We need to motivate them with new things, with technology, with something else yet."
- "I have low students. I think when you have a group of kids that when you give them a piece of paper with words on it and they don't want to read it, to me that's low. "
- "And, I'm finding out that I know it's working because my grades are up big time this year with what I've been doing. And, I know there's still a piece we're not getting and I guess the problem is I have students that I feel if I'm going to be successful, it's not the kids in the middle or the upper kids I've got to worry about, it's the ones at the end. There's like 20 - 30 kids out of 130 I've got overall and I need to find out what I've got to do to help them because they're the ones that can't do it. Because they're just not - they don't have the gift. You know? And I would rather have the tools that I could to help meet those kids. That's what I really want."
- "It'd probably be about the same because the - I just don't know that it benefited my medium to lower students as much as I was hoping it would. But, you're stronger students are probably going to learn it no matter which way you try to teach it. You know, probably a little better one way than the other but they're still going to learn. But, I was hoping I would hit the middle to lower students a little better and I'm not sure that I did."
- "Basic skills? What I'm telling you here is it's nothing original but kids these days, they don't know their times tables. How do I teach them slope when I have little Johnny, 'okay, to finish out the problem, all you have to do is add 19 and 31.2. Okay, Johnny, add 19 and 31.2 and I'll wait while you do that. Johnny all you have to do is add 19 and 31.2. Okay, Johnny make sure you line up your decimal point first.' I'm still doing that. You know what I mean?"

5.2.4.2 Pride

A few of the teachers in each condition mentioned their students' pride. All of them felt that students needed to feel pride in what they were doing. Two of our treatment teachers mentioned pride, or confidence, as being important for their students. One teacher though that when

students could do things on their own, they became proud, whereas the other teacher felt that confident students do well in the classroom.

Table 34. Treatment teacher comments on students' pride

- "I think it made them very…I think it gave them a sense of pride to be able to do the next thing by themselves. I also think, you know, the problems really lend themselves to reading over what the situation was and it was something that they can look at and they can figure out from the previous…now, I wouldn't start like "Try number 1 by yourself." But after doing the first two, and you know, time being of essence, I would say, "Hey, you know, why don't you try number 3 and see if you can do it by yourself," and I think it lent itself because of the first two had already setup, they already experienced success and in a similar problem. So, they were a little more comfortable in attempting the third problem."
- "Yeah, from day one. From when we first started off because one of the biggest things to me in teaching, or learning I should say, is confidence. If you have low confidence, you're not going to do very well and those are the kind of students I've had - low confidence. They're confidence increased as the year progressed and those that didn't grasp - the lower students is who we are talking about - didn't grasp the concepts that I wanted them to grasp but at the same time know that it is a maturity thing."

Four of our control teachers mentioned pride, or confidence, being important for their students. One of the teachers felt that it was his/her job to promote confidence in the classroom, while another wanted students to develop pride in what they were doing but didn't expect that to happen. The other two teachers felt that doing well and being confident went hand-in-hand.

Table 35. Control teacher comments on students' pride

- "So, I kind of made sure I promoted some of the good things out of each one and then also emphasized the fact that the accuracy of some of them was really good. So, they - and I think they learned from it and I think they were really - some were more pleased about their results than others - but at the same time, the whole idea was they were going to learn from viewing the other people in their group - the different groups' presentations and then I think was going to fuel them to be able to put together a better one the next time they did."
- "Well, as they become older, they become more jaded and less interested in performing and showing their learning and it's not cool anymore. I have other classes that are not as interested in succeeding in math as these kids are but I think that's an assumption of age. I would hope that, as these 7th graders progress, they continue to want to learn and to be proud of it but I don't have much hope."
- "And you want them to feel confident because then they start doing well. Confidence level is a huge thing."
- "I think that once they were understanding the concept, they had a very high self-esteem. They were proud to understand these concepts which before some of them had a fear because they didn't know how to approach some of the problems."

5.2.5 Policy

Several of our teachers had opinions about the current policies that are in effect across Texas or in their individual schools. Five of our treatment teachers commented about current policy topics, such as teaching students with English as a second language, test requirements, and how the SimCalc method could affect student outcomes if adopted statewide.

Table 36. Treatment teacher comments on policy

- "We do have teachers to allow the students to speak Spanish in the classroom and I disagree with that. I think they've been doing that for 1st through 5th and I think it's time that they move on."
- "We are required to take a certain number of grades through six weeks and that was the only thing I found difficult in using the workbook for such a long period of time, that if I didn't have a few worksheets or a quiz or something in there to monitor how they were doing, I didn't want to wait until the end of two weeks or two and a half weeks to give a quiz or a test."
- "Well, it's real disappointing and it's really sad because I mean, people complain about Texas having a Taks Test, but hey, if that's what it takes to keep kids on track I don't have a problem with it because you're not letting kids slip through the cracks that way."
- INTERVIEWER: So how did the SimCalc or the MathWorlds work out? INTERVIEWEE: They were fine. I enjoyed it. I wish everybody could have used it, all the students, all the math teachers, go out there to the workshop and so on and start using it. Not only in middle school but also in elementary because it means a lot. A lot of those kids don't get those activities, they don't get all those geometry, they don't cover proportion and rate and so on. What they do is just basic. But, if they were to have something like this in elementary and then pick it up in middle school, I think it would be very successful for them to succeed and to TAKS or anything. But they have to start from elementary and then up.
- "The problem was the state of Texas gives what you call a TAKS. It's a lot of pressure. In elementary, the majority of those kids are slow. They're not dumb or anything like that, they're slow. It's not their language - they place them in resource. At that time, they could do it. Several years ago, they could do that. They could put them in resource. Let's say, 5th graders - let's say 100 or 200 fifth graders. 75 or 100 were placed in resource and they are not tested. They are not tested in elementary. So, when they get to high school, you talk about 75 to 100 students who have never been exposed to regular classes. And then, when they get to middle school here, they mix them and they place them in regular classes. And that's why scores are low."

There were 6 control teachers who offered opinions on current school or Texas education policy. They discussed a variety of topics including how challenging the curriculum is, which teachers are assigned to teach advanced classes, teaching students with English as a second language, and how teachers spend their time at school.

Table 37. Control teacher comments on policy

- INTERVIEWER: So, at present, it's not part of the curriculum but you're of the opinion

that the curriculum should step it up a little more and be just a little more challenging?
INTERVIEWEE: Absolutely. And what's interesting is, that woman I was telling you about that I started teaching with last semester, like I said, she came from a school that was all about Chicago math. I mean, they started in the early grades and it goes through 12th. This stuff that we were introducing in 7th grade, she said they did that in 5th and 6th using Chicago math.

- "In my school, we have two teachers who monopolize all the advanced classes for math. We only have three others, including myself, who have nothing but regular kids, you know the regular enrolled kids. And that should be nixed. It should be that way so the ones, when you have those advanced classes, you appreciate them more and you can better relate to both lower and high. I've heard of some studies. I haven't read them myself but I've heard of some studies where student achievement can be maximized. One factor that maximizes student achievement at the secondary level is for a teacher not to teach - to have both kids."
- INTERVIEWEE: How I see it? I think the biggest responsibility of a teacher is to teach. Not to teach to a test. So, every time you start talking about, 'well, we need to do this because of the test.' Forget about the test. The biggest issue here is that the kids need to learn stuff.
  INTERVIEWER: Okay.
  INTERVIEWEE: Okay? And it doesn't matter whether you have materials. If the kids are Chinese, you need to help them and if the kids are from Vietnam, you need to help them. If the kids are from Africa, you need to help them. If the kids are from Mexico, they need to help them. And, basically, when you are doing this - you are not doing a service to the kids. What you are doing is - for the most part, I don't understand the language so I'm not going to do this because the kids, at the end, are going to be tested in English. Yeah, of course they are going to be tested in English but it's also true that they need to know before they can test and the kids don't know. And, the reason they don't know is because they have a barrier of language for the most part. I'm in the minority. I mean, teachers aren't teaching anymore.
  INTERVIEWER: Right.
  INTERVIEWEE: Most of our time is doing other crap. I'm going to tell it like it is. They need to leave us alone and let us teach unless they don't trust us.
- "I'm teaching to the scope and sequence. But, I'm not - so I'm teaching kids that are on 2nd grade reading level, 7th grade curriculum. And then when they take the test - you know, the Texas Assessment - it's given to them on a 2nd grade level and here I've been teaching them 7th grade curriculum. Now, does that make sense? I don't think so. So I'm having some problems with - because it's not fair to the kids."
- "One of my frustrations as a teacher - my total number of kids is 152 junior high kids and a teacher - we talk about trying to build relationships with our students? How do you do it with that many kids when there's often five of them around you asking a question?"

5.3 Technology

In the interview, all of the teachers were asked a few questions about technology. The control teachers were asked if they used any kind of technology while teaching, and if they did, what

kind of support they had in using those technologies. The treatment group was asked specifically about MathWorlds, as well as any additional technologies they might have used. We asked them to elaborate on any problems they encountered while using MathWorlds as well as the technical support they had at their school. All of their discussion was coded as "Technology discussion" which had the following breakdown into subcategories.

Table 38. Break-down of the Technology Code

Technology Code Subcategories	Description
Problems Encountered	Treatment teachers were asked explicitly about any technical difficulties they encountered. Their discussions of these problems were about installation of the software, software malfunctions, or hardware malfunctions.
Computer Set-Up	Some of the treatment teachers described the set-up or layout of computers in their classroom. This could be a few classroom computers, a computer lab, a traveling cart of laptops, or laptops that every student carries with them.
Other Technologies Used	All of the teachers were asked if they used any other technologies while they taught this year.
Perceptions of Technology Used	Many teachers described their perceptions of technology in terms of their students' or personal comfort with using technology.

5.3.1 Problems Encountered

5.3.1.1 Installation

29 of the 47 treatment teachers encountered problems when they, or the system administrator at their school, were installing the MathWorlds software. All of them seemed to be experiencing the same problem: when the software was initially installed it was through an "administrator" account, and the students were unable to access the MathWorlds simulation files because "student" accounts did not have access to the files. Here are four examples of how teachers described the problem:

Table 39. Treatment teacher comments on problems with MathWorlds installation

- "The only problem I had the first day was that I had downloaded it onto this laptop and I downloaded it using an administrator login and I - when I logged onto the computer the second time - and I had it hooked up to an in focus projector - I logged on as myself and the software was on there so I thought everything was fine and I clicked on it and the world came up and everything - all that stuff - and so I tried to open one of the simulations and so I went to "open" and I went to - and it opened straight up to "My Documents" I think - I don't remember what it was - what the window was - but Math World wasn't on there anywhere. And I thought "What is the deal? I cannot find it." So, like panic mode because you've got 13 7th graders "Miss, do you want me to help you - where is it? Where is it?" So, they were - I don't remember what I had them doing - so, we lost a little bit of class time and then what I - the only way it would work is I had to

log in as an administrator and it was there so I had to log in however I loaded it on there and when I logged in as an administrator, the same way I had logged in when I downloaded it, then when I opened it up, it was there. It was in My Documents or whatever folder it had gone to. Math World was there. And, I downloaded everything into our computer lab and there were no problems at all on that. "

- "We had our technician - we have two technicians. Well, we have a technician and then we have an assistant. The assistant loaded everything up. The computer lab - we started out with 30 computers and then I think one of them died or something so we ended up with 29 computers and they were all downloaded. And, the first time they downloaded it, they had problems finding the files. They had to go digging for them and I think what happened was we have two settings - we have like a - you have to log in either as a teacher if you're a teacher, or you have to log in as a student if you're a student and when they downloaded the software the first time, they downloaded it under the teachers. So, when the kids got on, they couldn't find it. So, we had to come back the next day and they had to reload everything with - under the students. That was the only problem they had."
- "Well, she had a problem at first and not realizing it that when she put it on some of the computers, the program would come up but not the documents that went with it. So, to make it work, she had to put it on the server and then the kids would bring it up from the server."
- "And then, when we'd get the kids, it came up but all of the files weren't there. They couldn't go to any of the files, like the graph racer, they couldn't go to any of the files. So, we had to take it and go back and work that around. I had to get a hold of him to get him to come in and he ended up having to build a separate drive of the files so the kids could then go to that - go to it through that drive. But, it was just a minor inconvenience that first day."

