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CLOSING THE GAP: IMPROVING THE MATH ACHIEVMENT OF STUDENTS WITH DISABILITIES THROUGH CO-TEACHING

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ABSTRACT

This action research study was designed to investigate how a regular and special education co-teaching approach to math instruction impacted the math achievement of elementary students with learning disabilities. Students were taught in an inclusive setting using both the regular and special education material.

The study was conducted with learning support students and regular education students. All students received instruction from the regular education teacher, the special education teacher, and the special education classroom paraprofessional. Each student used the regular education and the special education curricular materials. Throughout the course of this study increased academic achievement was recorded in all areas for both the regular and special education populations. An increase in the frequency and quality of participation was also noted for special education students.

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My Journey

Five years ago I was a new special education teacher in an urban elementary school, where I was given a caseload and a desk in another teacher's classroom. I was entrusted with the responsibility of creating a schedule and figuring out how, what, and where to teach my students. I begged, borrowed, and stole classroom space, curricular materials, and lesson ideas from anyone who was willing to give the poor, classroomless first-year-teacher a hand. I walked around with my Tupperware box full of teaching supplies, pushing into classrooms that would have me, and pulling out from the ones that would not.

In October of that year, we were given the first of many district-mandated reading programs that were supposed to be the "magic fix" for everything that had been ailing our students. It was a scripted Direct Instruction program that didn't allow much, if any, room for reflective practice. The reception of this program among my colleagues was largely negative. Many teachers felt insulted by the scripts and trapped by the need to stay within the confines of a "canned" program. I, however, had had a lot of training in teaching using scripted Direct Instruction materials and was just happy to have a program to follow.

So now, in October of my first year, I had new materials to place in my Tupperware boxes. Unfortunately, even though my caseload was steadily

growing, I was still conducting groups at tables in the corners of other people's classrooms. At one point in my day I was assigned to work with ten students simultaneously. Five students sat at the table with me, and five sat under and around it doing independent work, while the teacher who was allowing me to use her table was conducting her reading lesson with fifteen other students in the middle of the room. It was not, to say the least, an ideal learning situation, but we made it work and our students were making progress.

As my class size grew it became impossible to keep pushing in and pulling out while meeting the academic needs specified in each IEP. I talked this over with the other learning support teacher, Crissi Corbin, who was experiencing similar problems with her class size and limited time and manpower. We decided that we might better meet student needs if we combined forces. She very generously offered to share her classroom with me, and we began what would become a very long and rewarding co-teaching relationship.

One year later I was a second year teacher and sharing a classroom with Crissi. We had ridden out the year before, teaching the district-mandated program as it was written with few if any additions or modifications. After discussing and analyzing the student data collected the year before, however, we decided that our new reading program wasn't a "magic fix" for all students in all areas of reading. It did a wonderful job of teaching students how to read but it did not provide opportunities for generalization. For example, we noticed that students were able

to read the print in their textbooks. They were able to use the visual prompts provided by the reading program but were unable to read books that did not include those prompts. We decided to continue our co-teaching model, while adding guided reading lessons to fill in the gaps we were seeing in the Direct Instruction model. Crissi taught guided reading to all of our combined class, while I continued to teach the district-mandated Direct Instruction program. Together the Direct Instruction program and the guided reading activities not only taught our students how to read but they gave them tools and opportunities to generalize those skills into new situations.

Fast-forward three years, and Crissi and I are still co-teaching, but our arrangement looks considerably different today. Last year Crissi became a fourth grade regular education teacher, and we assumed that our co-teaching days were over. However, a few months into the year we were, once again, discussing student data. This time our concern was math. I was piloting a new district-sanctioned math program and was very pleased with some of the progress that my students were experiencing. However, as with the Direct Instruction reading program of a few years earlier, it was not complete in and of itself. Crissi also had noticed some very troubling gaps in her students' math skills. Their problem solving skills were reasonably good, but they were unable to solve word problems, and their computation skills were not as developed as she expected them to be. I was experiencing quite a different predicament. My students had

relatively good computation ability but few opportunities to develop problem-solving skills. Once again, we decided to combine forces and curricular materials.

My Rationale

Over the last few years I feel like I have lost a great deal of control over what and how I teach in my classroom. In the beginning of my career I was not provided any direction other than a list of students in need of services. Now, in light of the scores achieved by the learning support population on the Pennsylvania State System of Assessment exams (PSSA's), my district has been mandating more and more scripted programs. I have been handed one "canned" program after another until there are currently very few moments of my day when I am not delivering a scripted lesson. The effects of many of these scripted programs are quite good. Not all lessons, though, are equally effective as written.

I have always believed that in order to make learning permanent I have to not only teach them skills but teach them how to learn, develop, and use those skills in the real world. Many students develop this ability naturally. They are taught how to do something and are able to transfer that knowledge to different situations. Due to their disabilities, however, many of my students have a difficult time doing this without teacher assistance. Too often students learn basic math computation, fluency, and problem solving skills in isolation, but they have difficulty transferring that knowledge to the district and state assessments.

After discussing this with Crissi, we agreed that we could further support one another's students. Many of hers arrived in her classroom with some very serious gaps in their basic computation and fluency skills. We actually discovered that my learning support students, in many cases, were outperforming their regular education peers when it came to strict computation and fluency. This was encouraging, but my students were still unable to perform at the below basic level in the district exams, whereas their regular education peers performed in the basic to proficient ranges. We were interested to see why this was occurring.

As we looked at our data and compared our methods of instruction, we realized that we might be more effective if we once again combined our approaches. In December of last year, we began teaching math in a rotation. Each student, both regular and Individualized Education Program (IEP), would receive a half-hour of instruction using the regular education program, a half hour of instruction using the Direct Instruction program, and a half hour of calendar and problem solving instruction. It was our hope that, through the use of these very different methods, all students would demonstrate greater engagement and achievement in mathematics.

LITERATURE REVIEW

Teachers are constantly looking for new ways of improving the academic and social functioning of their students. Sometimes this means bringing in supplemental materials and sometimes it means completely changing the way something has always been taught (Will, 1985). Due to government testing and funding, these dramatic changes have become more and more common over the last few years. This has been particularly true within the area of special education. Since the passing of the *No Child Left Behind Act* of 2002, students with disabilities are held to the same standards as those without. Thus, teachers must seek to fill the gaps in student achievement while keeping up with the regular education curriculum (Malmgren, McLaughlin, & Nolet, 2005). To do so successfully may involve new approaches to classroom teaching.

The Historical Context of the Least Restrictive Environment

Special education is one of the most volatile areas of instruction. Changes come about due to government legislation or cases of parents or groups of parents suing districts for what they believe to be an ineffective delivery of services. Due to these constant changes, it is important to look at research through the lens of an historic perspective (Martin, 2005; Will, 1985).

Individuals with Disabilities Education Act (IDEA). IDEA was first passed in 1975 as P.L. 94-142 and has been reauthorized several times since then.

This law covers children from birth through the age of twenty-one who are identified as having a disability. Disabilities covered under IDEA include: mental retardation, hearing impairments, speech or language impairments, visual impairments, serious emotional disturbance, orthopedic impairments, autism, traumatic brain injury, other health impairments, or specific learning disabilities (IDEA, 1997). This important law ensures students' right to a free and appropriate public education (FAPE). IDEA defines FAPE as:

> Special education and related services that have been provided at public expense, under public supervision and direction, and without charge, meet the standards of the state educational agency, include an appropriate preschool, elementary, or secondary school education; and are provided in conformity with the individualized education program (IDEA, 1997, Section 602, pp. 10-11).

The reauthorization of IDEA also requires the education of students with disabilities in the same environment as their non-disabled peers to the furthest extent possible (Baker and Zigmond, 1990). The law also requires that all students with disabilities participate in state minimal competency tests. However, it does not mandate that these scores be factored into accountability indexes (Malmgren, McLaughlin & Nolet, 2005).

No Child Left Behind (NCLB). The No Child Left Behind Act (NCLB) was passed in 2002 and mandated that students with disabilities be held to the same academic standards as students not identified as having disabilities. Therefore, all students are tested and evaluated on the same standards and must be taught the same curricular content (Malmgren, McLaughlin & Nolet, 2005). NCLB also set guidelines for the certification and continuing education of special education teachers and allocated funds for "establishing programs that train and hire regular and special education teachers (which may include hiring special education teachers to team-teach in classrooms that contain both children with disabilities and non-disabled children)" (NCLB, 2002, sec. 2123, p. 1631).

Gaskin Vs. Pennsylvania (2005). In 1994 lawyers and advocates for twelve significantly disabled students with disabilities brought a class action lawsuit against the Pennsylvania Department of Education (PDE). The plaintiffs asserted that the students in question, as well as many others like them, were denied the right to a free appropriate public education (FAPE) in a regular education setting. According to the Individuals with Disabilities Education Act (IDEA), school districts are responsible for providing a full continuum of services both within the regular classroom with supplementary aids and services and in a pull out setting. The plaintiffs in this case alleged that PDE failed to ensure that school districts were in compliance with IDEA protocol (Pennsylvania Department of Education, 2008).

After 10 years of litigation, Judge Robreno passed the final motion on the Gaskin Vs. Pennsylvania settlement agreement on September 19, 2005 (Rhen, 2005). On October 14, 2005 Linda Rhen issued this statement to school districts across the state:

> The goal of the settlement is to ensure that Individualized Education Program (IEP) teams consider the regular classroom with supplementary aids and services before considering a more restrictive placement. It does not usurp the role of the IEP team in making individualized placement decisions tailored to the needs of specific students. (Rhen, 2005, p. 1)

The ruling in this case requires IEP teams to consider an educational placement within the regular education setting before placing students into a more restrictive setting; it also sets up committees and groups of law makers at the state level to monitor and report on student placement statistics (Rhen, 2005).

Current Best Practice Debates

Should students with learning disabilities be held to the same standards as non-disabled students? As noted above, with the passage of No Child Left Behind legislation in 2002, special education students are being held to the same academic standards as regular education students (Malmgren, McLaughlin & Nolet, 2005), but many special education researchers feel that it is not realistic to

hold students with disabilities to the same standards as those without (Mercer, Jordan, & Miller, 1994; Woodward and Baxter 1997). According to Malmgren, McLaughlin and Nolet many special education students score well below minimum performance objectives on state assessments, and most school districts that fail to meet their annual yearly progress (AYP), fail to do so solely based on the scores of the special education population.

Several sources acknowledge two serious limitations when applying state and national standards to students with disabilities (Mercer, Jordan & Miller, 1994; Woodward and Baxter 1997). First, there is very little mention of students with disabilities within the standards. Second, standards, by nature, do not correlate with the research based math and reading programs that have shown to be effective for students with disabilities (Mercer, Jordan & Miller, 1994; Woodward and Baxter 1997). Woodward and Baxter (1997) go on to state that the standards movement seems to be in direct opposition to the call for inclusion. They propose that it is unrealistic to expect students with disabilities to achieve on the same level as their non-disabled peers while simultaneously removing specialized instruction.

According to Malmgren, McLaughlin & Nolet (2005), however, these standards are not as inaccessible as some special education researchers have implied. They assert that, while an average of only 11% of students with disabilities reached a proficient score on state assessments in 2002, there may be

several factors, other than disability, that could affect these scores. Through their research Malmgren, McLaughlin & Nolet (2005) have determined that schools that receive high scores for students without disabilities also seem to receive higher scores for students with disabilities. Furthermore, the researchers found that the percentage of students qualifying for free and reduced lunch had no significant effect on test scores. Malmgren, McLaughlin & Nolet (2005) stated that:

> Student performance is cumulative and is influenced by the entire school. Focusing accountability solely on individual children's performance can end up 'blaming the victim' for failure as opposed to recognizing the responsibility and impact of all the faculty and staff in a school. (p. 95)

Standards and accountability are here to stay, but school communities must take responsibility for student achievement and find ways to foster success (Malmgren, McLaughlin & Nolet, 2005).

What materials should I use? One of the major debates that has stemmed from the standards movement is the question of what materials to teach. All students are held to the same standards, so many educators and researchers feel that students need to be taught using the same materials (Katsiyannis and Prillaman, 1990). Cynthia Warger (2002) states that:

> The bar on which students with disabilities are expected to learn was raised by the 1997 amendments to the Individuals With Disabilities Education Act (IDEA), which emphasize students' participation and progress in the general education curriculum. Navigating the general education math curriculum has become a key to student success. (p. 2)

However, many other educators feel that since the regular education program failed once, students with disabilities need a specialized program to make progress comparable to their peers (Kroesbergen, Van Luit & Maas, 2004; Warger and Pugach, 1996).

There are several reasons for using the regular education program for students with learning disabilities. First, the regular education program gives students exposure to the regular education curriculum, prepares students to achieve higher standardized test scores, and eliminates the use of what some researchers have called ineffective special education programs (Katsiyannis and Prillaman, 1990). Several researchers have stated that most special education programs are ineffective because they spend too much time focusing on how to perform skills and neglect the knowledge of what is being done (Strengthening the Third 'R'; 2000, Warger, 2002). For example, students are taught the process of how to subtract with regrouping but they are never taught why it works. In

contrast to this belief, research conducted by Kroesbergen, Van Luit, and Maas (2004) indicated that when compared to the regular education instruction, explicit or direct instruction was more effective. Students given the explicit instruction experienced an increase in automaticity and problem solving skills.

Where should education take place? Due to recent legislation, inclusion is becoming the placement of choice for many students with learning disabilities (Salend and Duhaney, 1999). The Association for Supervision and Curriculum Development (2008) has defined inclusion as, "The practice of educating all or most children in the same classroom, including children with physical, mental, and developmental disabilities" (ASCD, para. 1).