This might seem like a fairly small problem to overcome, but for most of the teachers it cost them 20 minutes to a whole period of class time that was wasted while they resolved the issue. For three of the teachers, they decided to not use the computer lab at all. One teacher had a "mini lab" in her classroom with 3 computers that she was able to install MathWorlds on herself and let her students use. The other two used their own personal laptops to display the simulations via a projector to the whole class. In all three of these instances the teachers decided to change their instruction plans drastically to accommodate for a technology problem. Here are their descriptions of the problem and their solution:

Table 40. Treatment teachers who chose not to use a computer lab because of MathWorlds installation problems

- "I think if they had had a chance to work in the computer lab, like it's meant to be, then it might have gone a little quicker. But, we had a couple days where we went down to the computer lab and our technology person assured us that…assured me that it was ready to go, no problem, and then nothing. We couldn't get to the files. But, I had 3 computers in my classroom that I put Math Works on and I didn't have any problem."
- "Oh, yes. The CD, when our computer tech installed it, it wasn't reading the files. I had no files. Nothing was coming up. So, they emailed the files to me and he was able to

install it into my laptop and I used the laptop and projected it out and that's how we did the whole project. Because, some days, trying to get it into the other computers, and trying to get him here to get it done, was mission impossible because we only have two computer techs for the whole district and they moved our server so we've had all kinds of craziness. And so, with the kids, we ended up doing it together as a group on the projector on that laptop because we were able to pick it up and I didn't want to take any chances and struggle and waste time - valuable time - them trying to get on the computer individually. I mean, we didn't have that kind of time. With all the interruptions, every minute was precious. So, we worked on, steamed ahead. We were good!"

- "Yeah, but the thing that we had trouble with was, our technology people have made it so that our computers that are shared computers - like the Computers On Wheels (COW) and computer lab - it's extremely difficult to add extra software. What we ran into was the fact that we could get the software loaded on the laptops but we couldn't pull up the documents for the SimCalc because those kinds of things are blocked. So, what I ended up doing - I have it on my personal teacher computer and I just used a projector. They didn't get as much hands-on but they were still looking at the simulations and we were still talking about what happens and all that stuff."

5.3.1.2 Software

None of the teachers described any hard software crashes that they experienced. However a total of 15 teachers described "glitches" or difficulties they had with MathWorlds. One teacher noticed that the simulation world would "disappear" if you dragged one of the other windows over top of it

Table 41. Treatment teacher comment on MathWorlds "world" disappearing

- "The world, just the world part, would disappear or go black when you pulled down the control system. And so I used a computer of my own out there and I guess the software was more compatible with it than it was the laptops. And, uh, they could see the world there so it was really not a lot of a problem, but I think it would have been nicer if the world would have worked. Yeah, when you click on the control and you bring the control box down it just erased the world. And the kids have fun cause they took the world…I mean they took the control panel and just erased. Which it wasn't the purpose behind it. And the only one time that got into a problem for them was once when it was black, they couldn't see the numbers at the bottom."

Five of the treatment teachers found it difficult to manipulate the scale or lines on the graph view in MathWorlds. For all of these teachers the problem was frustrating, and one teacher decided to draw the graph on the white board instead of using MathWorlds.

Table 42. Treatment teacher comments on difficulty using the MathWorlds graph

- "One thing is that sometimes the scale of the graph was difficult to work with when the kids were having to draw graphs on the computer. Uh huh. It was too broad for them to feel comfortable estimating and then they couldn't get things exactly like they thought it should be, like the table indicated. They couldn't graph the points that were on the table and so, that as seventh graders, that was too abstract for them to think, well I can graph

some that are close. They were frustrated because they couldn't graph exactly what they had."

- "I think maneuvering the graphs themselves when the kids were trying to simulate or model different situations, they had a hard time. The pieces didn't drag very easily. They shifted the entire graph. When they needed to move the dot, the whole thing would change scale and I know they had trouble with that a little bit."
- "The main issue was when we had - it was related to technology - but whenever you had to take the graph and we had to extend it to fit the situation, we never could get it to work. Every time, you know, we would start to extend the graphing, it would expand. You know, the whole graph would expand and getting it to come back. And so, it was technology issues more than the kids not understanding what was going on. And, we just stopped and drew it on the board. So, that was kind of how we did it. So, it was more technology issues than them not fully understanding what was going on."
- "It worked out overall but sometimes it was a little hard to work the graphs, especially when you wanted to have the kids build the graphs themselves on the computer. It was a little hard sometimes. It was a little hard for me. I used my laptop."
- "Well, when I asked them to run that simulation, they couldn't fit the graph to where it would run the whole simulation and some of the students figured it out. You know how you can click… And stretch the graph and I had a couple students that were able to do it but, as a whole, the class - we really lost 10 or 15 minutes trying to figure out how to do that"

One teacher found it difficult to return MathWorlds to a previous state in the software after the students changed the settings.

Table 43. Treatment teacher comment on reverting MathWorlds to a previous state

- "I only had a little bit of trouble with the software as far as kids were playing with the software. They were so excited about all the different things they could do then. For some reason, they changed the line's original settings, so it was hard for me to get back and put them where it should be and that was one of the things."

Two of our teachers expressed that they wanted to have a "blank" graph or table to insert their own equations or simulations into.

Table 44. Treatment teacher comments on wanting a "blank" graph or table

- "Okay. I felt restricted by Math Worlds. When I wanted to show them something and I couldn't show it to them. I felt - I feel like there should be a blank table somewhere that will open and allow you to put any numbers in that you want and that will calculate those numbers for you. Similar to what an Excel spreadsheet would do."
- "The only thing I wish we had is one that we could change however we wanted to - you know, add lines to it if we want to add lines or pretty much, if you wanted to change one around to give them another example, you had to just open one up and change it around and then you couldn't really - just be able to do whatever we want to with it."

One teacher felt that the "clown" character in the simulation was inappropriate for 7th graders.

Table 45. Treatment teacher comment on appropriateness of MathWorld's characters

o "The only thing I would say is that, the same we saw as teachers, that 7th grade minds. They go straight to the gutter and there is this clown that is like the original prototype of something. And it was actually the first one that was even worse when we brought it to my very first teacher training. Instead of the kids running it, it's this clown and he has a - it used to be even worse - but anyway, the dot on the clown is anatomically a little low. It's more like his belly button now but it used to be a little lower and that coming up for some reason and I don't think I put this in my notes but if they could only - I can't remember the exact circumstance when you get it - but it's like when you first open it, it's there before they open the regular file. I would put something else there that looked more like the rest of the content instead of that snowman or clown or whatever he is. The teachers noted it right off. When we went to the teacher training, they were like, 'oh this guy will not do.'"

Two teachers had difficulties with the actual names of the simulation files. In one case the names of the files were too similar and her students would look at the wrong one. In another case the teacher found that the names of files in the workbook did not correspond to files on the computer.

Table 46. Treatment teacher comments on simulation file names

o "Where it says "Graph Race 1A Main." That would let them construct it and then they'd go to Graph Race 1A and it would show them what it looks like. They would get into the wrong one; get an idea what it looks like before they graphed it."
o "There were just a few places where - I mean, this is a minor thing - but, the names in the books of the files was different from the file name on the actual software and so we had to hunt just a little bit but that was just in a couple of cases."

Thankfully, none of the teachers experienced debilitating software crashes while they were teaching. However, for all of the teachers who had problems with the software, the problems were at least frustrating and took time away from their instruction.

5.3.1.3 Hardware

12 out of our 47 treatment teachers experienced problems with the hardware they were using while teaching the unit. One of the teachers expressed that his/her projector would sometimes fail to work while she was teaching.

Table 47. Treatment teacher comment on broken projector

o "My projector didn't work. It kept shutting off."

Another teacher experienced a networking problem, in which students could not log onto the laptops. In this case the teacher projected the simulations from their laptop while the students watched.

Table 48. Treatment teacher comment on network problems

○ "It was kind of mixed and it got to a point where, when a student would come to my room, I would have them log on, and if they could log on, then I would let them work in groups. And if they couldn't, then I just did everything with the projector."

The 10 other teachers said that computers would crash or "die" while they were teaching. The crashes were due to hardware malfunctions, or particularly with laptops, the batteries had not been charged enough previously. Most teachers handled computer crashes by asking students to share computers. Here are examples of two teachers discussing the hardware crashes they experienced:

Table 49. Treatment teacher comments on computer crashes

○ "The minute you have a computer and I would have even throughout the class where one of the kids for some strange reason, their computer would just shut off. I mean it's just one of those, it didn't happen often, but really just a weird thing would happen. If that happened instead of worrying about rebooting or restarting I'd just tell them just look with the person beside you."
○ "It is very frustrating. One week I couldn't even go into the lab because something had happened with the computers and the computer tech had to reinstall all the software. The computer lab itself was not conducive for 30 kids. I couldn't get around to the kids; I had to step over them. Some of the computers I would say on an average of two computers every time we were in there would crash and we couldn't get the program to work. So, yeah, the technology was pretty frustrating and I don't think it's anything ya'll could control, but the campus technology, they wouldn't let me have the big computer lab where I could have walked around because it was tying up the computer lab for three weeks, three to four weeks and other classes go into the big computer lab to work. Technology, yeah, was a little bit frustrating."

For most of the teachers, when a computer crashed they were able to move a student to another computer or have students share with classmates.

5.3.2 Computer Set-Up

Our treatment teachers were asked what their computer set-up was like while they were using SimCalc. The teaches said they used a computer lab, a mobile laptop cart called a COW (computers on wheels), one or a few computers they had in their classroom, or a combination of going to a computer lab and using classroom computers. The following table shows the number of teachers that used each set-up possibility:

Table 50. Break-down of computer set-ups for treatment teachers

Computer Set-Up	Number of Teachers

Computer Lab	31
Computers on Wheels	10
One Laptop with a Projector	5
Combination of Computer Lab & Classroom Computer	1

Going to the computer lab was the most popular computer set-up for our teachers. Almost all of them went to the computer lab every day, however one of these teachers mentioned that they only took his/her students to the lab three days a week: Mondays, Wednesday, and Thursdays. On the remaining days he/she would supplement her unit with doing other activities outside of the SimCalc curriculum. Another teacher mentioned that it might be better to only go to the lab a few days a week:

Table 51. Treatment teacher comment on using the lab less frequently

- "But, you know, looking back, I think if I would do it like every three days or something like that, that it may run better or certain lessons might work better from the aspect of running it in the room I can run the simulation on this whiteboard, even write on it, point things out easier than I could in lab with the in focus projector. But a few of them I could see where maybe every now and then if I bring it back to the classroom setting I may get better production toward the end than what I felt like I got.

Three other teachers mentioned that scheduling the computer lab for a long block of time was difficult or controversial at their school.

Table 52. Treatment teacher comments on scheduling the computer lab

- "It was a problem because we are short on labs and computers here so, you know, we - at the beginning of the year - reserved the lab for - I think I reserved it for four weeks - and, you know, so that was basically four weeks where other teachers weren't allowed to use that lab."
- "Well, I had the whole range of reactions. Some teachers didn't mind and some teachers felt like it wasn't fair that I took the computer lab for three weeks."
- "Well, there were a couple of people that wanted to know when I'd be finished, but when they understood that my Principal had kind of asked me to go to the SimCalc training - they knew - in fact they were kind of told that they had to plan something else for those three weeks and not to use the lab."

Four teachers mentioned that the room configuration of the computer lab was difficult to use. For the first three, they had a U-shaped configuration with the computers facing the wall. While the last teacher quoted here found the lack of a white-board in the computer lab a problem.