According to the Pennsylvania Annual Performance report for 2006 published in February 2008, 49.7% of students in special education programs receive all or most of their specialized instruction within the general education classroom. Only 12.4% of students are involved in pullout programs for all or most of their specialized instruction, and 4.2% are in a full time setting.

Academic Outcomes

There has been extensive research done on the academic effects of inclusionary settings on students with disabilities; however, most of these studies yielded inconclusive or opposing results (Salend and Duhaney, 1999; Rea, McLaughlin, & Walther-Thomas, 2002; Saint-Laurent et. al., 1998). Rea, McLaughlin, and Walther-Thomas studied the achievement of students with

disabilities receiving services in an inclusion setting as compared to those receiving services in a pullout setting. Their research indicated that students with learning disabilities received higher classroom grades in all areas of academic instruction when they were placed in a regular classroom setting; however, there was not a significant difference in state assessment scores. Saint-Laurent et al. (1998) found that there was no significant difference in the math achievement of students with learning disabilities when placed in an inclusion classroom. Both of these studies, however, found that academic performance in no way decreased as a result of the inclusionary placement (Rea, McLaughlin & Walther-Thomas, 2002; Saint-Laurent et al., 1998).

When it came to the academic progress of students without disabilities, Saint-Laurent et al. (1998) found that the math scores of students without disabilities increased significantly on a post-test when compared to the scores of students educated in a non-inclusionary setting. Baker and Zigmond (1990) found that, while test scores did not increase, off-task behaviors decreased. The results of this study implied that regular education students in an inclusion classroom spend less time assigned to workbooks and worksheets. This seemed to result in fewer off-task behaviors and less instructional time used for behavior management. While this study did not speculate as to why inclusion students spent less time on workbooks and worksheets, it may be due to the presence of the special education teacher. Special education teachers are trained to fill every

moment of instructional time with meaningful, teacher monitored activities. Also the presence of an additional teacher allows the regular education teacher to plan more small group activities while closely monitoring all students.

Social Outcomes

When looking at the social benefits of inclusion, the research is clearer. Vaughn, Elbaum, and Schumm (1996) conducted a study that was designed to determine if students in an inclusive setting display more feelings of social rejection and loneliness than do their peers educated in a pullout setting. The researchers focused on three inclusive classrooms located in a large school district in the southeastern United States, where 75% of the enrolled students received free and reduced lunch. There were a total of 64 students in the second through fourth grades in this study, including 16 students who were categorized as having learning disabilities, 27 labeled as low achievers, and 21 categorized as average achievers. The researchers administered standardized rating scales in the areas of peer liking, self-concept, loneliness, and alienation. The research suggested that low achieving and learning support students are significantly less well liked by their peers; however, the research also suggests that there is no correlation between instructional setting and peer acceptance. Just because students are pulled out of the classroom to receive special education or remedial services, does not always mean that they will be disliked, and just because they are "included" in their regular education classroom does not mean that they will be accepted by

their peers (Vaughn, Elbaum & Schumm, 1996). While this study shows that inclusion is not a magic fix for the social problems of students with disabilities, other studies have gone on to show that students with disabilities educated within the regular education classroom tend to have more "meaningful" friendships and report less loneliness (Pavri and Monda-Amaya, 2000; Vaughn, Elbaum, Schumm & Hughes, 1998).

All of these studies have put forth the belief that the greatest indicator of peer acceptance is the attitude of the teacher toward the students in question (Pavri and Monda-Amaya, 2000; Vaughn Elmaum, Schumm, & Hughes, 1998; Vaughn, Elbaum & Schumm, 1996). Whether they are low achieving, learning disabled, or any other exceptionality, acceptance must first come from the teacher.

What do the stakeholders think? Two studies conducted on students' preferences on educational placement suggest that students preferred to receive learning support services in a pullout setting (Klingner, Vaughn, Schumm, Cohen, & Forgan, 1998; Vaughn and Klingner, 1998). When asked to defend their preference, students stated that they learned more in the learning support classroom and that they enjoyed having a quiet place to go for help (Vaughn and Klingner, 1998). Learning support students also reported that the work in the regular education class was "too hard" (Klingner, Elbaum, Schumm & Hughes, 1998). Students who preferred the general education classroom generally sited

social benefits (Klingner, Elbaum, Schumm & Hughes, 1998, Vaughn and Klingner, 1998).

Parents also have very strong feelings about inclusion. Duhaney and Salend (1999) conducted a study focusing on the feelings reported by the parents of students participating in an inclusive classroom. Overall, these feelings were positive. Both parents of students with and without disabilities reported that their children were more accepting of all individuals, that they exhibited fewer behavior problems, better self-concepts, more friendships, and were made more ready for the "outside world." Both groups, however, expressed the concern that their students would not receive the help that they deserved because the teachers' attention was focused on the other group of children.

Co-Teaching

Educators have been called to teach all students in regular education classrooms; however, according to Pugach and Wesson (1995), many classrooms are organized and run in such a way that teachers are only able to effectively meet the needs of the "average" student. Historically, the primary method of instructing low-achieving students, they remind us, has been through pullout programs. Due to recent legislation, however, there has been an enormous push to educate all students within the regular education classroom (Pugach and Wesson). Unfortunately, these regular education classrooms are often not equipped to provide for the needs of all students (Pugach and Wesson). Hence,

Pugach and Wesson, as a possible solution to this problem, suggest initiating a cooperative teaching approach within the regular education classroom. In implementing this intervention, each classroom would be equipped with both a special and regular education teacher.

DeBettencourt (1999) defines co-teaching or collaborative teaching as an approach where, "general and special educators share the responsibility for all activities related to the planning and delivering of instruction, as well as evaluating, grading, and disciplining students" (p. 27). Kloo and Zigmond (2008) further define inclusion as, "… draw(ing) on the strengths of both the general educator, who understands the structure, content, and pacing of the general education curriculum, and the special educator, who identifies unique learning needs of individual students and enhances curriculum and instruction to match those needs" (p. 13). In these definitions, DeBettencourt (1999) and Kloo and Zigmond paint a picture of two teachers sharing all aspects of instruction. Ideally students will have twice the resources and knowledge bases from which to acquire help, and the teachers involved in this model will be able to play off of each other's strengths and interests to make their instruction effective for all students.

Types of co-teaching models. There are five common ways of organizing a co-teaching model (Vaughn, Schumm, & Arguelle, 1996; Kloo and Zigmond, 2008). The first method is one teacher teaching and the other assisting. In this model, the regular education teacher would teach the lesson while the special

education teacher would give help to those students who are struggling to grasp the material. The second method is parallel teaching. In this model the class is broken up into two heterogeneous groups. Each teacher takes one group, and both teachers teach the same lesson. The next method is station teaching. In this model, the curricular content is divided and each teacher assumes the responsibility for teaching his or her own part of the curriculum. The fourth method is alternative teaching. In this model the regular education teacher teaches a large group of average to high-average students while the learning support teacher teaches a small group of struggling students. The last method is through team teaching. This is very much a tag-teaming model. One lesson is being taught to all students while the learning support and regular education teachers take turns delivering instruction (Vaughn, Schumm, & Arguelle, 1996; Kloo and Zigmond, 2008).

Student and teacher perspectives. Pugach and Wesson (1995) studied the perceptions of regular education students, special education students, and teachers involved in a co-teaching model within two separate classrooms. Participants included two regular education teachers, one special education teacher, and fifty-five fifth grade students. Of the fifty-five students, thirteen were identified as having learning disabilities. Prior to this study all thirteen of these students had been receiving services within a pullout learning support setting (Pugach and Wesson).

The study was conducted in the fall of 1989 in an elementary school located in an urban school district in a middle-sized Mid-western city. The elementary school consisted of 580 students in kindergarten through fifth grade. The population of the school was 30% African American, 10% Hispanic, and 60% Caucasian (Pugach and Wesson, 1995).

The researchers used two primary measures for collecting data. The first of these was a collection of eighteen interviews of nine regular education students and nine special education students. These students were chosen at random from the fifty-five students in the study. The second measure was a collection of transcripts from open-ended interviews with teachers. After the interviews were conducted, the student and teacher responses were sorted into three categories: classroom social climate, instructional effects, and teacher roles and tasks (Pugach and Wesson, 1995).

After reviewing the data, the researchers found that students reported an overall positive feeling toward the co-teaching model. They reported that they felt good about their learning and progress and that the act of giving and receiving help was the norm and not something of which to be ashamed. When asked about the roles of each teacher within the classroom, most students responded that the two classroom teachers were the subject experts while the learning support teacher was the one who was available to help them on a one-to-one basis. However, no students identified the learning support teacher as being there to help

a specific group of students. In analyzing the responses of the teachers, the researchers found that the most beneficial part of the co-teaching experience for them was the ability to meet individual needs (Pugach and Wesson, 1995).

Warnings. While co-teaching can be a very rewarding and professionally satisfying experience, there are several drawbacks to sharing instructional responsibility with another teacher (Salend et. al., 1997). Teachers interviewed by Salend et al. (1997) sited several negative aspects to co-teaching. They listed lack of time for planning and implementation, resistance from other teachers, and increased workload and responsibility as some major dilemmas when trying to implement a co-teaching model. They also said that it was difficult to overcome differences in philosophies, teaching styles, background, and territorial issues. Kloo and Zigmond (2008) state that, "Simply putting two teachers…in a room and telling them to work together does not accomplish the lofty goals described by advocates of co-teaching" (p. 14). Teachers have to work at becoming a team.

All of that work can, however, be beneficial to both the teachers and students involved. Teachers interviewed by Salend et al. (1997) went on to say that co-teaching improved their personal and professional lives, made teaching more satisfying, and allowed teachers to test new teaching methods. Brownell, Adams, Sindelar, Waldron, and Vanhover (2006) state that, "Teachers learning and working together to achieve common goals is considered by many scholars to be a central element of major school reform efforts. Including those aimed at

improving the inclusion of students with disabilities in general education settings" (p. 169). Clearly, if we are to meet the call for a more inclusive environment of education, we must support teaching and learning within co-taught classrooms.

Keeping All of This In Mind…What Do I Teach?

Combining direct and constructivist instruction. Constructivism and direct instruction are terms that have been tossed around and debated for years, and while distinctly different, each form of instruction has unique benefits (Kroesberge, Van Luit & Maas, 2004). Parkay (2001) states that constructivist educators, "view learning as an active process in which learners construct understanding of the material they learn" (p. 594). This curriculum model focuses on what students already know and supports their natural ability to build new understanding (Parkay). The National Institute for Direct Instruction states that, "Direct Instruction (DI) is a model for teaching that emphasizes well-developed and carefully planned lessons designed around small learning increments and clearly defined and prescribed teaching tasks. It is based on the theory that clear instruction eliminating misinterpretations can greatly improve and accelerate learning" (National Institute for Direct Instruction [NIFDI], What is Direct Instruction?, para. 1) The NIFDI believes that, while many teachers hold fast to their values of autonomy and creativity, if student achievement is to improve, teachers must put these things aside for the benefit of academic growth.

They state that, “all students, if properly taught, can learn” (NIFDI, What is Direct Instruction?, para. 3).

Koesbergen, Van Luit, & Maas (2004) conducted a study based in The Netherlands that compares the effectiveness of constructivist-aligned and explicit instruction for low-achieving students. This study focused on 13 regular education schools and 11 special education schools. A total of 265 students in grades two through six were randomly placed into three groups. One group received constructivist-based instruction, one group received explicit instruction, and one group served as a control. Progress was measured with two multiplication pre and post -tests, one on automaticity and one on problem solving. The researchers measured motivation through the use of a standardized motivation mathematics questionnaire.

The results of this study implied that each program had its benefits. The automaticity test showed no difference between the constructivist-aligned and explicit instruction groups. However, the explicit instruction group out-performed the constructivist group on the problem solving assessment. When strategy use was isolated, both the constructivist and explicit instruction groups used more effective and a greater number of math strategies than did the control group. When motivation was measured, researchers found that students in the constructivist group were more task oriented. They wanted to perform math tasks because they were fun, not because they were required. Overall, both programs

worked in different ways, but they both yielded better results than did the control group (Kroesbergen, Van Luit & Maas, 2004).

Design of the curriculum. There are two basic types of curricular design: spiral and strand (Snider, 2004). According to Snider, a spiral curriculum is defined as a curriculum that is organized into, "10-20 chapters or units that spiral for several years" (p. 31). While this, according to Vicki Snider, is the most common form of curricular design found in traditional and constructivist textbooks, it is not the most conducive to student achievement. Snider goes on to state that, "The spiral design hinders student learning by (a) treating topics superficially, (b) introducing concepts at an inappropriate rate, (c) minimizing academic learning time, and (d) providing insufficient cumulative review" (p. 31). Within this traditionally organized approach, a unit is introduced, covered, and tested year after year with minimal retention. Each year, the concept must be reviewed before any new skills are taught. Students who think they remember how to perform the skill do not pay attention to the review and are often lost when it comes time to learn new skills, while students who do not understand the initial concept are not given the amount of time needed to relearn the skill (Snider).

According to Snider (2004) a strand curriculum is a program in which, "Each lesson is organized around multiple skills or topics rather than around a single skill or topic. Each skill/topic is addressed for only 5 to 10 minutes in any given day's lesson but is revisited day after day for many lessons" (p.34). This

program organization not only plans for retention and generalization but it, "makes it possible for topics to be treated in depth. The strand design allows important concepts to be reinforced over days, weeks, and even years" (p.36). In organizing materials in such a way, students are not given the opportunity to lose skills over the course of a year. Each topic is continually taught, reviewed, and reinforced. This is the type of program usually seen in a direct instruction model of math instruction.

Implications for Practice

Special education is a field that is constantly changing (Will, 1985). Historically it has been the responsibility of the special education teachers to find new ways of implementing and acquiring new materials in order to keep their students progressing toward that ever-present goal of proficiency. However, in the past few years, with the passage of IDEA and NCLB it has become the responsibility of the entire school community (Malmgren, McLaughlin & Nolet, 2005). Many students with disabilities are no longer educated in isolation. They are integrated into classrooms and programs with their non-disabled peers. Hence, in order to make this integration successful for all students, changes must be made to the way both regular and special education have traditionally been organized. Many of these changes are being addressed through co-teaching models of instruction (Kloo and Zigmond, 2008).

RESEARCH DESIGN AND METHODOLOGY

I am a fourth grade learning support teacher in an urban elementary school located in a large school district that encompasses a small city and its surrounding suburban and rural communities. The school is situated in what our neighbors lovingly call "south side." Below is a table displaying the student population for our school as well as that of my fourth grade learning support class:

Table 1

Our School Demographics

Population	Our School	My Class
White, non Hispanic	39%	45%
Black, non Hispanic	33%	27%
Hispanic	26%	27%
Asian/Pacific Islander	1%	0%
Free and Reduced Lunch program	65%	82%
Total Student Count	509	11

Within my class I also have a variety of learning needs. All of my students have IEP's. 100% of them qualify for reading and language arts support, 73% qualify for math support, 81% qualify as having specific learning disabilities, 18% as having other health impairments, and 45% have been diagnosed as having some form or combination of Attention Deficit Disorder or Attention Deficit Hyper-activity Disorder (ADD/ADHD).

For this study I co-taught math with Crissi Corbin, a fourth grade regular education teacher. Combined, we had a group of nineteen math students. While I

will be reporting some observational and survey data from all nineteen of these students, I chose to focus my academic achievement data collection on 4 of my learning support students. I chose these 4 students, not because their data was most favorable to my study, but because they had the fewest extraneous variable that would skew the data I presented.

Before implementing my study, I compiled a written outline of my plan that included all data measures and consent forms. I then submitted them to the Human Subject Internal Review Board (HSIRB) at Moravian College. I also submitted a consent letter to my principal in order to gain approval from her (See Appendix A). After receiving HSIRB and building principal approval to conduct my study, the first thing I did was present the study to my students. I did this in a class-meeting format. I told them what I was going to do and how they would have the opportunity to be involved. I explained to them that their involvement would not affect their grade, the work they would be required to do, or their relationship with me. I then told them that if they chose to participate now and later on decided that they no longer wanted me to use their work, they had the option of dropping out of the study at any time without penalty. I also took several minutes to go over the parental consent letters I would be sending home that day. I sent consent forms home with each of my and Crissi's students (See Appendix B). This form explained what we would be doing in math class this year. It also assured parents of the anonymity of their students and the

expectations of the study versus the expectations of regular math participation. I also received consent from my co-teacher (See Appendix C). Now we were ready to begin the study.

Throughout this study I have used a variety of data collection tools. These tools consisted of both qualitative and quantitative methods, and included survey and interview data, teacher created assessments, fluency data, district quarterly assessments, 4sight scores, and the field log.

Student Survey and Interview Data

I used a combination of survey and interview questioning to gain insight into my students' feelings toward the study and the general set up of math instruction. I introduced my study with individual interviews. I used a standard survey questionnaire (See Appendix D), and gave each student a chance to sign his or her own student consent form (See Appendix E). It was important to me that each student had the chance to either accept or deny the opportunity to be in what the students and I later began calling "Our Story." After conducting the initial interviews, I used weekly surveys and open-ended response questions. See appendix F for a list of open-ended response questions.

Teacher Created Assessments

Basic fact assessments. This was a series of assessments given at the end of each marking period. Students were tested on their knowledge of addition, subtraction, multiplication and division facts (See Appendix G). They were shown flash cards and given 3-5 seconds to give the answers for those facts. The amount of time given to respond was dependent on the processing speed of the individual student. For example, students who have shown that they are able to see, process, and respond to information at a speed commensurate with their fourth grade peers received 3 seconds. Students who have demonstrated a processing speed significantly slower than their fourth grade peers received 5 seconds.

Math goals data. This was a series of assessments designed to measure students' progress toward their IEP goals in math. Each student received a packet that consisted of questions corresponding to their individual goals (See Appendix H). At the time of my study most of these packets contained probes on addition and subtraction with regrouping, counting money to $5, telling time to the nearest minute, and addition, subtraction, multiplication, and division story problems.

Fluency Data

In order to measure student fluency I used two different tools. The first was a weekly mixed operation fluency probe provided by the AIMSweb Publishing Company (2008). This probe was given at the students' instructional

level. They were timed for two minutes and the scores were reported as digits correct per minute. During the first week of school I collected base-line data on each student to see what grade level probe was appropriate. The third grade probe, which was given to 6 out of my 7 students, consisted of addition and subtraction with and without regrouping, single and multi-digit multiplication, and division facts through 9's. The first grade probe, which was given to 1 student, consisted of addition and subtraction without regrouping, and the second grade probe, which this student took later in the study, consisted of addition and subtraction with and without regrouping and single digit multiplication (See Appendix I).

I also used the quarterly fluency assessments given to all fourth grade math students in the district. In these assessments students were tested on one operation at a time. They were given 2 minutes on the addition and subtraction probes and 3 minutes on the multiplication and division probes. Students were given a score of below basic, basic, or proficient in each category based on how many facts they were able to answer in the allotted time. The benchmark scores are as follows:

Table 2

District Fluency Benchmarks

	Not Fluent	Progressing	Fluent
Addition	0-89	90-94	95-100
Subtraction	0-89	90-94	95-100
Multiplication	0-89	90-94	95-100
Division	0-89	90-94	95-100

District Quarterly Assessments

These assessments were designed by a committee of math specialists and teachers to test student proficiency on skills taught within a given marking period. Students were tested on the skills from the district pacing guide. They received scores of "below basic," "basic," or "proficient" in each skill and on overall achievement.

4sight Scores

The 4sight Assessments (2008) are a series of five tests that closely mirror the Pennsylvania States Standardized Assessments (PSSA's). Our school district uses them in order to help prepare students for the high stakes state tests. My learning support students take the same tests as their non-disabled peers with several accommodations. Each student takes the test in a small group setting within the special education classroom. We are able to read the entire math assessment aloud to our students with IEP's. We can also write the answers for the open-ended questions. This test is given on a fourth grade level, and students earn scores of "below basic," "basic," "proficient," and "advanced."

The Field Log

Throughout my study the field log has been the place where I recorded my data. As students completed surveys and open-ended questions, I placed them in the field log. I put graded assessments and fluency charts in the field log. I also used the field log as a place to write and analyze my field notes.

My field notes were a form of reflective journaling that Hendricks (2006) defines as a tool for recording personal feelings, conversations, and observations. As suggested by Hendricks, I set aside a specific time and method for writing down my reflections. As I taught each lesson, I kept a pack of post-it notes by my table. When something happened or a student made a comment that I wanted to write about later I jotted it down on the post-it. Immediately after math time I had my planning period. This is when I took my post-it notes and wrote my journal entry.

As I wrote, I used brackets to distinguish between what happened and how I felt about or interpreted the event. This way when I went back to my field log to find patterns in my data I could look at how I felt at the time and how those feelings have changed in light of what has happened since writing the entry. I could also look at the events from an outsider's point of view without being swayed by the assumptions that I initially made.

Trustworthiness Statement

In order to ensure the safety of my students and the reliability of my data, several factors must be addressed. As I planned my study, I consulted data collected over the past several years to determine if this intervention was really something that was needed and if it had the possibility of causing harm or benefit to my students. I also looked at each of the curricular materials that I was planning to use. I was interested to see if these materials, actually, filled the gaps

in student achievement that I was seeing in my data. I then turned to the research to see if anyone else had attempted a study similar to mine, and what results were reported. Through this data, curricular, and literature analysis, I determined that the intervention that I was interested in studying had a very good chance of increasing my students' math skills and a very low possibility of causing a decrease in skills or an increase in undesirable behaviors.

Student safety and confidentiality. Due to the nature of my study, all of my students are under the age of eighteen and most of them have been diagnosed as having a learning disability in reading, language arts, math, or any combination of the three. These special vulnerabilities required me to take extra care and precaution when planning and reporting my data. I had to make sure that my students were making progress toward grade level standards, while effectively implementing each individual IEP.

I also took measures to ensure the anonymity of my students. Their names were changed and the key to the pseudonyms was kept with the rest of my research data. In addition, any distinguishing details not relevant to my study were modified.

Data collection and analysis. As recommended by Hendricks (2006), I collected several forms of data to ensure credibility. This is known as triangulation of data. Hendricks defines triangulation as, "a process in which multiple forms of data are collected and analyzed" (pg. 72). Hendricks goes on to

state that the purpose of triangulation is to fill the gaps that may occur in research if only one form of data collection were used. In order to do this I used three forms of data collection: student generated artifacts, observational data, and inquiry data.

I used two types of student-generated artifacts. The first of these were formative assessments. Hendricks (2006) defines formative assessments as assessment occurring throughout the study. This type of assessment was completed in the form of weekly fluency checks. These are important because formative assessments enabled me to determine if the intervention was being successful or if I had to change what I was doing to ensure the success of my students. I also used summative assessments. These assessments are defined as a means of measuring, "instructional outcomes at the conclusion of an intervention" (Hendricks, 2006, p. 74-75). These assessments took the form of a collection of probes measuring progress toward math goals, 4sight assessments, and district quarterly assessments. I used these assessments as a quick snap shot of where my students were at a given point in time.

My next form of data collection was observational data. These data are important because they can help to show why an intervention succeeded or failed (Hendricks, 2006). For this, I used participant observation, which I recorded in an electronic field log. This field log was kept on my computer under a password

lock to which no one, except me, had access. It will be destroyed after the conclusion of my study.

My last form of data collection was inquiry data. Hendricks defines inquiry data as a way of, "gathering information from participants about their knowledge, values, beliefs, past experiences, feelings, opinions, attitudes, or perceptions" (p. 89). I did this through a combination of interview and survey questions. Through this type of data I was able to get an idea of my students' feelings about math and my study.

The following table shows the instruments I used for data collection and the dates each assessment was given:

Table 3

Assessment Tools

Assessment Tool	Dates Given
Weekly Fluency Assessments	Every Friday starting on September 12th
Math Goals Probes	Weeks of August 25th, October 20th, and January 21st
4sight Assessments	Weeks of September 1st, October 27th, and January 12th.
District Quarterly Assessments	Weeks of October 20th and January 21st
Field Log	Daily entries.
Initial Interview	August 29th
Survey/Open Ended Response Questions	Every Friday starting on September 5th

My biases. Before conducting my study, it was important that I looked at the assumptions I was making about my students and their performance. I have been teaching special education for the last five years and I have experienced the full gamut of student achievement and readiness. I admit that, at times, I tended to underestimate what my students are capable of achieving. When Crissi and I began co-teaching math I thought that it would be a good experience for my students to "be exposed" to the fourth grade curriculum, but I did not think that they could be held to the fourth grade standard. As we worked through our first year of co-teaching math, however, I began to see that they could and should be held to the same standard as their non-disabled peers. In light of this, I have to be sure to include assessments that will measure student progress toward both IEP and grade level goals.

OUR STORY

In the Beginning…

As I walked out to bus duty on the first day of school and looked up at all the new fourth grade faces, I wondered which of these smiling, nervous children would become my new school family. Which one would be my nudge? Which one would be the reason I come to school in the morning, and which ones would combine a little bit of nudge and a little bit of inspiration? I was sure they were all standing up there on the fourth grade landing just waiting to start their last year of elementary school.

Our story really begins and ends with these students. I chose five children on which to focus my study: Megan, Neil, Sahara, and Mae. Each of these students is a fourth grader between the ages of 9 and 10. All five students have been identified as having learning disabilities in reading, language arts, and mathematics. Sahara is diagnosed with Attention Deficit Hyperactivity Disorder (ADHD), and Neil and Mae are English as a Second Language Students (ESL). My plan was to collect academic achievement data on these five learning support students and take interview and observational data on all nineteen of the students in Crissi's and my combined classes. In this way, I was able to monitor the rate of achievement for my learning support students while keeping track of the opinions of the entire group.

This story will chronicle their journey through the first half of their fourth grade year. We begin on Friday of our first week back at school. All of my students are seated on the carpet awaiting dismissal to lunch. We have about ten minutes before they have to be back to homeroom, so I take this opportunity to introduce my study.

"This year," I say, trying to sound excited, "we are going to have the opportunity to participate in something very special."

"What," says Neil, sounding skeptical. I can just see him thinking, "Ok, now how much work is this gunna have to be?" No one else seems to have had any reaction to my news.

I go on to explain that just like they go to school during the day, I go to school at night, and as part of my homework I am going to write a long story about our class, and they will be the main characters. As I go through this rehearsed speech, I can see some students begin to listen a little bit more closely. "This is starting to sound interesting," I can see them thinking, but they are still cautious. After all I did use the word "write" and to many of my kids this has become a dirty word.

I ask if they have any questions and a couple of students raise their hands. "What's the story about?" asks Sahara.