Table 53. Treatment teacher comments on the difficulty of using the computer lab

- "So, the first week we were in the computer lab, the kids were getting a little too involved with just manipulating the graphs and charts and opening and do this and that and making the people run and slowing them down, doing this and that, but it was hard to carry on like a class discussion. And I think it also had to do with the configuration of the room -

the way our computer lab is setup - all the kids - they are like facing the perimeter of the wall." o "That was a struggle with our computer lab and I don't know if it's the setup of the computer lab but there was never a way to get all of their attention in the computer lab." o "The problem is the classroom is an extra large classroom and all the computers are on the wall, on the outer edge of the wall. So, when I'm on one side of the classroom, the classroom's about close to 30 feet long, I think. So, when I'm on one side of the classroom, it's hard to see what the students on the other side are doing." o "One of the problems I had was when I was in the computer lab, the board is all the way to one end, one of the far ends and when I wrote on that board the people - half of the people could not see it. We don't have any portable boards that I could have taken into the computer lab."

Ten of our teachers used a mobile computer lab, called a COW, exclusively while teaching the SimCalc curriculum. Half of these teachers mentioned how their students shared laptops because there weren't enough laptops for all of the students.

Table 54. Treatment teacher comments on sharing laptops

o "We had sixteen laptops in the room, which meant several kids shared which was a good thing because they talked about what they needed to know." o "Well, in working with the laptops, everybody worked in pairs because we only had 16 laptops and there are 28 kids, I think, in that class. So, everybody worked in pairs and I think that provided a lot of discussion for a lot of them and I didn't especially pick who they had - I didn't like say, 'well, this one should work with that one.' I didn't set it up that way. It was just a matter of convenience and how the desks were arranged and who they had been working with just prior to the unit starting." o "I had laptops in my classroom and I only had 12 but this unit works really well if you can get 3 kids per computer and I rotated - 'and you're the only one that can do the computer today' - and then we rotated. Every third day you got to do the computer." o "Well, actually two to a computer. Each computer, laptop, I had two students at and I think that helped also." o "And they would go ahead and it's a portable lab I use and there's supposed to be 30 computers in it that, so far, what I know of, it's been vandalized so there's very few computers left and the computers that are in it, I thought had to be checked out as a whole but you can check them out individually. So, when I was going back, there was 9 computers to start off with…and I have 27 students. And I thought it was okay because they would take turns working it."

For one of the teachers using a COW, the biggest struggle was getting the laptops to and from his/her room every day.

Table 55. Treatment teacher comment on transporting laptop carts

o "Yeah, there's just a problem with getting it. I mean, it's not so much the scheduling it but we share a wireless lab between two buildings and they're about a half a block from each other. So, you have to actually take the machine and wheel it down all these

sidewalks and get it back to the building and then carry it back over there next period and come back. It's just a lot of traffic."

One of the teachers mentioned that they didn't want to use the COW at first and had preferred to be in a computer lab. However, after they began teaching the unit they realized that the COW had some advantages over the computer lab.

Table 56. Treatment teacher comment on using COW instead of computer lab

- "You know, when the whole thing started, I was kind of undone that we got the laptop instead of the computer lab because I had really wanted the lab so they could each have their own and I just - you know, you can kind of keep an eye on everyone better when you are in the computer lab because you can just turn and see everyone's computer and what they are doing with it. And, I thought, 'this would be much better. Too bad it didn't work out that way.' And, then when actually we got underway with the laptops I thought, 'you know, this ever so much better because they're always going to be talking about it then' and even though I didn't have that kind of situation where I could see exactly where they were at all moments unless I went to the back of the room, I also had the possibility of stopping, putting a graph on the overhead and just talking about it from there. So, we could interject other things as the lesson went or talk about, 'well, what would happen if we changed this' and 'try changing that on your computer now.'"

Five of our teachers only used one laptop computer with a projector in their classroom. They would run the simulations from the front of the class while the students watched. Some of the teachers would let their students come up to the front and use the laptop on their own. Three of our teachers used a laptop with a projector because they could not get the software to work on the machines they were originally planning to use.

Table 57. Treatment teacher comments on using a laptop with a projector instead of a computer lab or COW because of technical problems

- "I set it up in my classroom, had it with the projector and had the kids take turns and they really enjoyed that part. But, I think if they had had a chance to work in the computer lab, like it's meant to be, then it might have gone a little quicker. But, we had a couple days where we went down to the computer lab and our technology person assured us that…assured me that it was ready to go, no problem, and then nothing. We couldn't get to the files."
- "The CD, when our computer tech installed it, it wasn't reading the files. I had no files. Nothing was coming up. So, they emailed the files to me and he was able to install it into my laptop and I used the laptop and projected it out and that's how we did the whole project. Because, some days, trying to get it into the other computers, and trying to get him here to get it done, was mission impossible because we only have two computer techs for the whole district and they moved our server so we've had all kinds of craziness. And so, with the kids, we ended up doing it together as a group on the projector on that laptop because we were able to pick it up and I didn't want to take any chances and struggle and waste time - valuable time - them trying to get on the computer individually. I mean, we didn't have that kind of time. With all the interruptions, every minute was

precious. So, we worked on, steamed ahead. We were good!"

- "Yeah, but the thing that we had trouble with was, our technology people have made it so that our computers that are shared computers - like the COW and computer lab - it's extremely difficult to add extra software. What we ran into was the fact that we could get the software loaded on the laptops but we couldn't pull up the documents for the SimCalc because those kinds of things are blocked. So, what I ended up doing - I have it on my personal teacher computer and I just used a projector. They didn't get as much hands-on but they were still looking at the simulations and we were still talking about what happens and all that stuff."

The other two teachers decided to move their lessons back into the classroom because they did not have enough "control" in the computer lab.

Table 58. Treatment teacher comments on using a laptop and projector instead of a computer lab because they lacked control

- "Our computer lab is setup where all the computers are around the walls so they're not facing a teacher. So, we ended up moving it to my classroom and I just projected it onto the wall so that I could actually see them all. Otherwise, they were doing whatever they wanted to whenever they wanted to and we didn't have much control over it. We have the projector on the ceiling that projects our laptop onto the whiteboard? So, I had a little bit more control in [the classroom]."
- INTERVIEWEE: Well, like I said, the technology - having to set up the lab - I had originally started the unit back in December but because of them messing with the computer so much, I just decided to use one computer on the projector and they would come up and watch or they would come up and mess with it but as a class. But that's in my case because I panic if they do something they are not on task with me as a class.
  INTERVIEWER: Now did each student have their own computer?
  INTERVIEWEE: At one point, yes.
  INTERVIEWER: And this was done in a computer lab and not in your regular class?
  INTERVIEWEE: Yes, but then I switched it for my own purposes, I switched it back to the room and we had one computer and the projector and everybody was participating with it.

One of our teachers alternated between using the computer lab and a laptop with projector in his/her classroom. This was because (s)he was unable to reserve the computer lab for the entire length of the unit.

Table 59. Treatment teacher comment on traveling between the computer lab and classroom

- "It was a little problematic for me to have to take the kids to the computer lab because, you know, basically, the way the lessons were, you know, Monday would be in the lab and then Tuesday we'd be back in my classroom, and then Wednesday lab - so it was going back and forth and me having to, you know, have all the supplies down there that we needed. So, that was kind of problematic."

5.3.3 Other Technologies Used

Both our treatment and control teachers were asked if they used any other kinds of technology besides SimCalc MathWorlds in the classroom. The teachers would describe workshops, tools, programs, and other hardware that they had used before. 10 of the treatment and 2 of the control teachers describe going to workshops or seminars that taught them "basic computing skills" such as making PowerPoint slides and using other Microsoft products. Almost all of the teachers had used graphing calculators before, but some used CBRs or Calculator Based Rangers with their students. These are motion detector devices that can graph motion onto the calculator. Another device that a few of the teachers used was Quizzing Remotes that they used to review material with their students. Teachers also mentioned other hardware, such as Electonic Whiteboards, Elmo projectors, and even Playstations. The most popular "Other Technology" was other computer software or programs on the Internet. The teachers used programs such as Understanding Math, Geometer Sketchpad, Sleek, Cinch It, Math for the Everyday World, Wild Wild Math, Pinker Plots, Skills Bank, coolmath.com, NCTM websites, and Microsoft Excel. The following graph illustrates how many treatment and control teachers used other technologies.

Table 60. Break-down of other technologies used by treatment and control teachers

Other Technologies	Treatment	Control
Workshop on the "Basics"	10	2
Calculator Based Rangers	5	4
Electronic Whiteboard	4	5
Other Computer Program	14	20
Quiz Remotes	3	2
Playstations	1	0
Elmo	1	1

5.3.3.1 Grants

Five of our treatment teachers and one of our control teachers told us that they had written grants, by themselves or with a colleague, so they could receive funding for technology in their school. Four of the treatment teachers and the one control teacher received a GEAR-Up grant from Texas Instruments.

Table 61. Teacher comment on GEAR-Up grant

o INTERVIEWEE: We have the Gear Up grant on our campus. Do you know what Gear Up is? INTERVIEWER: No, I don't. INTERVIEWEE: It's a grant with quite a bit of money involved in it and a person that's in charge of it for 7th grade. Gear Up is to promote college participation so we receive monies for trainings, for technology, for anything - for all kinds of things for the students, 7th grade, and then next year, it moves to the 8th grade and that person and this will follow them through until they graduate and they provide technology - anything that can keep the kids involved active to help them and promote the education so we can get them to the point where they will go to college. So, we've received monies and training on

things to use for them so it's something that will help the students. The principal's happy about it and we're working with that also.

The remaining treatment teacher received a grant to supply his/her school with two "mini" labs that contained eight computers and 15 PlayStations.

Table 62. Treatment teacher comment on technology grant

○ "I wrote a grant for half a million - me and another teacher - and it was a 3-year program and we had to do certain things for three years. But it's totally cool. It is awesome. We have two 'mini' math labs because of that. And we have all these PlayStations and all these CD's that have all these interactive, colored games that are educational-wise. This mini-lab has PlayStations and computers and so it's a little mini-lab that it's called "5 we need" and we can go in there real quick and not tie down the big lab that has 25 computers. We can leave that for other people that need it: language arts, history, whatever. I've got about 15 PlayStations in there. And eight computers so a whole class can go in there and have some kind of activity. Every child would be occupied."

5.3.3.2 Technology that Teachers are Wishing for

When asked what kinds of other technologies they used, two of the treatment teachers described technology they wished they had at their school. One teacher would have liked to use a CBR with his/her students, while the other thought an electronic whiteboard would be advantageous.

Table 63. Treatment teacher comments on technology they wish they had

○ "I've done some work with some graphing calculators. It's just I don't have a lot of graphing calculators here. We're a very poor school district and we don't have whole lot of other technologies. I'd like to get some CBR's and do some stuff with those but we haven't had the funds to get that yet."
○ "Yeah. We don't have any SmartBoards but we're hoping to get some before long on that because I've been looking at those, too. In fact, I'm going to take an online course in the spring - in the fall - starting in January on the computer - dealing with geometry on the SmartBoards."

One of the control teachers also mentioned that they wished they had Smart Boards in their classroom, and that they were in the process of writing a grant to receive one.

Table 64. Control teacher comment on technology they wish they had

○ "Right now we're trying to write a grant, just another teacher and I, just to get Smart Boards in the rooms."

5.3.4 Perceptions of Technology Used

5.3.4.1 Student Comfort With Technology

During the interview, the teachers were not asked about how comfortable their students were with the technology, however 23 of our treatment teachers made comments to this affect. 11 of these teachers felt their students were very comfortable with the technology.

Table 65. Treatment teacher comments on their students feeling very comfortable with technology

- "That a lot of these kids have internet accounts, you know, they get them free through Yahoo or whatever. A lot of them exchange pictures with their families through internet accounts. A lot of them are very comfortable with computers. They are very comfortable and that's - this is the first class ever that I've had where all of them didn't have a problem - didn't have any kind of fear or apprehension - that they could not do it or that it would be difficult or they couldn't work with the computer."
- "They've had a lot of computer experience."
- "They weren't afraid to attack the computers. I mean, by attack, I mean to take a chance with it."
- "Everybody uses - I mean, we're in a real techy kind of environment. Our parents are that way. Our kids are that way. So, yeah, that was all good."
- "The kids in the accelerated classes are the kids that have more access to computers so therefore the technology skills were higher there."