"Us," replies Megan, still eyeing me in disbelief. I tell the class that Megan is right. The story is going to be about them. "This year," I say, "I am

going to be studying the way Ms. Corbin and I teach math, and you are all going to help." I went on to explain that they would have three teachers for math. I would be teaching something called Saxon Math, Crissi (Ms. Corbin) would be teaching the lessons that all of fourth grade gets to see, and Mel (Mrs. Hoyt) would be helping them with review and fact practice. Then everyone would go to math meeting. I explained that math meeting was a half-hour group where we worked on many different skills. There would always be a calendar time, a telling time, a money problem, and a word problem, but other stuff could be thrown in. If we are working on factors maybe there will be a factor of the day. If we are working on measurement, maybe they will have to find something in the room that is one inch long. I seemed to loose them when I started listing things they would have to do this year. The next question was about when they could leave for lunch.

I have to admit, I was a little disappointed at my students' reactions. I was trying to make this sound like an exciting adventure that we were all going to take together, and all I got was skepticism and growling stomachs.

We get started. As we began the next week of school and started our math programs, both my students and I were able to see how this was going to work, and we were both a little bit more optimistic. After analyzing the data from the baseline assessments I had given the week before and the district assessment data from last year, Crissi and I put each student into one of three groups. These

groups were based on current achievement and were meant to be very fluid. As students improved or as we moved into different skills, the groups were rearranged. This has become an ongoing process. Throughout this study, there were never more than two weeks in a row where our math groups remained stagnant.

As we approached the end of our second week together, I took the opportunity to do some interviews and introduce my study to all of Crissi's regular education students.

These interviews turned out to be a lot more exciting for both the kids and me. I set up a game to be played during my math group and called each student to my desk one by one. They got to sit in "the wheelie chair" and we talked about our plan for this year and how they felt it was going so far. After the interview, I gave each student the opportunity to sign his or her own consent form. This allowed them to decide for themselves whether or not they wanted to participate in the study. It was my hope that this would help them to understand their part in how Crissi and I make decisions about math. Throughout the study I planned to explain to our students what changes were taking place and what data they provided to help us to make those changes.

As we talked, I got some very insightful answers to my questions. I found the most useful questions to be, " Do you think that the way Ms. Corbin and I are teaching is helping you to get better in math? Why?" Of course, for the first

interview everyone replied with a "yes." I didn't expect them, in the first interview, to be comfortable enough to tell me that what I am doing is failing. That would come later. However, the explanations of the "yes" were very insightful. Here are some of the student responses to this question:

Table 4
Student Opinions of Math Groups

I think the way you are teaching math is helping me because…	
"we can do 3 different types of math in an hour instead of having to sit and teach and teach."	"we get more one on one time than with the huge group of the whole class."
"because we don't go to just one person."	"other people can tell you other things about math."
"each of you teach different things."	"we do three different things not just one."

Each of these responses came from regular education students who were not accustomed to small group instruction. In the past, they may have received small group instruction for a half hour a day in reading centers, but math has not historically been taught to our regular education population in this format.

The More Things Change…

Change was very common throughout this study. In the first few weeks Crissi and I rearranged groups, materials, and the amounts of time spent and what was taught at each teacher directed center. These changes came about as our data indicated that they would be beneficial to our students.

Changing content. A few weeks into the study Crissi and I began to look at our groups and content. We decided that our students, both those with and

without IEP's, were actually a lot further along in their math acquisition skills than we had expected.

Originally, we planned to use the third grade Saxon program with all of our groups. Our theory was that, by using the third grade program, we could fill in some of the gaps in basic math skills that have historically been present in both regular and special education fourth grade students. This year's students, however, were different. While some students took considerably longer to acquire skills, we did not experience the well-defined gaps that we have seen in the past. Because of this, we needed more challenging materials.

I contacted my director to see if I could get a fourth grade level Saxon kit. A week later, we were fully up and running with the regular fourth grade curriculum and the fourth grade Saxon program. All of our students were receiving a full ninety minutes of teacher directed fourth grade instruction. This was more than I had ever imagined possible.

Time and content for each group. Over the first few months, we also changed our overall schedule. Originally we had three twenty-minute teacher directed centers with a half hour whole group math meeting. I taught the Saxon program, Crissi taught the regular education program, Mel, my paraprofessional, did fact practice and daily review sheets, and then Crissi and I co-taught the math meeting. This worked very well except that twenty minutes was not enough time to teach our Saxon or regular education lessons. We had to find more time. We

did this by having students complete the fact practice and daily review sheets as morning work, and having Mel teach the math meeting in her group. Now we had three half hour teacher directed groups.

It Becomes Routine…

In spite of all these changes we fell into a routine. I taught the Saxon program, Crissi (Ms. Corbin) taught the regular education program, and my paraprofessional (Mrs. Hoyt) taught math meeting. Here is how a typical math cycle would have progressed from the viewpoint of one of my IEP students:

> *Recess is over. Ms. Corbin and Ms. Berk tell us it's time for our first group. I grab my Saxon Math folder and head over to Mrs. Hoyt's group. Mrs. Hoyt does math meeting. We all sit in front of the math meeting board. First we read and write the date three different ways. This is too easy for me. I'm way smarter than this. Well, sometimes I do forget how to write the date in number form.*
>
> *Next, we have a number of the day. This number is always our lesson number. Today the number is twelve. We have to write number sentences that equal twelve. Some kids give easy kindergarten answers like, 10+2=12. I go for a 3-step problem. I say that 5+5+2=12. Mrs. Hoyt says it is, "fabulous." Mrs. Hoyt says that a lot.*

After Number of the Day we practice telling time to the minute. Then Mrs. Hoyt gives us a time that something started and when it ended and we have to tell her how long it took. This is hard. I don't like this one.

Then we talk about money. This is my favorite. Today's amount is 42¢. There are a lot of ways to make 42¢. I thought it was funny when Neil made Mrs. Hoyt write forty-two pennies on the board. She says that we aren't allowed to use just pennies anymore.

Then we have problem of the day. This is really hard. Mrs. Hoyt reads the problem and we have to help her figure it out. Sometimes we add or subtract and sometimes we multiply or divide. Sometimes we even have to do two things to get one answer. I don't think that's fair. If you only get one answer you should only have to do one problem. Today I wasn't sure what to do so I just added all the numbers. I didn't get the right answer.

Now it's time for Ms. Berk's group. I hope we play a game. Sometimes if we get through all of our work, Ms. Berk plays the "Berk vs. Students" game. It's fun. Ms. Berk never wins and she acts like she's mad but I know she's just pretending.

"Today we will learn how to identify a missing addend and how to identify the missing number in a sequence," Ms. Berk says. I have no idea what she means but I know that she will show us so I'm not worried yet. She puts an example on the board. We do a few together, and then Ms. Berk says we are ready for the game.

Ms. Berk hands out the white boards and markers. I check my marker to see if it works, while Ms. Berk writes the score board up. Here comes the first problem:

146, 141, 136, 131, 126, 121, ____, ____, _____ Rule: ____

I'm excited. I know this one. I write the answer on my board and look around to see if anyone is having trouble. I know that if I can help someone who is struggling I can earn a helper point for the students. I have to be careful though, because if I tell them the answer and don't help them to get it on their own, Ms. Berk will take a cheater point. This is the only way Ms. Berk ever wins, by taking cheater points, talker points, or bragger points. Ms. Berk always gives the students points if more than half of the group gets the right answers and because we are allowed to help each other we always end up with the right answers.

We keep playing. I get some questions right and sometimes I even get to help the people in my group. Sometimes, though, they have to help me, but that's ok. By the time we had to switch groups the score was Students 13, Berk 4. We won big.

Now it's time for Ms. Corbin's group. We are doing factors with Ms. Corbin. We have been working on factors for about a week now. I think that I am finally starting to understand. Ms. Corbin asks the group who can define a factor. I raise my hand and tell her that it means, "numbers the same." Ms. Corbin says that is not exactly correct and she calls on another kid to answer. I chew on my pencil while another student gives the correct answer. Then Ms. Corbin asks about the factors for 10. I raise my hand again. This time I am going to get the correct answer. I say 2 times 5 equals tens. Ms. Corbin says that I'm right. I knew it. We keep doing factor problems and I get a lot of them right. One time I even knew the answer and no one else did. That made be feel good, but I didn't know all of them though. I have trouble counting by 6's. I can never remember what comes after eighteen without counting on my fingers.

Ok, math is finally over and it's time to get packed up and go to gym class. We are doing track and field. We run around the field and see who can get the most laps in forty minutes. I think I would rather do math.

Transferring Knowledge

The weeks flew by, and we continued to investigate and learn. I looked for evidence of students transferring knowledge from one group to another group. Sometimes I was impressed at what I saw and sometimes I was disappointed. We will start with the disappointments, just to get them out of the way.

One day during my Saxon Math group I was teaching the problem solving technique of making a table. Mel was also teaching the same skill during math meeting. The problem of the day in math meeting was:

> Bob has $8. Each week he saves $3. How many weeks will it take until he has $24?

And the problem that I was using was:

> Joe has $10. Each week he gets $2 allowance. How much will he have at the end of ten weeks?

Both problems called for students to make a chart demonstrating the growth of money as the weeks proceeded. Students were supposed to make a table showing how much money the child would have after 1 week, 2 weeks, and all the way up to 10 weeks. This is a skill we have practiced with other word problems and I felt that they had been exposed to it enough times that I could

have them do the problem independently. My first group had a very difficult time figuring out the answer. They tried to solve the problem by multiplying and were unable to complete the problem in this way. This I told myself was due to the fact that they did not have math meeting yet. They were not given the pre-teaching that the rest of the groups would get. The next group would be better. It wasn't. These students too did not seem to understand what the question was asking them to do. They too multiplied to find their answer. I wondered if they were not paying attention in math meeting or if this skill was too hard for them.

As my group worked, I walked over to math meeting and told Mrs. Hoyt's group what was coming in my group and that they had to pay attention to the problem of the day because they would see the exact same problem again. It didn't help. While a few students made charts, no one got the correct answer. I think this skill was just a little outside what they are ready to do independently. I should have re-taught the skill as soon as I notice that they were struggling.

Ok, now for the successes. There were many lessons where I introduced a topic and the kids would announce that they had just worked on it in Ms. Corbin's group or they would say something like, "remember how Mrs. Hoyt said to do that." This was very common when we were teaching fractions and measurement. The way the programs worked out Crissi and I worked on fractions at the same time. Crissi was working on fractional parts, adding and subtracting fractions, and placing fractions on a number line. I was working on identifying the

numerator and denominator, writing equivalent fractions, and breaking a ruler into fractional parts. Crissi and I both found that during this time our programs complimented each other very well.

During one lesson, I was working on breaking inches on a ruler into fractional parts so that the students could measure an object to the quarter inch. I drew a line on the board. Then I broke the line into four segments. Finally, I drew three lines on each segment to break it into four equal parts. It looked like this:

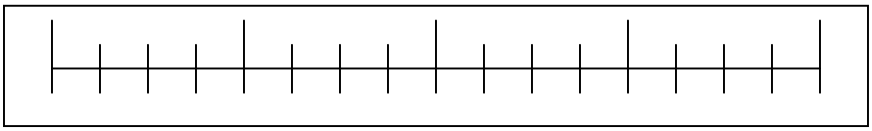

Figure 1. Fractional parts of a line segment

I asked the students to tell me how many equal parts there were in the first segment. I made the lines at the beginning and the end of the segment darker so they would understand where to look. This is what happened:

> *Berk: Can anyone tell me how many equal parts are in the first segment of the number line?*
>
> *Neil: Three*
>
> *Berk: Why do you say three?*
>
> *Neil: 'cause see…one…two…three (he points to each line)*
>
> *Mae: No, wait!*
>
> *Neil: What? There're three lines. One…two…three.*

Mae: But there are four parts…see…one…two…three…four (she points to the spaces between the lines).

Berk: That's right Mae. When we break a number line into parts we have to count the spaces in between.

(I take the chalk and color in the first space.)

Berk: Ok, now how much of the first segment is colored in?

Mae: One

Berk: One what?

Megan: (raising her hand then putting it back down again) One fourth?

Berk: Yes Megan. How did you know that?

Megan: (with a little more confidence) Ms. Corbin said that you have to count how many parts and put that on the bottom then count how many are colored in and put that on the top.

Berk: Yes! One out of four parts are shaded.

Later that week this same group of students was in Crissi's group. Crissi wrote 5/8 on the board. Then she pointed to the eight.

Corbin: What do we call this number?

(Silence while the group thinks it over)

Neil: Wait! Remember? Ms. Berk said that "D" means down.

Megan: Oh yeah. That's the denominator.

Mae: So the top one is the numerator.

These are just two examples of the many opportunities our students had to transfer their knowledge from one group or activity to another. Most of the time, my students did this very well.

The More Things Change…Again

As we approached the last two months of the study, we were told that due to district initiatives in reading our math time might be cut. According to new district policy, every special education student must receive ninety minutes of regular education reading, forty minutes of special education reading, thirty minutes of an additional reading intervention, and another thirty minutes of re-teaching the regular education lesson. This only left forty-five minutes for math. With forty-five minutes I would barely be able to teach my Saxon program. Co-teaching would be impossible, and my study would be over.

In the wake of these new requirements the entire special education staff and our principals attended many meetings to discuss scheduling and the advantages and disadvantages of the new initiative. Throughout these meetings the importance of special education students being exposed to on-level math concepts was questioned. I had the test scores to show the benefits but I was curious to see what my students thought about it.

After one of the more frustrating meetings, Crissi and I talked to all of our kids. We told them what was going on and we warned them of the possibility of having to stop co-teaching math. Then we asked them to write letters telling us

whether or not they wanted math to change and why. Here are some of there responses:

"I think we should keep doing math groups because…

…I can pay more attention in a small group."

…We can do more things and in litteler time."

…We can get more experience with more than one teacher."

…We can get more 1 on 1 time."

…With small groups if you get something wrong they can work with you on it so you understand."

…One group is so boring because we only do one thing. Moving to more teachers we get more activities."

…We find different ways how to remember things."

"I think we should not continue doing math centers because…

…It just does not work for me because I think we should do it in a class together like a team."

…Because it confuses me too much because like in the first group we do something and in the second group we do something way way far different."

Over all, fourteen of our nineteen students were in favor of our math centers and were very upset at the possibility of having to stop. Neil and Megan, however, were in very strong opposition to the small group centers approach.

This concerned me. Both students stated that the small group centers were too confusing because the activities at each center seemed to be unrelated. In analyzing these responses, I realized that they were right. Most days, the three of us were not teaching the same skill. One of the things that I thought was a benefit of this model was proving to be a stumbling block for two of my students with IEP's.

In order to better understand the perspectives of these students, I took one day and just followed a group of students from teacher to teacher. For this observation, I chose Neil and Megan's group. They started with Mel. Here they worked on the computer to improve their fact fluency. Next they went to the Saxon Math group. This group was being taught by a student teacher for the day and she was covering measurement to the ½ inch. Then they went to Crissi who was working on factors. After Crissi they did math meeting with the whole group. This math meeting covered skills from time and money to calendar and word problems. After my observation, my first reaction was, "wow, I knew we were covering a lot of information in a day but I had no idea it was this much." I must admit I was impressed. Then I took myself and my teacher perspective out of the analysis and looked at the experience through the eyes of a student with a learning disability. I asked myself if we were expecting too much from these kids.

Our meetings with administration spanned about two months. In that time I was conducting my study on a day-to-day basis, expecting to be told at any time that I was done and we had to change our schedule. After many meetings, however, it was decided that this initiative was not going to work with our current staffing. We were told that we could continue co-teaching math for the rest of the year. I had another month to study my teaching and my students, and I was determined to make the best of it.

Megan's Story

Megan in her own words. "Hi, my name is Megan and I like pizza and I have one brother, two cats. Their names are Jinks and Chase. They are so cute. And I love them. I have one mom, one step-dad, and my real dad. My brother is nice to me. Sometimes."

Megan on math -the first few months. Throughout my study, I gave my students weekly opportunities to tell me how they felt about math in general and then how they felt about the way we were teaching math. Here are some of Megan's thoughts:

9/12/08

"When I close my eyes I see red like fire…the colors I see make me not want to touch the paper."

10/24/08

"I think we should not continue doing math centers because it just does not work for me because it confuses me too much because like in the first group we do something and in the second group we do something way different from what we did in the first group and in the third group we do something way way far different."

Megan in my words. Megan is a hard working student who thrives in a small group but tends to get lost when expected to pay attention in a whole group setting. She needs to have someone sitting within reach to keep her on task and actively engaged in the lesson. She has a great imagination and is very good at expressing herself and her needs.

Megan started this school year as a student with a reading and language arts IEP only. Crissi and I started to notice the red flags of her math delays the first week of school. As we began pre-testing students Megan stood out as being someone we should watch carefully. By the end of the first marking period, we were ready to recommend the addition of math support into Megan's IEP.

Megan on math -the end of the study. Throughout this study, Megan made tremendous growth. Near the end of the study Megan really began changing her tune when it came to her opinion of math and math centers. Here are her responses during the last month of the study:

12/4/08

"It is to, well, way, way, way too easy so you should give me 5th grade work and I would be a lot happier. I am not scared of math no more."

12/4/08

"We should continue doing math centers. It is better now…and if we continue centers it would help me now."

1/20/09

"When I first came to 4th grade, I thought math was very scary like red and blue fire and now it looks like pink with red polka dots and red and pink is my favorite colors."

Neil's Story

Neil in his own words. "Hi, I'm Neil I like to play football. My favorite food is chocolate. I have 1 brother and he is 9 years old. I also have one sister. She's real mean. She is 13 years old. That is all I can tell you about me."

Neil on math - the first few months. Neil's opinions of math followed opposite patterns to those of Megan. Here is what Neil had to say in the beginning of the study:

9/26

"We are getting better in math. It is fun. Math is Fun."

Neil in my words. Neil is the clown of my classroom. He loves to make people laugh and to shock both his peers and adults with his sense of humor. Neil's comprehension and reasoning skills are better than most and he always keeps me on my toes. I constantly have to use the line, "I'm not sure. Let me look it up at lunch and I'll get back to you."

Neil came to me this year as a student with an IEP in reading, language arts, and math, but his math skills are swiftly approaching those of his regular education peers. He is currently in our middle level math group. This group contains six students. Neil is the only one with an IEP in math.

Neil on math -the end of the study. At the end of the study Neil had changed his opinion of math. He said that:

12/1/08

"I don't like math no more. I don't like math because it got easy. So that why I don't like it. If you want to make me like math give me 10th grade math work."

Both Megan and Neil seemed to change their opinions for the same reason. They both found that math had gotten easier for them. While Megan enjoyed finally knowing what was going on, Neil missed the challenge and excitement of always being pushed.

Sahara's Story

Sahara in her own words. "I like to play with my family and friends. I like to talk with my friends and my favorite pet is a dog and cat. I have 4 sisters and 4 brothers."

Sahara on math - the first few months. Sahara has kept a very grounded view of math throughout the study. She entered my class in the middle of the first marking period. She has jumped around a lot in her young life and has never had a steady home or school. Due to these circumstances, Sahara has a very strait forward and practical way of looking at the world.

11/14/08

"We go to school to learn how to count money so when we go to the store we won't get robbed at the store."

Sahara in my words. Sahara arrived in my classroom mid-way through the first marking period. Ours was the eighth school she had been enrolled in since kindergarten. She spent two days just going through the routine refusing to talk to anyone. When she did speak is was only one-word answers given to direct questions. I had a very hard time figuring her out. Then one day after I had given her a math pre-test on which she got a 100%, I had an idea. I put a big sticker on it and gave it to her. I told her to take it home to show Mommy how well she was doing. Sahara smiled at me and took her test. The next day, Sahara came into my room and told me how proud Mommy was and how she promised to get her

something special on payday. From that day on, Sahara has been opening up on a grand scale.

Sahara has a lot of difficulty paying attention and completing tasks. She has been diagnosed with Attention Deficit and Hyperactivity Disorder (ADHD). So she spends a lot of instructional time avoiding her chair and playing with the material. Due to her transience, Sahara also displays many gaps in her skill acquisition. There are many skills she has not been exposed to, simply because she was not is school when they were taught.

Sahara on math centers-the end of the study. Sahara's personality by the end of the study was still very strait forward and practical, but her opinion of math was a little bit less so.

12/5/08

"Math is fun some times. I like having 4 teachers."

1/20/09

"Math is fun when we get to go to math centers."

Mae's Story

Mae in her own words. "I'm Mae. I was born in New York. I like Tinkerbell. My mom, dad, and sister were born in Mexico. All my family lives in Mexico and New York. My favorite color is green because Tinkerbell haves green. That is all about me.

Mae on math - the first few months. Mae is a student of few words. Her comments reflect that.

9/12/08

"I think math is colorful because I like math."

9/19/08

"I am getting better, I'm making a goal in math."

9/26/08

"I think you should keep doing what you're doing now because the more you help us we will get better."

Mae in my words. Mae is an extremely shy student. She is terrified of speaking in public and does everything she can to avoid drawing attention to herself. She is quiet and well behaved, and easily gets lost in the masses of a whole group lesson. When she is in a small group, however, she is a completely different student. Mae participates, is animated, and excited to show what she can do. She enjoys helping her classmates and takes pride in having a skill that she can share with someone else.

Mae, like Megan, also began the school year with a reading and language arts IEP. She, due to her shyness and avoidance of attention took a little bit longer to show up on our radar. Crissi and I had a difficult time determining if she knew the skill and was just reluctant to speak out or if she was reluctant to

speak because she didn't know what was going on. We finally decided to add math goals at the end of the first marking period.

Mae on math centers-the end of the study. By the end of this study, Mae really came out of her shell. She is now willingly participating in whole group discussions and she is still a very active member of the small group. Her academic achievement has also come a long way.

12/4/09

"I think we should keep math centers because it is very fun and it is helping me and others people."

Academic Achievement

As a special education teacher I have many tools for monitoring the academic achievement of my students. These tools include: basic fact assessments, math goals probes, fluency data, district quarterly assessments, and 4sight assessments.

Basic fact assessments. The first week of school I gave each student identified with a math IEP a series of fact assessments. Mae and Megan were not given the baseline assessments because they did not have math IEP's at that time. These assessments consisted of all the basic addition facts with sums through twenty, subtraction facts with differences through nineteen, and multiplication and division facts through 9. Students were shown flashcards and they were given 3-5 seconds to answer. For the baseline assessment I did not test any

students on the division flash cards because this is not a skill covered until fourth grade. Sahara was, also, not tested on multiplication or division facts on the baseline or first marking period. At the end of the second marking period I gave Sahara the multiplication but she was not ready for the division assessment. I gave Neil, Megan, and Mae all four assessments at the end of the first and second marking period. Here are the results of these tests:

Table 5

Addition Facts

	Addition Facts		
Name	Baseline	1st	2nd
Neil	99%	100%	Mastered
Sahara	82%	97%	100%
Megan	Not Assessed	100%	Mastered
Mae	Not Assessed	100%	Mastered

Table 6

Subtraction Facts

	Subtraction Facts		
Name	Baseline	1st	2nd
Neil	100	100%	Mastered
Sahara	94%	100%	Mastered
Megan	Not Assessed	61%	100%
Mae	Not Assessed	99%	100%

Table 7

Multiplication Facts

	Multiplication Facts		
Name	Baseline	1st	2nd
Neil	77%	95%	100%
Sahara	Not Assessed	Not Assessed	64%
Megan	Not Assessed	91%	96%
Mae	Not Assessed	82%	96%

Table 8

Division Facts

	Division Facts		
Name	Baseline	1st	2nd
Neil	Not Assessed	70%	88%
Sahara	Not Assessed	Not Assessed	Not Assessed
Megan	Not Assessed	76%	86%
Mae	Not Assessed	82%	89%

Math goals probes. In order to ensure that I was meeting each student's IEP, and to make sure that I was able to accurately report that information to my administration and the parents of my students, I gave a series of probes at the end of each marking period (See Appendix I). These probes were simply worksheets downloaded from the Internet and assembled into a packet that was designed to measure students' progress toward their IEP goals. While each IEP is inherently different, many of my students were working on similar skills with different levels of acquisition needed to meet their goals. The probes covered skills such as: word problems, multi-digit addition and subtraction with regrouping, time to

the minute, and counting money up to five dollars. Each skill has a corresponding worksheet. I collected worksheets from the following websites: Edhelper.com and The Math Worksheet Site.com: On-line Worksheet Generator. The following tables display those data:

Table 9

Neil: Math Goals Data

Neil	Word Problems	Multi-digit addition with regrouping	Multi-digit subtraction with regrouping	Time to the minute	Money up to $5
Baseline	0%	97%	50%	44%	8%
1st	70%	100%	92%	83%	92%
2nd	100%	93%	77%	94%	91%

Table 10

Sahara: Math Goals Data

Sahara	Word Problems	Multi-digit addition with regrouping	Multi-digit subtraction with regrouping	Time to the five minute	Money up to $5
Baseline	0%	55%	0%	11%	0%
1st	0%	85%	0%	0%	33%
2nd	70%	95%	76%	0%	92%

Table 11

Megan: Math Goals Data

Megan	Word Problems	Multi-digit addition with regrouping	Multi-digit subtraction with regrouping	Time to the minute	Money up to $5
Baseline					
1st	70%	93%	90%	89%	100%
2nd	100%	100%	100%	100%	100%

*Megan does not have baseline scores because she was not identified as having an IEP in math when the baseline assessments were given.

Table 12

Mae: Math Goals Data

Mae	Word Problems	Multi-digit addition with regrouping	Multi-digit subtraction with regrouping	Time to the minute	Money up to $5
Baseline					
1st	20%	97%	97%	89%	92%
2nd	100%	98%	70%	100%	83%

*Mae does not have baseline scores because she was not identified as having an IEP in math when the baseline assessments were given.