Seven treatment teachers mentioned that their students had little experience with technology, and may not have been as comfortable using it.

Table 66. Treatment teacher comments on their students not feeling very comfortable with technology

- "Well, um, some students, I mean, their experience on a computer is just about none and, as far as logging on the computer, you know, how do they do that and they would forget how to bring up the program and things like that were problematic."
- "I didn't give them homework. That I ruled out because I have 13 7th graders and I think 2 of them have computers at home so that was just an impossibility."
- "The other thing again with the technology is since some of the students, these are seventh graders, this is the first time they ever had their own log in."
- "I know the first day, they had something with looking up on the internet or computers or resources and, these kids, they don't have any. They are your lower level, low income kids."

The remaining five teachers felt they had some students in each category, with some of their students being computer savvy and some uncomfortable using technology.

Table 67. Treatment teacher comments on variation in student comfort with technology

- "Yeah, and two or three times later than the other guys would get it. There was really only one girl that ever struggled and hers was more of a language barrier and because she comes from a very poor family, she's never had a computer."
- "They were the ones that are like a little bit shy because they don't - usually they are not like that but I have only one that was not very good with the computers so the other ones,

they were good. So, they were like, 'oh, okay. I know how to do it' because they were into the technology. One of my students, he was not very good the computers so he was like lost always all the time."

- "But, what I would like is some alternate, don't need a computer, again particularly my regular kids are less likely to have a computer at home or access than the sometimes, as a group, that's not without exception but sometimes my higher achieving kids are a little more likely to have a computer."

Two of the treatment teachers went on to mention why they thought their students enjoyed going to the computer lab. For the first teacher, (s)he believed it was just because the students had more "free time" in the computer lab. Whereas the other teacher believed it was because they hadn't gotten to use the computers for math class before.

Table 68. Treatment teacher comments on why their students enjoyed the computer lab

- "Of course, [the students] all wanted to go to the computer lab and I believe the reason was they started to find that they could have a lot of more free time, I suppose - during the class. The classroom, they have to respond to me, I was right there. I wasn't walking to the other side of the classroom like I did in the lab."
- "They actually liked to get on the computers because - I don't have any resources available that they actually get to do math on the computers. You know, we do history on the computers with my 8th graders and the math kids come in and see that I use the laptops and stuff but I don't use them in their class because I don't have any software. So, they were real excited about that there was finally some math software that they could use."

5.3.4.2 Teacher Comfort With Technology

During the phone interview, 14 treatment teachers commented on how comfortable they felt with using technology in the classroom. Four of these teachers expressed that they felt very comfortable with technology, and they were confident in using technology in the classroom. It is interesting to notice that two of these teachers had previous careers focused on technology.

Table 69. Treatment teacher comments on being comfortable with technology

- "Because, I've taught computer literacy long enough to know that when you introduce something, you've got to give them a day to play around or you lose their attention. They are going to play no matter what."
- "So, computers are my thing. This is what I do best at. I'm just the Math teacher because I have to teach one or two other classes."
- "25 years of information technology and engineering, prior to teaching."
- "Well, my background is that, I have a degree in computer science and I'm also an MBA/CPA so I came to teaching after doing something entirely different in the business world for a long time. So, the technology doesn't really bother me."

The remaining ten teachers did not feel comfortable with technology, and were apprehensive in teaching with technology.

Table 70. Treatment teacher comments on not feeling comfortable with technology

- "I don't think they ever really had the kind of scare that I had, but I just don't do computers well. I mean I was real proud of myself for at least loading it. I was worried that I even loaded the disk wrong, but Ken told me I did it all right."
- "I'm not very knowledgeable on the technology end of things."
- "I'm not that great with technology. I don't mind using graphic calculators, but when it comes to computers I'm one of those I like to make sure everything works."
- "I'm not very computer literate but they enjoyed it."
- "Well, I'm currently taking a class, a college course online. It's just a computer class learning the basics about computers because I don't feel like I'm really computer savvy."
- "Well, with me with the technology, I thought I was really good with technology and I still think I'm good with technology but I wouldn't be able to teach a computer class for example. For me, as a teacher, that's what really hurt me."

5.4 Math Topics

In the interview, the teachers were asked to describe math topics that went well or were difficult for their students. These became the first two subcategories of math topics. The teachers also described math ideas as either "basic" skills that should have been mastered before coming to 7th grade, or as topics that were being newly introduced to their students. From this point, the Math Topics node has the following breakdown:

Table 71. Break-down of the Math Topics Code

- Math Topics
  - Difficult
    - Basic
    - New
  - Went Well
    - Basic
    - New

The following graphs show the results of this analysis between the treatment and control conditions.

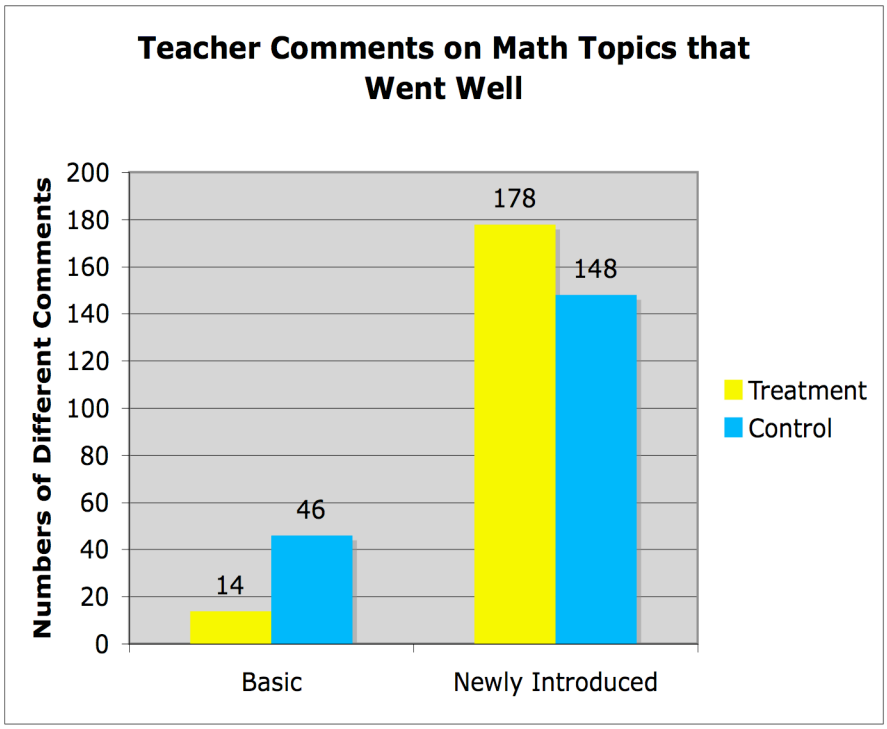

Figure 5. Number of treatment and control teachers who commented on Basic or Newly Introduced topics going well for their students

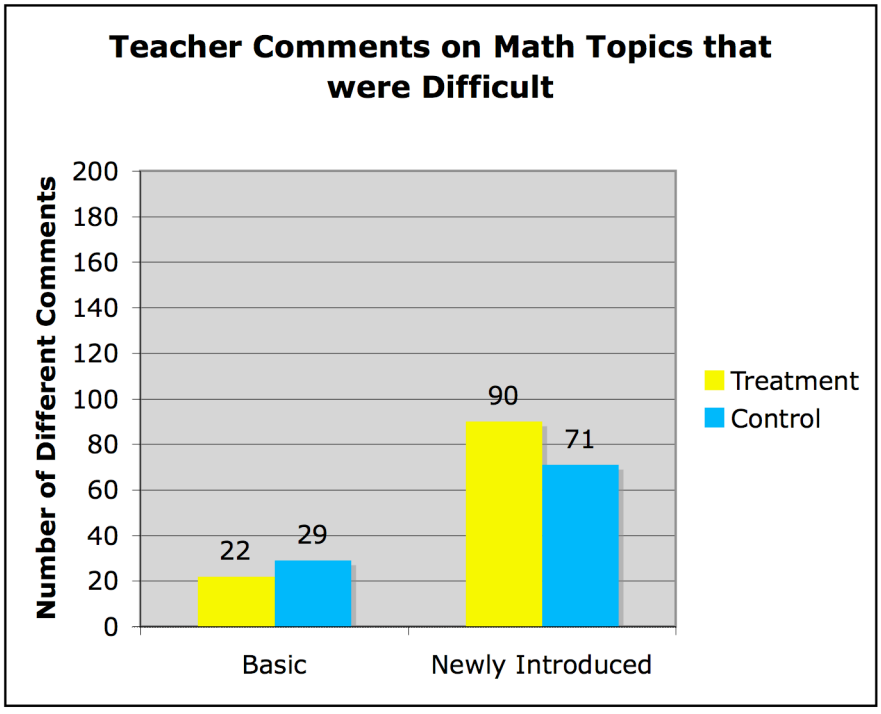

Figure 6. Number of treatment and control teachers who commented on Basic or Newly Introduced topics being difficult for their students

Overall, the teachers talked about more topics that went well than topics that were difficult. In both cases, control teachers talked about more basic topics than treatment teachers, and treatment teachers talked about more newly introduced topics than the control. This can be seen in the following table.

Table 72. Number of treatment and control teachers who mentioned that Basic or Newly Introduced topics that went well or were difficult for their students

	Basic Topics	**Newly Introduced topics**
Treatment	36	268
Control	75	219

By running a chi-square analysis on this table we get the value of $\chi^2(1) = 18.47$ ($p < 0.001$), which means that treatment teachers routinely talk about more newly introduced topics than control teachers, and that control teachers talk about more basic topics than treatment teachers. Furthermore, there was a negative correlation between teachers talking about basic topics and their students' gain scores, as well as a positive correlation between teachers talking about newly introduced topics and their students' gain scores. Interestingly, the correlations still held when I examined discussion of basic or newly introduced topics going well, but not when the topics were discussed as difficult. These correlation values can be seen in the table below.

Table 73. Basic and Newly introduced math topics correlated with student gain scores.

Math Topics Discussion	**Significant correlation to student gain scores**
Basic Topics going well	$R = -0.379$, $p < 0.0001$
Basic Topics going well or difficult combined	$R = -0.273$, $p < 0.008$
New Topics going well	$R = 0.257$, $p < 0.012$
New Topics going well or difficult combined	$R = 0.316$, $p < 0.002$

At this point the basic and newly introduced math discussions were broken down into specific mathematical skills. The wording and descriptions of these mathematical ideas come from the language the teachers used in the interview. These skills can be seen in the table below with their description.

Table 74. Break-down of Basic and Newly Introduced math topics

Math Topics	**Description/Examples**
Basic Topics	*Should have been mastered before 7th grade*
Arithmetic	Adding, subtracting, multiplying, and dividing.
Simple Graphing	Using Ordered pairs, plotting points, reading points, and axis labeling.
Percents	Finding percent of the whole and percent differences.
Fractions	Basic fraction arithmetic

Vocabulary	Understanding mathematical vocabulary
New Topics	*Newly introduced to students in the 7th grade*
Translation between representations	Being able to match or translate data to a table, graph, and equation.
Picking "Easy to Read" Points	Picking points on the graph that will simplify subsequent operations.
Independent and Dependent variables	Identifying and understanding the difference between independent and dependent variables.
Graph Interpretation	Understanding what graphs mean and interpreting them correctly.
Equations/Formulas	Creating equations from data.
Slope	Understanding the meaning of slope and being able to find the slope value from a graph.
Proportions	Solving proportion problems and understanding the difference between proportional and non-proportional relationships.
Rate	Being able to find the rate and/or unit rate from data.
"Real World" Applications of math topics	Describing real world events that graphs/data could represent.
Tables	Being able to fill in charts or tables when given data with a proportional relationship.

When talking about what was difficult for their students, treatment teachers talked about slope the most often while control teachers talked about proportions. It is also interesting to note that an equal number of control and treatment teachers discussed graph interpretation as a difficult concept for their students. The results of this analysis can be seen in the graph below.