Fluency data. Our students were given two different forms of fluency assessment. The first was a mixed operation probe that was given weekly. Students were given 2 minutes to complete a page of math problems. Then each student's score was divided by 2 in order to find the number of correct digits completed in one minute. These math probes were given on the student's instructional level. Neil, Megan, and Mae were given the third grade probe. This assessment consisted of multi and single digit addition and subtraction problems with and without regrouping, multiplication, and division. Sahara was initially given the first grade probe, which consisted of single and multi-digit addition and subtraction problems without regrouping. Near the end of the study Sahara was moved from the first grade probes to second grade probes. These assessments included single and multi-digit addition and subtraction problems with and without regrouping. The figures below show their progress on these weekly fluency probes:

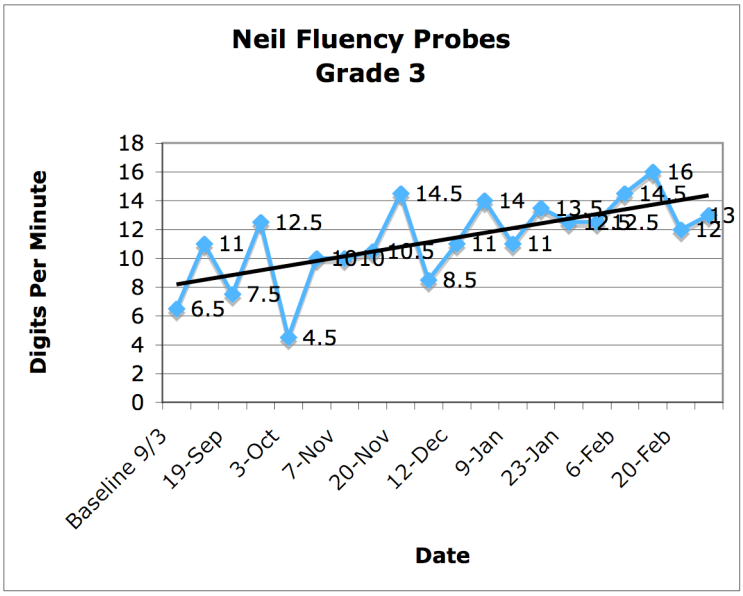

Figure 2. Neil's 3rd grade fluency probes

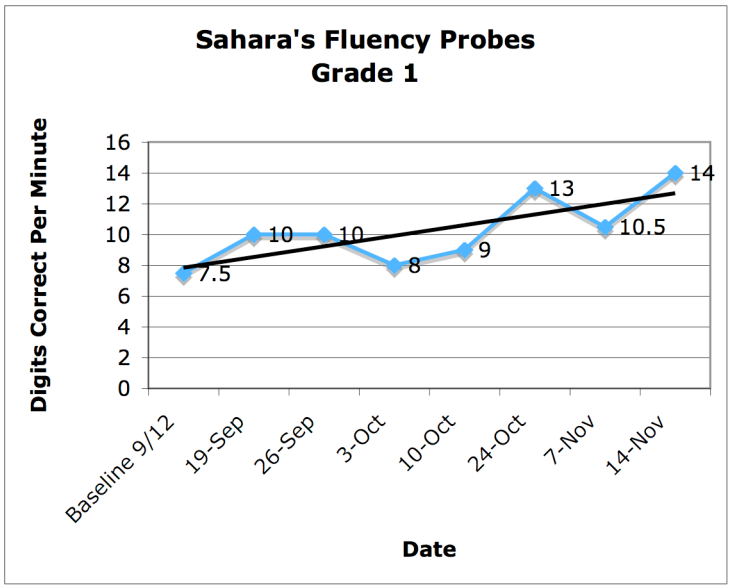

Figure 3. Sahara's 1st grade fluency probes

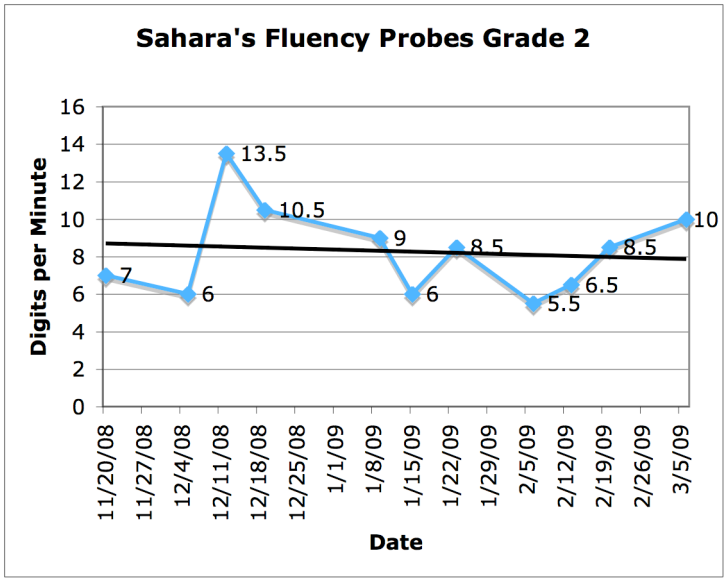

Figure 4. Sahara's 2nd grade fluency probes

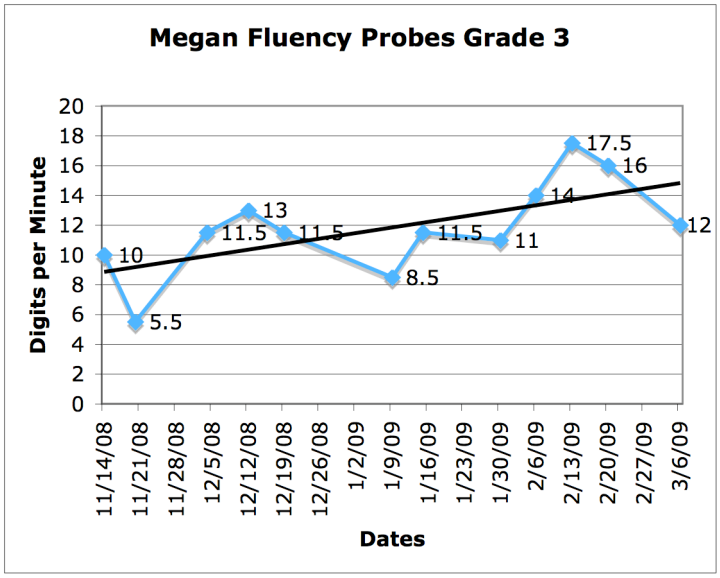

Figure 5. Megan's 3rd grade fluency probes

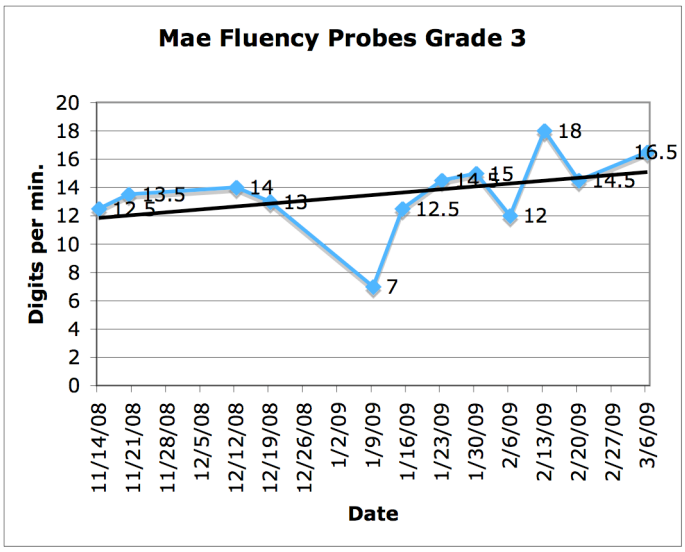

Figure 6. Mae's 3rd grade fluency probes

In addition to the weekly assessments, our school district gives every student a series of quarterly fluency probes on addition, subtraction, multiplication, and division. This year the district decided that fourth grade did not need to take the addition and subtraction assessments. However, in light of the first marking period assessment results, they decided that they wanted to monitor these fluency skills as well. These probes consist of one hundred basic facts. The following table reflects our districts standard of mastery for fact fluency:

Table 13

District Fluency Benchmarks

	Not Fluent	Progressing	Fluent
Addition (2 minutes)	0-89	90-94	95-100
Subtraction (2 minutes)	0-89	90-94	95-100
Multiplication (3 minutes)	0-89	90-94	95-100
Division (3 minutes)	0-89	90-94	95-100

The following table shows each student's score on these assessments:

Table 14

Neil: District Fluency Assessment

Neil	Addition	Subtraction	Multiplication	Division
1st Quarter			Not Fluent	Not Fluent
2nd Quarter	Not Fluent	Not Fluent	Not Fluent	Not Fluent

Table 15

Sahara: District Fluency Assessment

Sahara	Addition	Subtraction	Multiplication	Division
1st Quarter			Not Fluent	Not Fluent
2nd Quarter	Not Fluent	Not Fluent	Not Fluent	Not Fluent

Table 16

Megan: District Fluency Assessment

Megan	Addition	Subtraction	Multiplication	Division
1st Quarter			Not Fluent	Not Fluent
2nd Quarter	Fluent	Not Fluent	Progressing	Not Fluent

Table 17

Mae: District Fluency Assessment

Mae	Addition	Subtraction	Multiplication	Division
1st Quarter			Not Fluent	Not Fluent
2nd Quarter	Progressing	Not Fluent	Not Fluent	Not Fluent

District quarterly assessments. The district quarterly assessments are teacher created test that are based on the fourth grade regular education curriculum and pacing guides. They are designed to measure a student's growth

within a given marking period. All students, regardless of academic level, are given these assessments at the end of every marking period. The following table shows the scores obtained by 4 of my students with IEP's:

Table 18

District Quarterly Assessments

	1st Quarter	2nd Quarter
Neil	84%	72%
Sahara	19%	50%
Megan	72%	75%
Mae	59%	81%

4sight assessments. The 4sight assessments are a series of 5 tests given at various points in the year. These tests are designed to monitor a student's readiness to take the Pennsylvania State Standardized Assessments (PSSA's). The math 4sights measure 6 skill areas. These areas are: numbers and operations, measurement, geometry, algebraic concepts, data analysis and probability, and open-ended response including an explanation of how the student got their answer. The following table shows the results for the first three assessments given this year. Sahara does not have any baseline scores because she was not enrolled in our school when the baseline assessment was given.

Table 19

Neil's 4sight Scores

Neil-4sight	Baseline	1st Test	2nd Test	3rd Test
Total Score	38.89% Below Basic	38.89% Below Basic	61.11% Basic	83.33% Proficient
Number and Operations	41.67%	50%	66.67%	91.67%
Measurement	25%	50%	50%	75%
Geometry	50%	25%	50%	100%
Algebraic Concepts	50%	50%	75%	75%
Data Analysis and Probability	25%	25%	25%	100%
Open-ended Response	37.5%	25%	75%	62.5%

Table 20

Sahara's 4sight Scores

Sahara-4sight	1st Test	2nd Test	3rd Test
Total Score	38.89% Below Basic	38.89% Below Basic	50% Below Basic
Number and Operations	41.67%	33.33%	66.67%
Measurement	50%	50%	0%
Geometry	25%	50%	75%
Algebraic Concepts	50%	50%	50%
Data Analysis and Probability	50%	25%	50%
Open-ended Response	25%	37.5%	37.5%

Table 21

Megan's 4sight Scores

Megan 4sight	Baseline	1st Test	2nd Test	3rd Test
Total Score	41.67% Below Basic	52.78% Below Basic	50% Below Basic	61.11% Basic
Number and Operations	41.67%	50%	41.67%	66.67%
Measurement	75%	75%	75%	50%
Geometry	25%	25%	50%	50%
Algebraic Concepts	25%	25%	50%	75%
Data Analysis and Probability	50%	100%	75%	75%
Open-ended Response	37.5%	50%	37.5%	50%

Table 22

Mae's 4sights Scores

Mae-4sight	Baseline	1st Test	2nd Test	3rd Test
Total Score	38.89% Below Basic	36.11% Below Basic	52.78% Below Basic	52.78% Below Basic
Number and Operations	33.3%	41.7%	41.67%	66.67%
Measurement	0%	50%	75%	50%
Geometry	25%	50%	25%	50%
Algebraic Concepts	75%	25%	100%	50%
Data Analysis and Probability	25%	0%	50%	25%
Open-ended Response	62.5%	37.5%	50%	50%

DATA ANALYSIS

Throughout this study, data analysis was an ongoing process. As a special education teacher, collecting and analyzing data is part of my daily teaching routine and this study was no different. As students took assessments or completed activities, I analyzed the results to determine a lesson's effectiveness and my student's readiness to move on to another skill.

Survey and Interview Data

Every Friday my students either filled out a survey or responded to a writing prompt. These responses gave me the opportunity to see how my students felt about their own skills and how they felt we were doing in helping or not helping them to improve. After the responses were completed, I read each one and put student quotes into a table so that I could easily find examples of who said what and when. This method of organizing responses also allowed me to notice trends in the survey data. I then put the entire survey or paragraph into a section of my data binder reserved just for that student. This way I could easily find it when I was analyzing my data.

Numeric Forms of Data Collection

These forms of data collection included teacher created assessments, fluency data, district quarterly assessments, and 4sight scores. In order to analyze this data I transferred all of the results into tables. These tables allowed me to compare my students to each other within a given test or to themselves across a

series of assessments. I used this data to make sure that my students were progressing within both the regular education and special education programs. It also allowed me to monitor student growth toward IEP goals. As a result of this data I made changes to my instruction and modified my study to better meet the need of my students.

The Field Log

Data analysis did not stop with student work. I also analyzed my observations and impressions of events. I did this through the field log. As I taught, I kept a pad of sticky notes at my table and when something noteworthy happened I wrote it down. Then during my planning period I would turn those notes into a narrative journal entry. Every two weeks I coded my field log. Ely, Vinz, Downing, and Anzul (1997) define coding as the act of re-reading the field log and placing notes in the margins. Ely, Vinz, Downing, and Anzul call these notes codes. The codes are designed to identify common themes throughout the narrative journal. After coding my field log I organized the codes into bins or categories. These preliminary categories allowed me to see patterns in my data. The patterns eventually evolved into theme statements. The diagrams below shows my preliminary codes, bins, and my final theme statements for this action research study:

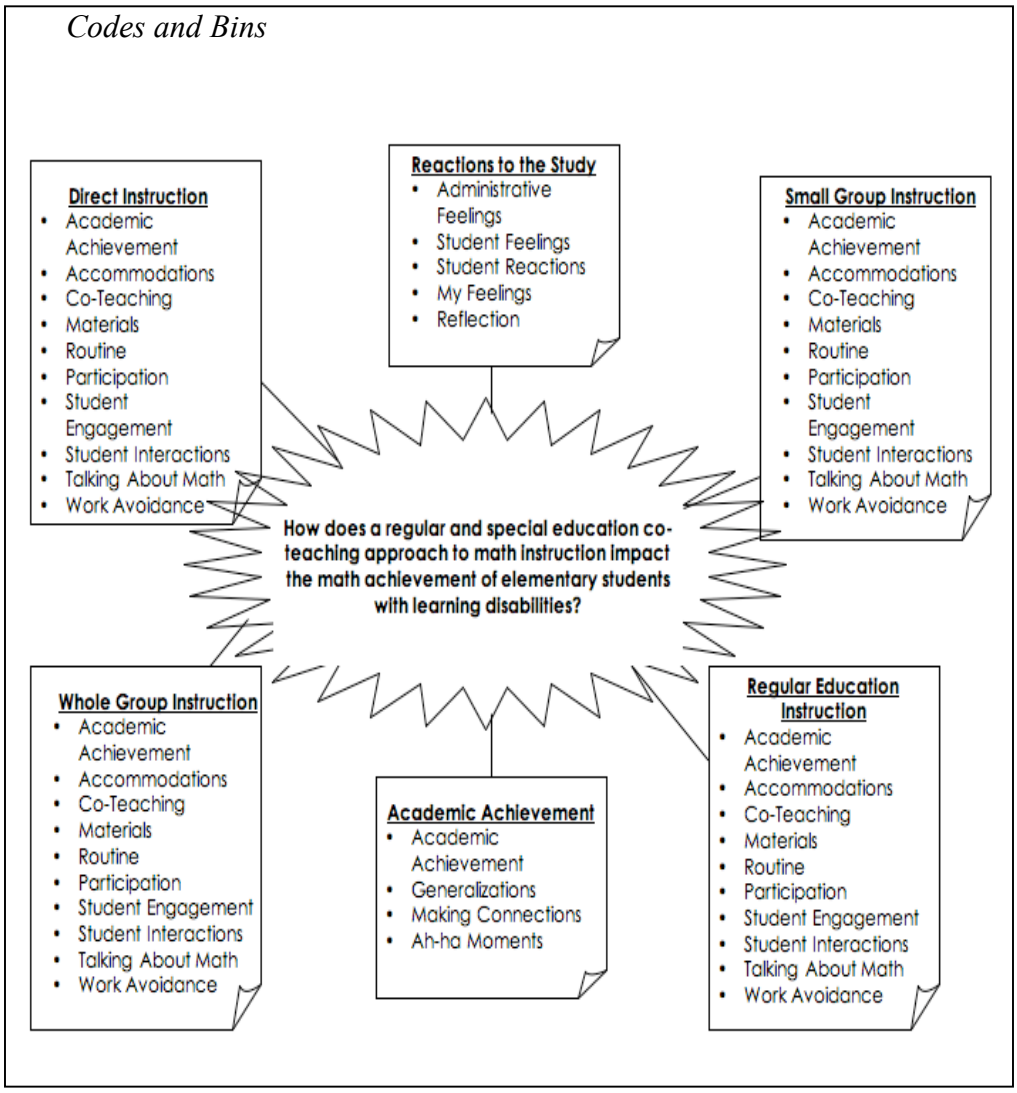

Figure 7. Codes and bins diagram

Theme Statements

1. Regular Combined with Special Education Instruction— the inclusion of special education students in regular education lessons has both served to expose students to grade level skills and increased student achievement on grade level assessments

2. Whole Group Instruction— through the course of this study, the students with special needs have increased participation in the whole group setting

3. Reactions to This Study— both regular and special education students demonstrated positive opinions of the co-teaching model

4. Academic Achievement— the use of a co-teaching approach to math instruction may lead to an increase in the academic achievement of students with and without special needs

Figure 8. Theme statements

FINDINGS

The Inclusion Of Special Education Students In Regular Education Lessons Has Both Served To Expose Students To Grade Level Skills And Increased Student Achievement On Grade Level Assessments

According to Katsiyannis and Prillaman (1990) special education students who are included in regular education classrooms are better prepared for grade level standardized assessments. My findings support this statement. The special education students who participated in this intervention increased their 4sight scores an average of 18.25% from the beginning of the school year to the end of the study. The following figure shows these scores.

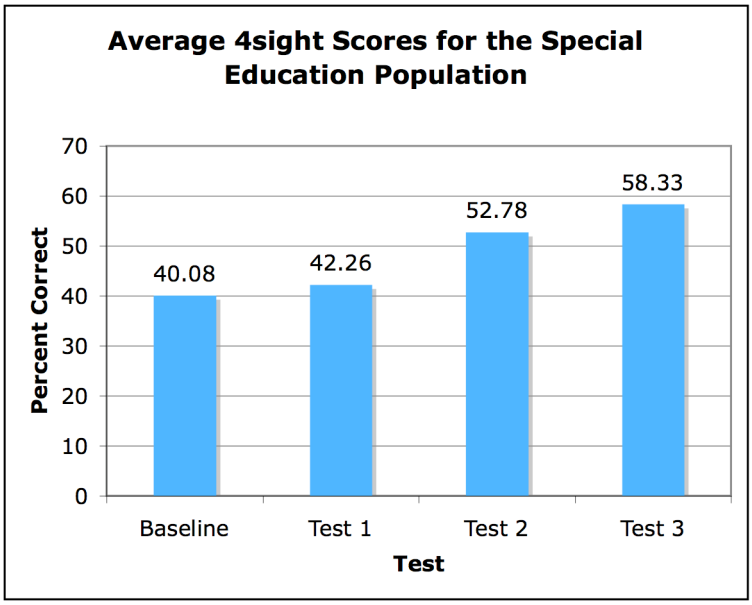

Figure 9. Average 4sight scores for the special education population.

The next figure shows individual student scores.

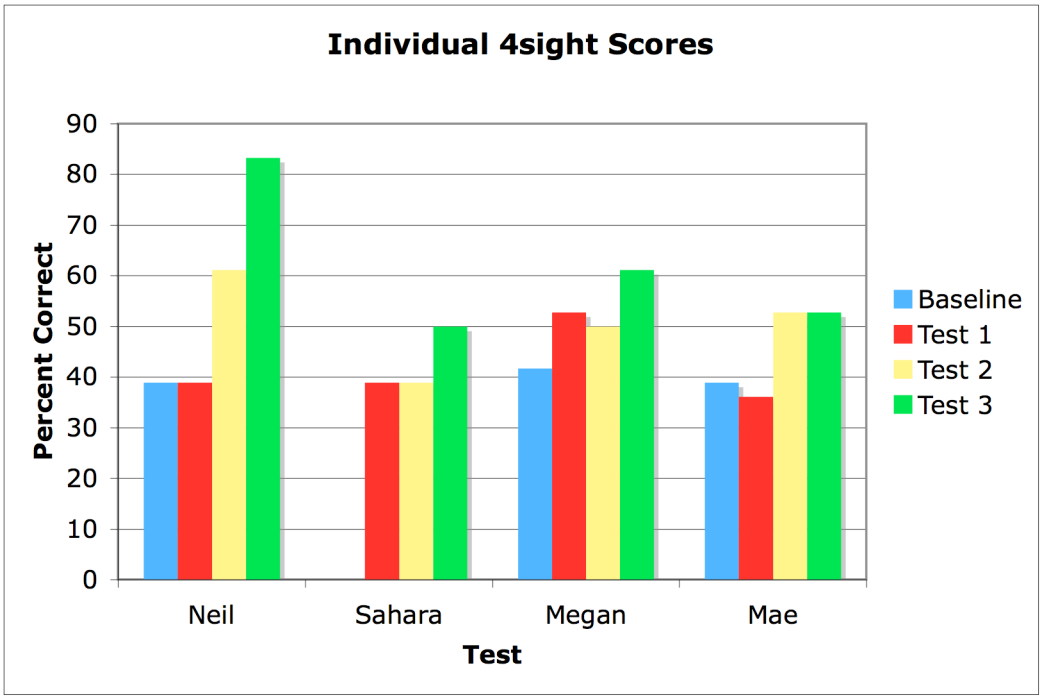

Figure 10. Individual 4sight scores for the special education population.

In addition to 4sight scores, I analyzed the results of our fourth grade quarterly assessments. I recorded an average score of 58.5% on the first marking period assessment and 69.5% on the second marking period assessment. This is an average increase of 11%. The following figure shows the scores of the individual students who participated in this study.

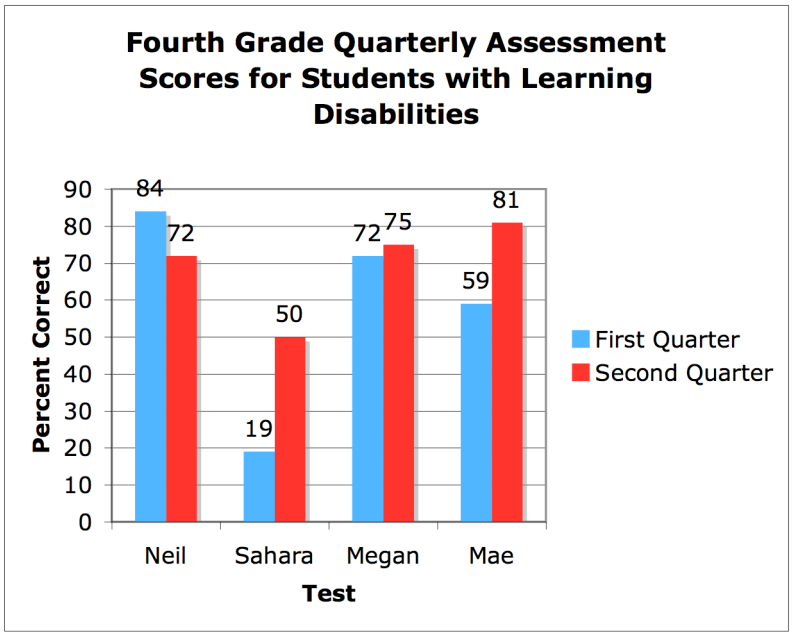

Figure 11. Fourth Grade Quarterly Assessment Scores for the Students with Learning Disabilities

This figure shows significant improvement for both Sahara and Mae. While Sahara is still considerably below benchmark with a 50% on the second marking period assessments, her growth from a 19% is noteworthy. Mae on the other hand started with a 59% on the first marking period assessment and increased to an 81%. This second marking period score is commensurate with the scores earned by her non-disabled peers. While, Neil and Megan did not show a significant difference in score from the first to the second marking period, both students started with scores in the 70-80% range.

Through The Course Of This Study, The Students With Special Needs Have Increased Participation In The Whole Group Setting

In the early days of my study I noticed that my learning support students were extremely reluctant to participate in whole group activities. They knew and willingly shared information during small group instruction, but when placed in a whole group setting with their regular education peers they seemed to turn suddenly timid. This, I theorized, was due to several factors.

Historically, learning support students have been taught in a small group setting for all of their core subjects. When they have had the opportunity to sit in on a whole group lesson, the material was usually outside what Vygotsky (1978) termed as their zone of proximal development. Vygotsky defined zone of proximal development as the skills that a student can complete with the help of a teacher or more advanced learner. If the material being taught is outside this zone, or if students are not given the help that they need to do the work, they cannot be expected to learn the content of the lesson, and therefore will have a very difficult time participating appropriately.

Due to this fact, I feel that some teachers have been guilty of allowing special education students to slide through whole group lessons with minimal participation. They viewed the time that learning support students were working on grade level material as exposure and not instruction. This has led to a learned passivity on the part of the student during grade level instruction.

However, throughout the course of this study, all students were given the tools they needed and were expected to participate equally in whole group and small group activities. I feel that the regular education instruction given to the learning support students in the small group setting has given them the knowledge and support needed to push the regular education material into their zone of proximal development. Through the analysis of anecdotal data, I have seen a steady increase in student participation. Even Mae, who was terrified to speak in front of a whole group, is now raising her hand and participating nearly as much as any of the regular education students. There is a new confidence within my special education students. They know they are able to do the work and are not afraid to try.

Both Regular And Special Education Students Demonstrated Positive Opinions Of The Co-Teaching Model

Research conducted by Pugach and Wesson (1995) suggested that students have an overall positive opinion of co-teaching. In their study, students reported that they felt good about their learning. They also reported a greater comfort when asking for help. According to this study, the act of giving and receiving help is a normal part of an inclusion classroom and nothing of which to be ashamed. I experienced very similar results in my own research.

Both my special and regular education students reported positive opinions of the co-teaching model. When asked to defend their opinions, some of their responses were as follows:

"The more you help us we will get better."

"It works a lot. I'm getting better at math all the time."

"Math was scary but now it's not scary it's cool and fun."

"Keep doing math centers because it is fun."

"We do a lot of math and it is a little hard but I like it…I do good."

"I like having four teachers because they help me when I'm struggling."

"We have four teachers. We are getting better in math. It is fun. Math is fun."

"We do a lot in math but it is fun. I like it a lot. It is good."

"I think it's fun to got to different teachers and do different things."

"First I go to Mrs. Hoyt, Ms. Berk second. Then I finally go with Ms. Corbin, my homeroom teacher. We do fun things in math."

"I'm good at math now."