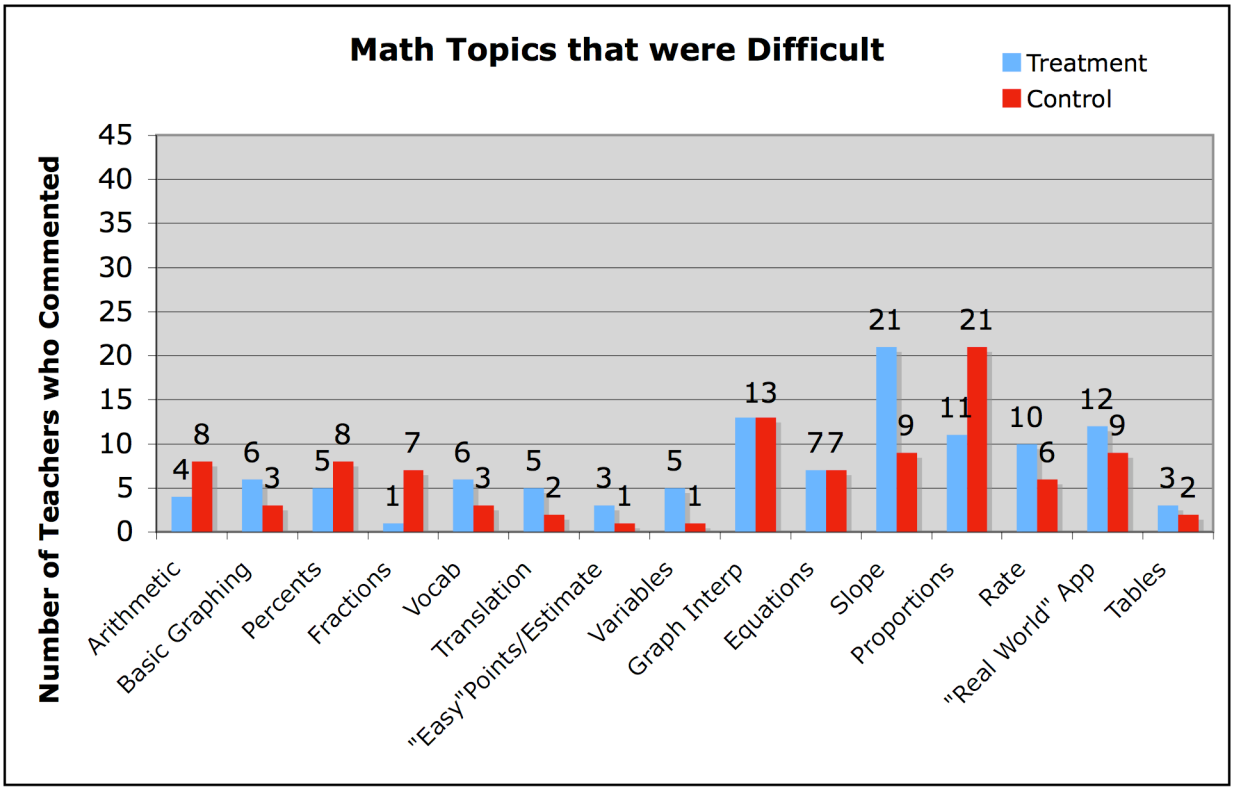

Figure 7. Number of treatment and control teachers that commented on specific skills being difficult for their students

Overall, the teachers talked about more topics that went well than topics that were difficult. Treatment teachers talked about graph interpretation and slope as topics that went well, while the majority of control teachers felt that proportions was a topic their students did well with. The results of this analysis can be seen in the graph below.

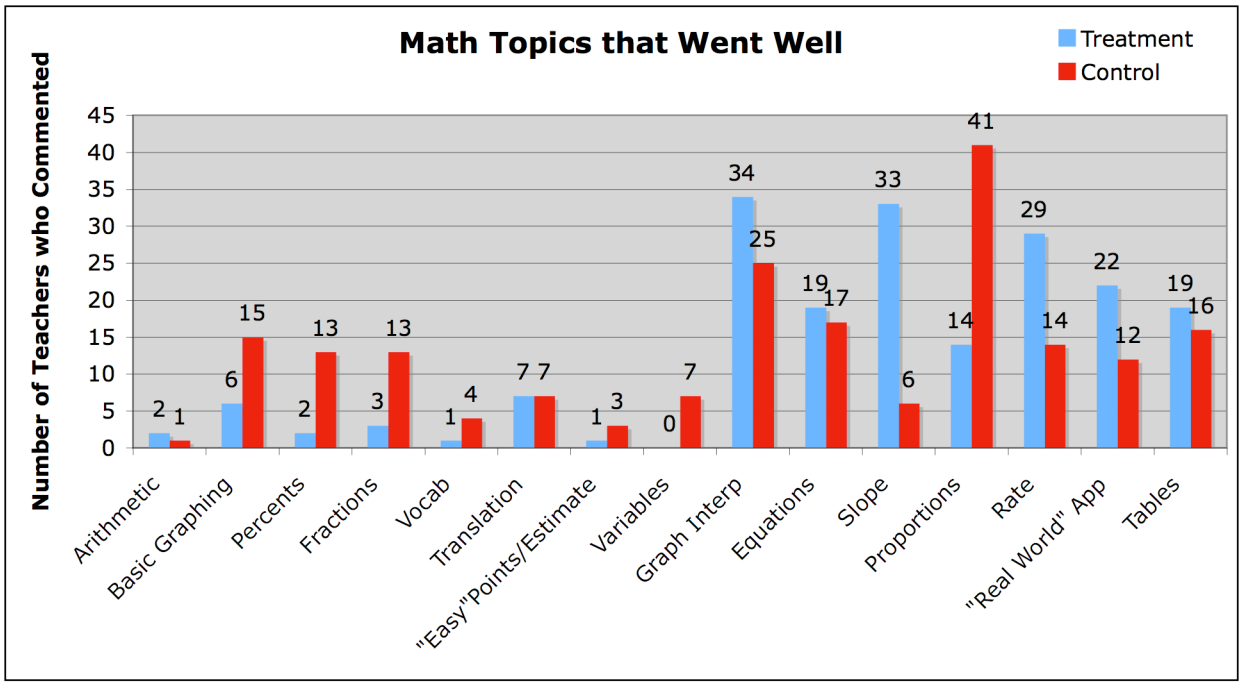

Figure 8. Number of treatment and control teachers that commented on specific skills that went well for their students

5.5 Administration

During the interviews, the teachers were asked about their administration and how their administration felt about their participation in the project. All of the teachers' statements about their administration were broken into three categories: Supportive, Unsupportive, and Apathetic. The following table shows the number of teachers who had supportive, unsupportive, and apathetic administration in each condition.

Table 75. Number of treatment and control teachers who had supportive, unsupportive, or apathetic administration

	Supportive	Unsupportive	Apathetic
Treatment	36	4	7
Control	37	2	11

We were concerned that the administration support would affect whether the teacher continued or dropped from the study. So these results were then compared to the teacher's retention to year two of the study. The graphs and tables below show these results.

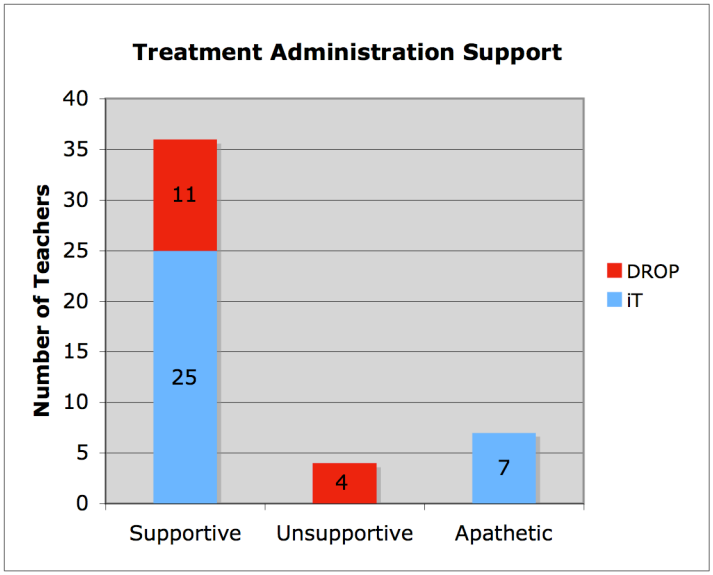

Figure 9 & Table 76. Treatment teachers' administrative support compared with participant retention

Treatment Condition		
	In The Study	**Dropped**
Supportive	25	11
Unsupportive	0	4
Apathetic	7	0

For the treatment condition, if we compare the administrative support to the teacher's retention in the study with a Chi-square analysis we get $\chi^2(2) = 11.85$ ($p < 0.001$). This means that treatment teachers who had an unsupportive administration were more likely to drop from the study for year two.

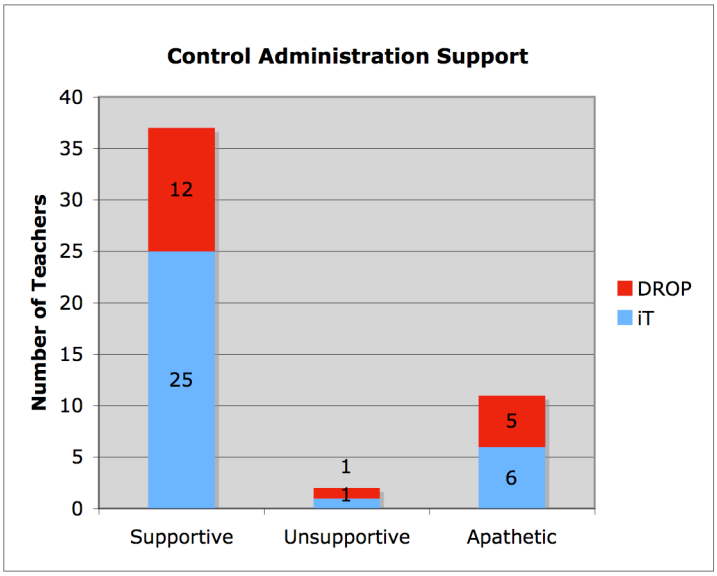

Figure 10 & Table 77. Control teachers' administrative support compared with participant retention

Control Condition		
	In The Study	**Dropped**
Supportive	25	12
Unsupportive	1	1
Apathetic	6	5

For the control condition, if we compare the administrative support to the teacher's retention in the study with a Chi-square analysis we get $\chi^2(2) = 0.80$ ($p > 0.05$). This means that we can make no claims about the teacher's administration have affects on their decision to stay in the study for the second year.

6 Discussion of Results

6.1 Philosophy and RQ1

In Section 5.1, I collected all of the statements of opinion teachers made throughout the interview and separated these statements into smaller subcategories. This analysis was performed so that I could be closer to answering RQ1, "What is the variety of attitudes in our teacher population?"

6.1.1 Trying new things and participating in studies

From the first two Philosophy subcategories, Participating in Studies and Trying Something New, we can see that most of our teachers said it was routine to participate in studies (53 out of 92) and they liked trying new things (71 out of 92). This would be expected for a study such as

this, since participation was voluntary, and in fact, the teachers had to apply to participate. However, there were still a number of teachers who said they were cautious about trying new things in the classroom (21 out of 92) and that participating in a study like this was a new experience (33 out of 92). These results suggest that the recruiting method used in the study reached a wide audience, and more importantly, that our population was diverse in their opinions about using new advances in teaching materials and methods. Having a population of teachers that are diverse in opinions as well as demographics is important to the SimCalc researchers since one of their goals was to demonstrate SimCalc's success with a "wide variety" of teachers.

Furthermore, by performing a Chi-square analysis on the data we can see that teachers who said it was routine to participate in studies like Scaling Up SimCalc were more likely to say they enjoyed trying new things, and conversely, teachers who said that it was new to participate in studies like this were more likely to say they were cautious in trying new things. This is a result that could seem obvious to many researchers but has important meaning for all scaling studies. The goal of educational scaling studies should be to evaluate their technology or curriculum in a variety of settings with a variety of teachers to provide evidence for the advancement's efficacy. If the scaling study only recruits teachers who enjoy trying new things and routinely participate in studies then they will fall short of their goal to reach a diverse population. This implies that special care must be taken when devising a recruitment method for such an expansive study.

6.1.2 Type of Teacher and Teaching Method

In Section 5.1.2 and 5.1.3 I illustrated what type of teacher the participants saw themselves as and how they characterized their own teaching method. There was a wide range of opinions articulated by our teachers that stretched from their use of repetition and homework to how closely their teaching method aligned with co-workers or the method presented by SimCalc/ TEXTEAMS. Once again, this diversity of opinion speaks to the diversity of participants recruited by Scaling Up SimCalc researchers. However, here I would like to call attention to the comments made by teachers who felt that the SimCalc or TEXTEAMS teaching method was different from their own.

In Tables 23 and 24 you can find quotes from treatment and control teachers who felt the teaching method presented to them, either SimCalc or TEXTEAMS, was different from their usual teaching method. There were a total of 12 teachers that felt this way (6 treatment and 6 control) and most of them expressed that the change in teaching style was a positive experience. However there were 3 treatment and 1 control teachers that expressed frustration while teaching their rate and proportionality unit.

Table 78. Examples of teachers who were experienced frustration with the new teaching method

Condition	Quote
Treatment	"I didn't give them much credit as first and, like I said, it was really hard to me to stand back and let them put it together and a few times I just blurted it out because it's frustrating to sit there and give them the wait time like you should. But, later on, they were really getting better at it."
Treatment	"First off, I was a little apprehensive teaching it because it was very different. The

	style would be very different from what I'm used to. With the technology. Also, I've been so used to lecturing, I'm from the old school, I guess - lecture and then we do discuss whatever we have covered, but usually I'll end up with a hand out where they can demonstrate to me that they have understood what they've done. With the computer, I did not get as much feedback from the student as far as paper and pencil work. It was like together. I really wasn't sure if the individual students were getting as much as it seemed like they were."
Treatment	"Yes. There were times when I felt like, if I could have maybe shown examples and maybe that just goes back to my old style of teaching - that's the old teacher in me. I just want to show examples."
Control	"It's very different the way I've taught it before in the sense that I guess I'm not a facilitator. I'm not the one bringing forth in the information. I'm getting it from the kids as they go through the lesson, which is basically what we're being pushed for now. So, in the beginning, I felt like, 'okay, am I getting through to the kids?' because I'm so used to being the one transferring the information. So now, they are trying to discover the information and I feel like some days, 'am I getting through? Are the kids really getting it?' And so, that's what my experience for this year has been."

We could assume that for the most part, teachers across the USA prefer to teach with methods and tools that they are comfortable and familiar with. While all of these teachers quoted above used the new teaching method presented to them, they were frustrated with either the lack of feedback they received from their students or letting the students discover the answers on their own. If their frustration in using the new teaching method is great enough, they may revert to their "tried and true" method once the study is complete. It is important for researchers to pay attention to the teachers' frustrations because they could represent barriers that prohibit the teacher from adopting the new method or technology. To take the research a step further, we could investigate what specifically caused the teachers frustration and evaluate ways that could bridge a teacher's current teaching method to the new one.

6.1.3 Unit Difficulty

There were several treatment teachers who made comments on their students' ability and gave opinions on how current school curriculum or policy could change. These comments can be found in Section 5.2.4.1 or Table 30. The teachers' comments fell generally into two categories: characterization of the students' capacity in their school/class, or characterization of the replacement unit's difficulty level. Here I would like to draw attention to the comments made about the unit's difficulty.

Table 79. Treatment teacher comments on replacement unit difficulty

o "In 7th grade. Because they are doing those linear equations and you might as well. I mean, you are doing unit rate - you might as well. So, it gave me a new experience as to whether they had the ability to do slope or not and, although we didn't go over it a lot, you know, I had to, you know, do one or two of the problems and then go on to the next thing. It did let me see that they could/would be able to slope in 7th grade."

- "For my students, that's just my opinion. I felt like it was a little difficult for them. Especially, not knowing - they've been so conditioned to choose these multiple choice questions that when they're faced with something that shows them to think and to give an answer themselves, it was a little complicated. I would venture to say, if they were to have math maybe like this for maybe two years consecutively, you'd see a big change."
- "I saw the whole unit as being pretty pre-algebra unit, not a pre pre-algebra unit. It struck me as a regular 8th grade, advanced 7th grade type curriculum, even towards the beginning part. And, I feel pretty good that we're teaching aligned with what the Essential Knowledge and Skills are for the 7th grade, as far as 7th graders. But, I love the stretch. I don't want to say I don't want to do that. It's just that I might do the more required earlier because we've got to make sure their solid in all their standard skills first."
- "Yeah. Neither I nor my teammate, we didn't try this with any of our regular classes. And she said, I wouldn't even try it with a regular class. Now, next year, I'm not going to have 7th pre-AP, I'm going to have 6th pre-AP and 7th regular, so I'll be doing it with a regular class but I will be doing it differently. To the extent that resource doesn't exist, I'll be trying to think of a way - because if a regular kid misses a day of this - the most likely ones to miss are the ones that are most likely to get a huge hole that they won't be engaged and then they'll be totally off track."
- INTERVIEWER: So how did the SimCalc or the MathWorlds work out?
  INTERVIEWEE: They were fine. I enjoyed it. I wish everybody could have used it, all the students, all the math teachers, go out there to the workshop and so on and start using it. Not only in middle school but also in elementary because it means a lot. A lot of those kids don't get those activities, they don't get all those geometry, they don't cover proportion and rate and so on. What they do is just basic. But, if they were to have something like this in elementary and then pick it up in middle school, I think it would be very successful for them to succeed and to TAKS or anything. But they have to start from elementary and then up.

All five of the teachers who commented on the unit's difficulty felt that it was more advanced than what was usually taught in 7th grade. The researchers who developed the replacement unit intended for the curriculum to be more advanced than the usual 7th grade curriculum and focus on function-based proportionality, yet still on par with an average 7th graders ability. While the first teacher quoted above was teaching the SimCalc unit, (s)he realized that 7th grade students had the ability to understand slope. Perhaps in the future this teacher will present slope, a conceptually more difficult math topic, to his/her students even though slope is not a topic on the annual 7th grade TAKS. The remaining 4 teachers expressed that the SimCalc unit was a stretch for their regular 7th grade students and that some pre-unit work needed to be done before they would teach the unit again. This view of the unit might have implications for how these teachers and other treatment participants in the study will implement SimCalc during Year 2 of the study. Researchers on the SimCalc project will need to document any changes teachers make to the curriculum during Year 2, and see if adding pre-unit work results in changes to the outcome measures.

6.2 Technology and RQ2

6.2.1 Time Tradeoff

One of my goals in analyzing the teacher interviews was to better understand the decisions and tradeoffs teachers are faced with while using technology in the classroom. It seems from the teachers interview responses, that there was a tradeoff between using the technology and the amount of time spent on the lessons. Whenever the technology would break or not work as intended the teachers had to take time away from the actual lesson to focus on solving technical problems. There was also an overhead time cost to setting-up the laptops in the classroom or transporting all of the students to the computer lab everyday. Below are some examples of teachers describing instances in which using the technology cost them class time.

Table 80. Treatment teacher comments about technology/time tradeoff

- "We had our technician - we have two technicians. Well, we have a technician and then we have an assistant. The assistant loaded everything up. The computer lab - we started out with 30 computers and then I think one of them died or something so we ended up with 29 computers and they were all downloaded. And, the first time they downloaded it, they had problems finding the files. They had to go digging for them and I think what happened was we have two settings - we have like a - you have to log in either as a teacher if you're a teacher, or you have to log in as a student if you're a student and when they downloaded the software the first time, they downloaded it under the teachers. So, when the kids got on, they couldn't find it. So, we had to come back the next day and they had to reload everything with - under the students. That was the only problem they had."
- "I think if they had had a chance to work in the computer lab, like it's meant to be, then it might have gone a little quicker. But, we had a couple days where we went down to the computer lab and our technology person assured us that…assured me that it was ready to go, no problem, and then nothing. We couldn't get to the files. But, I had 3 computers in my classroom that I put Math Works on and I didn't have any problem."
- "Well, when I asked them to run that simulation, they couldn't fit the graph to where it would run the whole simulation and some of the students figured it out. You know how you can click… And stretch the graph and I had a couple students that were able to do it but, as a whole, the class - we really lost 10 or 15 minutes trying to figure out how to do that"
- "The CD, when our computer tech installed it, it wasn't reading the files. I had no files. Nothing was coming up. So, they emailed the files to me and he was able to install it into my laptop and I used the laptop and projected it out and that's how we did the whole project. Because, some days, trying to get it into the other computers, and trying to get him here to get it done, was mission impossible because we only have two computer techs for the whole district and they moved our server so we've had all kinds of craziness. And so, with the kids, we ended up doing it together as a group on the projector on that laptop because we were able to pick it up and I didn't want to take any chances and struggle and waste time - valuable time - them trying to get on the computer individually. I mean, we didn't have that kind of time. With all the interruptions, every minute was precious. So, we worked on, steamed ahead. We were good!"

- "It was a little problematic for me to have to take the kids to the computer lab because, you know, basically, the way the lessons were, you know, Monday would be in the lab and then Tuesday we'd be back in my classroom, and then Wednesday lab - so it was going back and forth and me having to, you know, have all the supplies down there that we needed. So, that was kind of problematic."

Many of the teachers felt frustrated when they lost class time to technical problems. As I described earlier, teachers are pressured to teach a set number of topics in a short period of time so that their students will pass standardized tests. Some of the teachers felt that the time and frustration that comes with using technology is too high a price to pay. One of our teachers who decided to use a laptop and projector instead of the computer lab said it was because (s)he didn't want to waste "valuable time" struggling with the technology because "every minute is precious". We could imagine that when the learning benefits of using technology are not obvious, the teachers will have a lower tolerance for resolving technology problems and might be less inclined to use technology in the future. This has an impact on the amount of time students would be able to spend with the technology resource in their math classes, which I will discuss in the next section.

6.2.2 Student Access to Technology

Students need access to a variety of sources of knowledge to maximize their learning. These sources of knowledge can be their teacher, workbook, peers, manipulatives, and technology. In every classroom, the teacher is the student's gateway to these sources of knowledge. For example, if a student wants to ask their peer for advice, then they must have a teacher that allows them to talk to their peers. In the same sense, the teacher is the student's gateway to using technology resources. When a teacher decides to use technology in their classroom, they are allowing the students access to another possible source of knowledge. From the interviews, I found that there are three main factors that affect whether a teacher will decide to incorporate technology into their teaching: (1)obstacles inherent in using technology, (2) the teacher's comfort with using technology, and (3) the teacher's belief in the technology's benefit for their students. In the table below I list and describe these factors.

Table 81. List and description of the factors of classroom technology adoption

Factors of Classroom Technology Adoption	Description
Obstacles in Technology Use	Some obstacles that face technology use in schools are the time cost in resolving technical problems, the availability of computer resources, and scheduling sufficient time with the computer lab or laptop carts.
Teacher's Comfort with Technology	Teachers who are not comfortable using technology feel they are less prepared to teach with technology and deal with technical malfunctions.
Teacher's Belief in Technology Benefits	If the benefits of using technology are not obvious to teachers, they will feel that their time is better spent doing traditional classroom work.

The three factors of technology adoption are tightly related. For example, if the teacher does not believe that using technology benefits her students, then she will be less inclined to overcome any obstacles that arise and instead find another way to teach the lesson. There were three of our treatment teachers that decided to just use a projector and a laptop to teach the unit when they had difficulty installing MathWorlds on lab machines. Also, when a teacher does not feel comfortable using the technology resources with their students, they may decide that the benefits of using technology are not great enough to continue using it. Two of our treatment teachers decided to just use a laptop and projector because they felt they were "out of control" while they were teaching in the computer lab. The three factors influence the teachers' decision to use technology or not in their classroom, which in turn affects how much time the students have to directly use the technology. In other words, the three factors affect the amount of student driven action with the technology in the classroom. These relationships are demonstrated in the figure below (Figure 11).

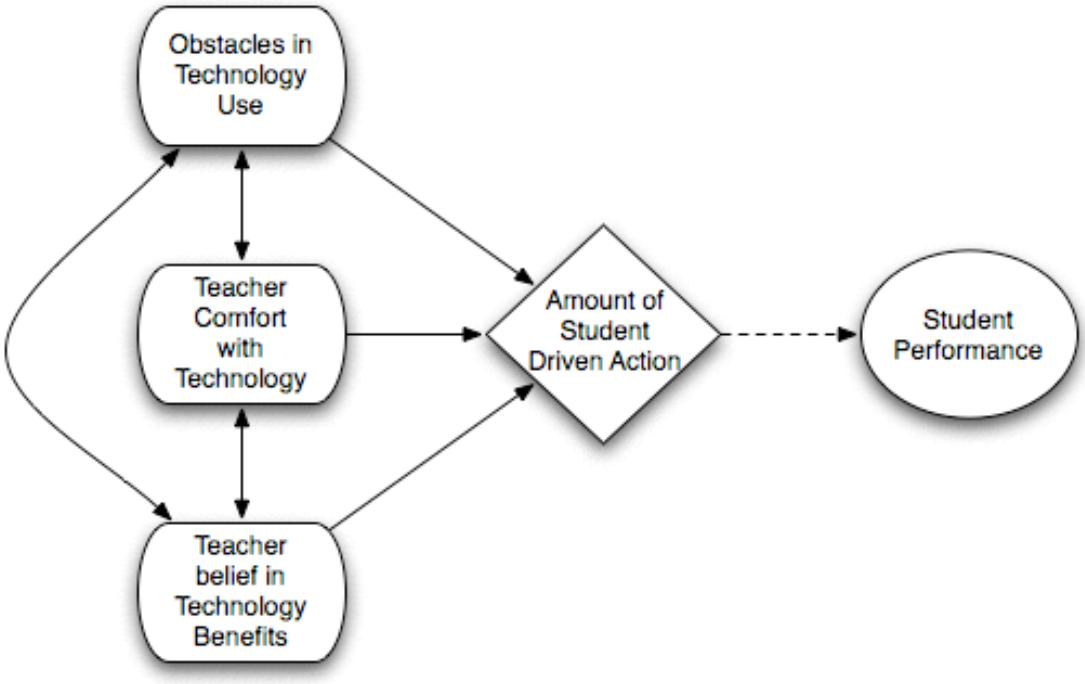

Figure 11. Student access to technology model

6.3 Math Topics, Administration Support and RQ3

6.3.1 Math Discussion and Student gain scores

As mentioned before in Chapter 2, 7th grade math classrooms in Texas typically focus on a formula-based approach to rate and proportionality (a/b = c/d), whereas SimCalc and TEXTEAMs tries to encourage a function-based approach to proportionality (y=kx). The pre & post-test used in SimCalc was designed to evaluate students with formula-based questions (taken from previous TAKS exams) and function-based questions (created by the SimCalc researchers). Not only did students in the treatment condition have higher gain scores overall compared to their peers in the control condition, but they also had even higher gain scores on the function-based portion of the test.

In studying the math topics discussed by the teachers during their phone interview, it was interesting to see that control teachers were more likely to discuss basic topics than the treatment teachers, and treatment teachers were more likely to discuss newly introduced topics than the control teachers. Also, the discussion of basic and newly introduced math topics correlated negatively and positively to the students' gain scores, regardless of whether the topics were discussed as going well or being difficult for the students. From these results, I believe that the math topics discussed by the teachers during the interviews correspond to the topics covered in their classrooms. Even if the topics were difficult for the students, as seen by the teacher, it still means that the topic was introduced and discussed with their students. Since the treatment teachers were using a curriculum and software package that focused on more complex, function-based mathematics, the students in the treatment condition were exposed to more complex mathematical ideas than their peers in the control condition.

6.3.2 Administration and Participant Retention

Unfortunately for the Scaling-Up SimCalc project, 15 of the treatment teachers dropped from the study. For 4 of these teachers, the reason *could* have been that they had unsupportive administration. However, the results presented in the document are far from conclusive on the matter. It seems for any scaling study, participant retention is a huge concern that is not easily predictable. Many teachers are asked to teach different classes and grade levels from year to year, which affects how many teachers can participate in studies that continue for multiple years. Also, for some schools and districts, there is a large turnover rate for school administration. While a teacher may have very supportive administration the year they volunteer for the study, the next year they could have a new principal who does not like their involvement in a study or use of technology. One of our treatment teachers expressed the pressure their principal was placing on them to finish with the unit:

> "[The principal] did sign the permission slip though. First thing he said was, 'well what you are just covering right now is probability and rate. I mean, in Texas, that's one of the TEKS out of all those things.' The TAKS is composed of more objectives than all the objectives you cover right now. So, how long is it going to take you?' Pressure. Finish it. Finish it. Go onto other objectives in the TAKS. A little bit of pressure by him. Either complete it or they're going to score low. You just hope there's only one objective or two objectives when there's other four or five objectives to cover." – quote from a Treatment Teacher

It seems that the principal described in the quote above did not feel that the SimCalc unit covered enough topics for the amount of time the teacher was spending on the unit. We could imagine in this situation that the teacher would be pressured to cut the unit short, and possibly rob the students of opportunities to explore more complex mathematical ideas. In order for any educational innovation to be widely accepted, both teachers and their administration must be convinced of its success. By doing this the teachers could feel free to use the innovation, in this case SimCalc, without feeling guilty or pressured to move onto other, more traditional lesson plans.

7 Conclusions

The impact of the Scaling-up SimCalc is obvious from the pre- and post-test results. Students whose teachers used SimCalc, performed better than their peers, whose teachers did not use SimCalc. With such positive results it would seem that SimCalc's success would be guaranteed, but this is not necessarily the case. Many successful innovations have failed to hold ground in the real world because they were not practical, too complex, or incompatible with current practices. Everett Rogers (2003), in his book "Diffusion of Innovations" listed 5 properties of innovations that affect the innovation's chance to be widely accepted. These factors are the following: relative advantage, compatibility, complexity, trialability, and observability. While the analysis of the teacher phone interviews did not provide definitions for all five of these factors in SimCalc, my research did shed light on some of them. In particular, in this document I have described how teachers see the relative advantage to using SimCalc, how compatible SimCalc is with current teaching practices, and how complex SimCalc is to use.

There are many benefits to using SimCalc. Besides raising test scores, teachers using SimCalc introduce more complex mathematical ideas to their students, which have ordinarily been considered outside a normal 7th grade math lesson. This result was reflected in the phone interviews when more treatment teachers mentioned more complex mathematical ideas than the control teachers. Also, several teachers expressed that SimCalc was advantageous in Chapter 5.2 when they discussed their teaching practices or current school policy. One teacher in particular said, "I just loved the investigation part of it… I would rather do that because kids learn faster when they do that." However, some treatment teachers struggled with using SimCalc because it was so different from their current teaching methods. In this case, SimCalc was not compatible with their current teaching style. Also, for some teachers, using technology such as MathWorlds is a complex process with many hurdles to overcome. I developed a model (Figure 11) that describes the hurdles that teachers face while using technology, and how this effects teachers' decisions on how frequently to use technology. It is important to note that if we had not conducted the phone interviews I would not have been able to paint such a detailed picture of the difficulties teachers faced while teaching this year. I hope to further identify the difficulties surrounding teaching with technology, so that research can be done to find ways to mitigate these problems for teachers.

Future research must investigate ways to bridge the gaps in teaching methods and encourage more support for teachers using technology. In particular, we should study and investigate the decisions teachers make in the classroom that affects their students' access to potential knowledge sources. By doing this researchers can make SimCalc more compatible for teachers with different teaching methods, and reduce the number of obstacles teachers face when using technology in the classroom. There also needs to be an increase in educational scaling studies, so that we can better identify the factors that effect the diffusion of educational pedagogy and technology. I hope to continue my investigation of the phone interviews and develop models of teachers' philosophies and how this affects their students' success. In particular, I want to further identify possible correlations of teachers' attitudes with the study's outcome measures. As well as cluster teachers based on the language they used, the decisions they made, and the opinions they expressed. I would also like to examine the buzz words, such as "discovery" or "student-centered class", that teachers use to describe their teaching methods and discover what these

buzz words mean to the teachers in our study. By continuing my research I can develop a more complete picture of the teachers' concerns and how they perceive the classroom. With continued effort, research, and support, we can look forward to the diffusion of more educational innovations such as SimCalc.

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Appendix A - Phone Interview Script

Greet the teacher politely; ask how he/she is, etc.

Introduction:
The way this interview works is that first I need to go over a couple of things, and then we'll get started with the "real stuff." First, I want to thank you so much for participating both last summer and while teaching rate and proportionality. Your participation is crucial to our project and research efforts to improve math instruction. As a final wrap-up to this year's work, we are talking with each of the teachers about how everything went.

The reason that we gather so much data is that we are very interested in learning from your experiences. This will help us to understand what happened, both the good and the bad. In this interview, I'll ask you some questions about your experiences with the unit, the technology, the students, and participating in the research aspects of the project. We're interested in what happened and also how you felt about it. It should take about an hour.

Your feedback is critical. Your responses could really change what we understand about TEXTEAMS, SimCalc, and Texas teachers. Your responses will be kept confidential, so we hope that you can feel candid and comfortable giving us as much feedback as possible – both the positives and the negatives.

Also, our hope is that this interview will give *you* a useful opportunity to reflect on your experiences.

So that we can accurately capture everything that you say, we would like to tape record this interview. Will that be ok with you?

Questions:
Teaching Experience

Overall, what was your experience like teaching rate and proportionality this year?
Control Group: Was there anything that you did differently this time compared to the last time you taught the topic?
What aspects of the unit went well? (Did anything else go well? Iterate on this exhaustively)
Was this your usual experience teaching rate and proportionality? How did it differ?
Were there any aspects of the unit you found did not go well or were difficult? (did anything else work out poorly? Iterate exhaustively.)
How closely did you follow the curriculum in individual lessons? Were there any parts at which you made improvements? What were they? How did you come to make them?
Experimental: We're going to be offering a workshop this summer on the best teaching strategies to use with these materials. Are there any ideas that you used that you'd like to share with those teachers?

Math

Tell me about one really important thing that your students learned this year. (What other important ideas did your students learn? Were there any others? Iterate.)
What are some of the things that your students learned as a result of this unit? (What else did they learn?)
Is there anything you wanted your students to learn that they didn't learn? What is it?
Control: How many years have you taught the curriculum you taught this year?
Experimental: Sometimes when teachers are teaching a new curriculum, they get into the middle and discover that something is a lot more confusing than they thought initially. Did this ever happen to you? How did it come up (How did you deal with it)?
Experimental: Did you ever talk with anyone about the math content of the curriculum?

Technology

If they have not mentioned the technology, ask:
Control: Did you use any kinds of technology in teaching the unit?
Control (if yes): What were they?
Control: Did anyone give you support in setting up or using this/these technologies? Tech support?
Experimental: How did we <the technology> work out? Were there aspects of the technology you found went well? Were there aspects of the technology you found did not go well or were difficult?
Experimental: How did SimCalc get set up on the machines? Did you do it?
Experimental: Were there any problems using the technology?

Students

What period did you target for studying?
Did you also use SimCalc with your other classes? Which ones? How did those work out?
Now we're going to focus on the target class. How does the class that we've been talking about compare to other classes you've taught?
How did your students react to the unit? Did they all feel the same way or were some reactions really different?
Was this class typical of students in your school or was it unusual in some way?
What percentage of your target class has difficulties reading or speaking English?
How did they deal/ you deal with the unit?
Do a lot of your students miss classes? Homework? Do you have a teacher's aide or someone who helps handling the diversity? How did you work with her/him to catch up? Did they learn SimCalc?
Have the recent Hurricane's effected your school much? Your classes? This class? How are you coping? (We're so sorry….)
Are there big gaps between the top students in your class and the bottom students?
Did you notice a lot of differences in understanding between, say, the top kids in the class and the bottom kids? (In how they engaged with the unit? In what they learned? Or in any other way….)
Now, just to get a bit more detailed, I'd like you to think of two students who did really well with the unit, who really learned a lot. How did that person learn the material? What bits were new to them? What did you notice that made you think that they had really

learned? Was there anything else that made you feel that they had learned?
Now, I'd like you to think of two students who had difficulty, who maybe didn't get it right away. How did that person learn the material? What bits were new to them? What did they struggle with? How did you happen to notice? Was there anything that the students struggled with at first but then came to learn? How did you come to know?
Now, we're going to do the same thing, but think about someone right in the middle? I'd like you to think of a specific person. How did that person learn the material? What bits were new to them?

Collaboration

Did you work with any other teachers during your unit? With anyone else?
Did you find the collaboration helpful?

Support

How is your participation in the study, (experimental: use of SimCalc) seen by the other teachers in the school? The principal? Math coordinator? The administration?
Are they enthusiastic about you continuing?
How do people feel about you using the computer resources? Is that a problem or is it ok?
Do you think they'd let you continue to do that when you are not part of a study?
How about the math content? Is it consistent with the directions your school has been moving and the things that people are worried about?

Research

First of all, remember back to when you came to the workshop in the summer, how did you feel about being in the TEXTEAMS plus SimCalc vs. the TEXTEAMS group?
How do you feel about it now?
The daily logging and record keeping. How often were you able to actually get these logs done the same day?
The test that we gave the teachers this summer was a little different from the kind of test we normally give. Could you tell us a bit about what you thought about the test as you were taking it, and how you felt about it?
Do you think that the workshop helped you do a better job on that?
Now, when you signed up for this study, you were signing up for something pretty adventurous. We were wondering whether this was unusual in your life, or pretty much the way you do things?
Have you tried other technologies in the classroom? When? What? How about professional development opportunities?
Apart from SimCalc, how many hours have you spent in TPD over the past three years?
Have you taken any classes? What were they in?
Do you like to try new things in the classroom or are you pretty cautious?
Think back to all the support you got from the research team starting with the DVD, email follow-ups, calls (the 800 number for assistance), instruction guide… Was there anything that the research team did that provided useful support?
Were there times during the unit when you felt like you needed more help or support?
What could the research team have done to support you better?

Wrap-up

Is there anything else we have not discussed that has been on your mind at any time during this project?

There are a few last things we need to know for reporting our results:

(1) What is your ethnicity?

(2) How old are you?

(3) Have you had any other careers besides teaching?

Thank you very much! The information you've provided will really help us work with other Texas teachers. (Remind delayed treatment teachers that we'll be scheduling the treatment workshop soon.) Remind immediate teachers that they are welcome to keep using these materials, and we'd like to know about it if you do!)

One last thing: the research team has asked us to remind you to send your box back as soon as you can. When do you think that will happen?

Appendix B – Complete list of codes with descriptions

Code	Description
Class Management	This code was used when teachers described class management issues, such as dealing with materials and resources in their classroom.
School Description	This code was used when teachers described their school setting.
Philosophy	During the interviews, teachers would often state their opinion or philosophy.
o Teacher Themselves	This code was used when teachers described themselves.
o Type of teacher	This code was used when the teacher described what type of teacher they are.
o Type of learner	This code was used when the teacher described what type of learner they are.
o Being in a study	During the interview, each teacher was asked if it was routine or new to be in a study such as Scaling Up SimCalc.
o New	This code was used when the teacher said it was new to be in a study.
o Routine	This code was used when the teacher said it was routine to be in a study.
o Trying New Things	During the interview, each teacher was asked if they liked to try new things or if they are cautious.
o Cautious	This code was used when teachers said they were cautious in trying new things.
o Will try them	This code was used when teachers said they liked to try new things.
o Students	During the interview teachers would often have opinions about their students.
o Pride	This code was used when teachers described their students' pride.
o Ability	This code was used when teachers described their students' ability.
o Types of learners	This code was used when teachers described the types of learners their students are.
o Methods	During the interview teachers would often described their teaching methods.
o New Approach	This code was used when teachers said the SimCalc/TEXTEAMs method was new for them.
o Approach the same as usual	This code was used when teachers said the SimCalc/TEXTEAMs method was similar to their previous method.

o Mistakes are good	This code was used when teachers said making mistakes is part of the learning process.
o Mistakes aren't good	This code was used when teachers said letting their students make mistakes was uncomfortable for them.
o Policy	During the interview teachers would often state their opinion on current school policy.
o Proposed changes	This code was used when the teachers proposed a new policy that should be used in their school.
o Issues with current policy	This code was used when teachers described problems with current policy.
Technology	We asked each teacher about technology they used in the classroom.
o Problems	This code was used when teachers described problems with technology.
o Installing	This code was used when teachers described installation problems.
o Software	This code was used when teachers described software problems.
o Hardware	This code was used when teachers described hardware problems.
o Computer Set-Up	We asked each treatment teacher about the set-up of the computers they used.
o Comp-lab	This code was used when teachers described using a computer lab.
o COWs	This code was used when teachers described using Computers on Wheels (COWs) or laptop carts.
o One + projector	This code was used when teachers described using a laptop and projector in their classroom.
o Other Technologies	We asked each teacher if they used any other technologies in the classroom.
o Workshop	This code was used when teachers said they had been to a workshop covering basic computer skills.
o Grant	This code was used when teachers said they had written a grant for more technology.
o Electronic Whiteboard	This code was used when teachers said they used an Electronic Whiteboard.
o CBR	This code was used when teachers said they used a Calculator Based Ranger (CBR).
o Computer Program	This code was used when teachers said they used a different computer program besides MathWorlds.
o Quiz Remotes	This code was used when teachers said they used Quiz remotes with their students.
o Elmo	This code was used when teachers said they used an Elmo projector.
o Playstations	This code was used when teachers said they used

	Playstations with their students.
○ Wishing for Tech	This code was used when teachers described technology they wished they had.
○ Perceptions	During the interview teachers described their own comfort, as well as their students' comfort, with technology.
○ Used by students before	This code was used when teachers said their students had used technology before.
○ Not used by students before	This code was used when teachers said their students had not used much technology before.
○ Teacher comfortable	This code was used when teachers said they were comfortable teaching with technology.
○ Teacher not comfortable	This code was used when teachers said they were not comfortable teaching with technology.
Administration	During the interview each teacher was asked about his/her administration support.
○ Supportive	This code was used when teachers said their administration was supportive.
○ Apathetic	This code was used when teachers said their administration was apathetic.
○ Unsupportive	This code was used when teachers said their administration was unsupportive.
Teacher Classification of Students	During the interview teachers were asked about their students.
○ ESL	This code was used when teachers described students that spoke English as a second language.
○ High Achieving	This code was used when teachers described their high achieving students.
○ Low Achieving	This code was used when teachers described their low achieving students.
○ Mid Achieving	This code was used when teachers described their mid achieving students.
○ Special Needs	This code was used when teachers described students with special needs. .
Materials	During the interviews teachers would describe their teaching materials.
○ SimCalc	This code was used when teachers described the provided SimCalc materials.
○ TEXTEAMs	This code was used when teachers described using TEXTEAMs materials.
○ Created by the Teacher	This code was used when teachers described using materials they made themselves.
○ Text book	This code was used when teachers described using a particular textbook.
○ Other source	This code was used when teachers described using other materials besides the ones listed above.

Math Topic	During the interviews teachers described particular math topics.
○ Went Well	This code was used when teachers described a math topic going well.
○ Basic	This code was used when teachers described a basic math topic.
▪ Arithmetic	This code was used when teachers described basic arithmetic (addition, subtraction, multiplication, and division).
▪ Graphing	This code was used when teachers described basic graphing, such as plotting points.
▪ Vocabulary	This code was used when teachers described mathematics vocabulary.
▪ Percents	This code was used when teachers described calculating percents.
▪ Fractions	This code was used when teachers described fractions and fraction arithmetic.
○ Newly Introduced	This code was used when teachers described a math topic new to 7^{th} grade students.
▪ Translation	This code was used when teachers described translating data from a table to a graph to a formula.
▪ Graphing	This code was used when teachers described graphing, such as plotting a function of a graph.
▪ Equations/Formulas	This code was used when teachers described creating functions from data.
▪ Tables	This code was used when teachers described creating tables and filling in values based on a proportional relationship.
▪ Proportions	This code was used when teachers described solving proportions and recognizing proportional/non-proportional relationships.
▪ Rate	This code was used when teachers described finding the rate.
▪ Real World Applications	This code was used when teachers described applying mathematical ideas to real-world circumstances.
▪ Slope	This code was used when teachers described finding the sloped of a line.
▪ Variables	This code was used when teachers described using variables and knowing how to identify the independent/dependent variables.
○ Difficult	This code was used when teachers described a math topic being difficult.
○ Basic	This code was used when teachers described a basic math topic.
▪ Arithmetic	This code was used when teachers described basic

	arithmetic (addition, subtraction, multiplication, and division).
▪ Graphing	This code was used when teachers described basic graphing, such as plotting points.
▪ Percents	This code was used when teachers described calculating percents.
▪ Fractions	This code was used when teachers described fractions and fraction arithmetic.
▪ Vocabulary	This code was used when teachers described mathematics vocabulary.
o Newly Introduced	This code was used when teachers described a math topic new to 7th grade students.
▪ Translations	This code was used when teachers described translating data from a table to a graph to a formula.
▪ "Easy to Read"/ Estimation	This code was used when teachers described picking "easy to read" points that make subsequent operations easier.
▪ Variables	This code was used when teachers described using variables and knowing how to identify the independent/dependent variables.
▪ Graphing	This code was used when teachers described graphing, such as plotting a function of a graph.
▪ Formula/Equations	This code was used when teachers described creating functions from data.
▪ Slope	This code was used when teachers described finding the sloped of a line.
▪ Proportions	This code was used when teachers described solving proportions and recognizing proportional/non-proportional relationships.
▪ Rate	This code was used when teachers described finding the rate.
▪ Real World Application	This code was used when teachers described applying mathematical ideas to real-world circumstances.
▪ Tables	This code was used when teachers described creating tables and filling in values based on a proportional relationship.
o Didn't Do	This code was used when teachers described math topics that they didn't do or didn't teach.
o My Fault	This code was used when teachers said it was their fault that their students didn't understand a math topic.
Project Perceptions	We asked each teacher about participating in the research.
o Materials	This code was used when teachers discussed the project materials, such as their log book, teacher

	manual, and supportive materials.
o Research Team	This code was used when teachers described interacting with the SimCalc research team.
o Teacher Responsibilities	This code was used when teachers described their responsibilities in the project, such as filling out their logbook every day.
o Workshop	This code was used when teachers described attending the SimCalc or TEXTEAMs workshop.
Other Teachers	We asked each teacher about their relationship with co-workers.
o Collaboration	This code was used when teachers described their collaboration with other teachers.
o Supportive	This code was used when teachers described supportive co-workers.
o Apathetic	This code was used when teachers described apathetic co-workers.
Demographics	We asked each teacher a few demographic questions.
o Age	Each teacher was asked his/her age.
o Ethnicity	Each teacher was asked his/her ethnicity.
o Other Careers	Each teacher was asked if they had other careers before.

Vita

Margaret (Meg) Kurdziolek was born on May 20, 1983 to Dr. Thomas Oscar Dickey III and Mrs. Susan J. Dickey. She grew up in Charleston, WV and graduated from George Washington High School in 2001. During her junior year of high school she decided to take a Computer Science class taught by her favorite teacher, Mrs. Donathan. From that point forward, Meg couldn't imagine studying anything other than Computer Science. She then attended Virginia Tech and graduated in 2005 with a major in Computer Science and minor in Mathematics. In 2006, Meg was awarded a National Science Foundation Graduate Research Fellowship, which has allowed her to continue her graduate studies and pursue a PhD in Computer Science. Meg has focused her research on Human Computer Interaction, specifically studying the use of technology in classrooms and educational settings under the guidance of Dr. Deborah Tatar. Meg is also an active member and officer of the VT chapter of the Association for Women in Computing. She anticipates receiving her PhD in May 2009. Her masters thesis was successfully defended on May 15, 2007.