The Use Of A Co-Teaching Approach To Math Instruction May Lead To An Increase In The Academic Achievement Of Students With And Without Special Needs

As I looked at the studies conducted by other researchers, I found very mixed results. St. Lauren et al. (1998) found that the math scores of students without disabilities increased significantly while there was no significant difference for students with disabilities. Rea, McLaughlin, and Walther-Thomas

(2002), however found that students with disabilities received higher classroom grades in an inclusion setting versus a pull-out program. However, they went on to state that there were no significant differences in state assessments. My research seemed to indicate that there were benefits to both groups of students. When given a math 4sight exam, the participating students who were not identified as having a learning disability showed an increase in average test scores from 49.44% to 88.43% over the course of three assessments. This is an increase of 39.02 percentage points. Students who were identified as having a learning disability reported an increase in average test scores from 40.08% to 58.33% over the course of three assessments. This is an increase of 18.25 percentage points. The graph below illustrates these data.

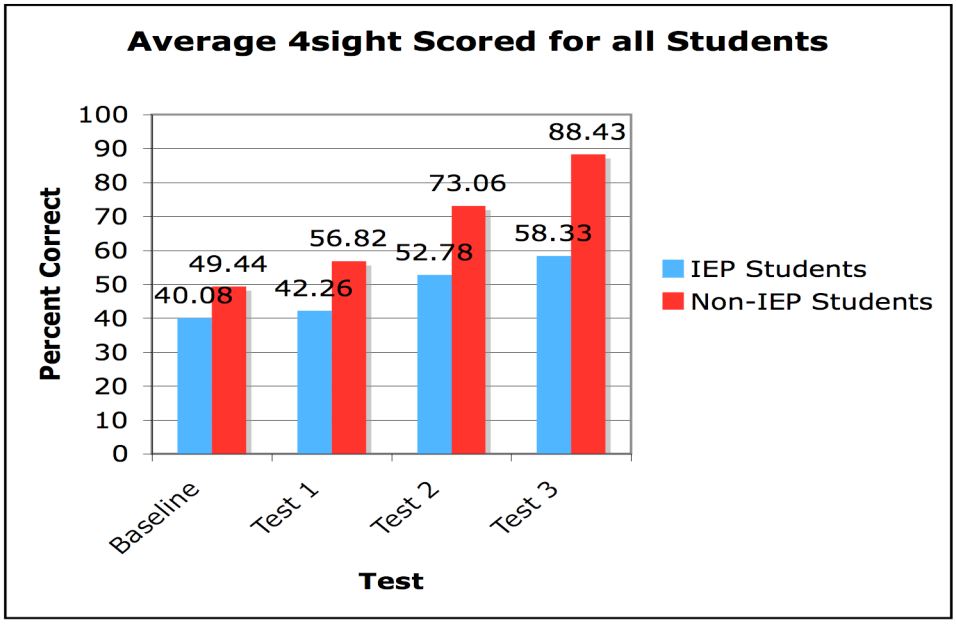

Figure 12. 4sight assessment scores for students with IEP's and regular education students.

Back to the Problem

When I first began planning this study I looked at my teaching, my students' learning, and my program of instruction. I found that the way in which I have been teaching my special education students was actually denying them the exposure to the regular education curriculum that their non-disabled peers were receiving. My learning support students were getting intensive instruction in their individual areas of weaknesses, but they were not being taught grade level skills. My goal in this study was to design a method of instruction that would both fill their individual needs and allow them to be taught on a fourth grade level.

As I review my data, I feel that I have done this successfully. My students are succeeding with fourth grade level material. They my not be performing at the same level as their non-disabled peers, but they are seeing and understanding fourth grade work. Also, and maybe more importantly, they believe that they are able to do the work.

WHERE DO WE GO FROM HERE?

This study has been a transforming experience in my educational career. I have not only collected data but also analyzed and presented those data in a professional format. In addition to this, and perhaps more importantly, through this study, I was able to increase my students' achievement in mathematics, classroom participation, and confidence. The work of a teacher researcher, however, is never done. As I analyzed my data, I was faced with new and equally challenging questions.

Was this Intervention as Effective for Our Regular Education Students as it Could Have Been?

In the months and weeks after the conclusion of my study, Crissi and I have looked closely at the data presented by our regular education population. These data showed a dramatic increase in scores. We were also very pleased with how far these students came when we compared their present scores with those they earned in the beginning of the school year. We were pleased but we still wondered if the learning support program was the best fit for the regular education students. We decided to put the special education program aside for these students, and see if a re-teaching or firming up model might be more effective. Crissi continued teaching the regular education program to all of our students and I began doing review and re-teaching activities with the regular education groups. We kept math meeting as it was. It is still too early in this new

intervention to draw any conclusions as to its effectiveness but I am interested to see how these changes will affect the academic achievement of the students without learning disabilities.

What Are the Effects of a Co-teaching Model in Reading?

When Crissi and I both taught special education we co-taught reading. In 2006, Crissi conducted her thesis study entitled "Reading Like Robots: Moving Beyond Decoding to Meaning Making," on the topic of combining a Direct Instruction and guided reading approach to reading (Corbin, 2006). This was accomplished through a co-teaching model. Crissi found that teaching students with learning disabilities using only one program was not giving them the skills they need to become readers. While the Direct Instruction program taught students how to sound out words, it did not teach them how to analyze what they read. Another program was needed. So Crissi designed a study that allowed students to receive instruction using the Direct Instruction program that was mandated by our school district and the guided reading instruction needed to allow students to experience and analyze authentic text. We continued teaching in this way for the next two years.

When Crissi began to teach regular education we had to stop co-teaching reading. It was not possible with the demands of the regular and special education programs to do both in the allotted time. Last year, however, we received a directive from our school district that mandated all students be

included in their regular education classrooms for reading. This opened the door once again for a co-taught reading time. While this intervention looked nothing like the one designed by Crissi in 2006, it has showed to be effective for many of my learning support students. Many of the results shown in the co-teaching of math have shown to be true for reading as well. My students are participating in regular education classrooms and conversations. They are using vocabulary and terminology from the regular education program and generalizing it into my learning support programs. I am very impressed by the effect that this intervention has had on the reading skills of my students, and I would be interested in studying these effects more closely.

Final Thoughts

As I look back on this study and all the work my students were able to accomplish, I am confident that, regardless of their label or disability, they have gained the confidence and skills they need to go on to be successful in fifth grade.

As for me, I will continue to question and analyze my teaching and how it affects the performance of my students. I will continue to collect data and base my teaching and further assessments on the results of those data. I have learned that research never stops. There is always another question to be answered and another problem to solve.

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Appendix A: Principal Consent Letter

Dear [redacted],

I am currently working on the thesis portion of my master's degree at Moravian College, and will be conducting a study to determine how a regular and special education co-teaching approach to math instruction will impact the math achievement of our students. I am writing to ask permission to carry out this action research study. Participation in this study involves only regular classroom activities.

The study will take place within my usual math time and will last through December 2008. During the study, I will collect various forms of data to determine how this instructional approach is improving our students' math skills. I will monitor students' knowledge of basic math skill, math fact fluency, problem solving skills, and overall growth. I will also use observation and conduct student interviews to determine how our students' feel about their math skills as well as their opinions on the math instruction they have been receiving.

Only my teacher research colleagues, my professor, and I will have access to the data collected in this study. All research materials will be secured in a protected location and will be destroyed at the end of the study.

If you have any questions please feel free to contact me at [redacted] or [redacted]. Thank you so much for your help.

Sincerely,

Kelly Berk

I attest that have received a copy, read, and understand this consent form, and . . .

☐ I give my consent for the implementation of this study.

☐ I do not give my consent for the implementation of this study.

_____	_____	_____
Name	Signature	Date

Appendix B: Parent Consent Letter

Dear Parents or Guardians,

I am currently working on the thesis portion of my master's degree at Moravian College, and will be conducting a study to determine how a regular and special education co-teaching approach to math instruction will impact the math achievement of the student in my classroom. I am writing to ask permission to use the data I collect from your child within my research report. Participation in this study involves only regular classroom activities. As a participant your child will not be asked to do anything above what is expected from all students in the class, and you may contact me at any time regarding your child's participation.

The study will take place within our usual math time and will last through December 2008. During the study, I will collect various forms of data to determine how this instructional approach is improving our students' math skills. I will monitor students' knowledge of basic math skill, math fact fluency, problem solving skills, and overall growth. I will also use observation and conduct student interviews to determine how our students' feel about their math skills as well as their opinions on the math instruction they have been receiving.

Only my teacher research colleagues, my professor, and I will have access to the data collected in this study. All research materials will be secured in a protected location and will be destroyed at the end of the study.

Our principal, [redacted], is aware and has given her consent for this study. If you have any questions please feel free to contact me at [redacted] or [redacted] or my Moravian professor, Dr. Joseph Shosh, at jshosh@moravian.edu. Also if you or your children do not feel comfortable speaking with me or Dr. Shosh please feel free to contact [redacted] school counselor, [redacted] at [redacted]. Thank you so much for your help.

Sincerely,

Kelly Berk

Please detach and return to Ms. Berk

I attest that I am this student's legal guardian and have received, read, and understand this consent form, and . . .

☐ I give permission for my child's data to be used in this study.

☐ I do not give permission for my child's data to be used in this study.

_____ _____ _____ Child's Name

Signature of Parent or Guardian Date

Appendix C: Colleague Consent Letter

Dear Colleagues,

I am currently working on the thesis portion of my master's degree at Moravian College, and will be conducting a study to determine how a regular and special education co-teaching approach to math instruction will impact the math achievement of our students. I am writing to ask permission to use the data I collect from your part in this process within my research report. Participation in this study involves only regular classroom activities, and you may contact me at any time regarding your participation.

The study will take place within our usual math time and will last through December 2008. During the study, I will collect various forms of data to determine how this instructional approach is improving our students' math skills. I will monitor students' knowledge of basic math skill, math fact fluency, problem solving skills, and overall growth. I will also use observation and conduct student interviews to determine how our students' feel about their math skills as well as their opinions on the math instruction they have been receiving.

Only my teacher research colleagues, my professor, and I will have access to the data collected in this study. All research materials will be secured in a protected location and will be destroyed at the end of the study.

Our principal, [redacted], is aware and has given her consent for this study. If you have any questions please feel free to contact me at [redacted] or [redacted] or my Moravian professor, Dr. Joseph Shosh, at jshosh@moravian.edu. Thank you so much for your help.

Sincerely,

Kelly Berk

I attest that have received a copy, read, and understand this consent form, and . . .

☐ I am willing to participate in this action research study.

☐ I am not willing to participate in this action research study.

_____	_____	_____
Name	Signature	Date

Appendix D: Survey Questionnaire

Student Survey

How would you rate your math skills as compared to other fourth grade students?

1 2 3 4 5

Low High

How would you rate your math skills this week as compared to the beginning of the year?

1 2 3 4 5

Low High

In what area do you think you are making the most improvement? Why?

_____

_____

_____

What, in math, would you like to do better?

_____

_____

_____

What can you do to achieve that goal?

_____

_____

_____

_____

What can I do to help you achieve that goal?

_____

Do you think that the way Ms. Corbin and I are teaching is helping you to get better in math? Why?

Yes No

_____

_____

Anything else?

Appendix E: Student Consent Letter

Student Consent Form

I _____

(would or would not) like to help Ms. Berk with her thesis study. I understand that nothing I do or do not do with this study will affect my grade or my relationship with my teachers. I also understand that I can talk to Ms. Berk or Ms. Corbin about my participation in this study and that I can drop out if I feel uncomfortable or overwhelmed.

Appendix F: List of Open Ended Questions

9/5/08—Initial Survey

9/12/08—When you think about math, what color do you see and why?

9/19/08—What are you and/or I doing to help you get better at math?

9/26/08—Describe to a visitor what you do in math.

10/3/08—What is your best and worst memory of math?

10/10/08—What would you like to tell me that will make Ms. Corbin and I better at teaching math?

10/17/08— My perfect math class would be….

10/24/08— Write a letter to a person of your choice persuading him or her to either allow us to continue co-teaching math or to have us stop co-teaching math. Defend your opinions.

11/7/08—When do you use math outside of school?

11/14/08—Why do you think teachers make you do math?

11/21/08—Do you think you are better or worse at math than you were in the beginning of the year? Why?

12/4/08—How has your opinion of math changed from the beginning of the school year to now?

1/20/08—Describe yourself to the reader of our story. Give them the information you would like them to know about you.

Appendix G: Basic Fact Assessment Sheets

Basic Addition Facts

0 +0 ____	0 +1 ____	0 +2 ____	0 +3 ____	0 +4 ____	0 +5 ____	0 +6 ____	0 +7 ____	0 +8 ____	0 +9 ____
1 +0 ____	1 +1 ____	1 +2 ____	1 +3 ____	1 +4 ____	1 +5 ____	1 +6 ____	1 +7 ____	1 +8 ____	1 +9 ____
2 +0 ____	2 +1 ____	2 +2 ____	2 +3 ____	2 +4 ____	2 +5 ____	2 +6 ____	2 +7 ____	2 +8 ____	2 +9 ____
3 +0 ____	3 +1 ____	3 +2 ____	3 +3 ____	3 +4 ____	3 +5 ____	3 +6 ____	3 +7 ____	3 +8 ____	3 +9 ____
4 +0 ____	4 +1 ____	4 +2 ____	4 +3 ____	4 +4 ____	4 +5 ____	4 +6 ____	4 +7 ____	4 +8 ____	4 +9 ____
5 +0 ____	5 +1 ____	5 +2 ____	5 +3 ____	5 +4 ____	5 +5 ____	5 +6 ____	5 +7 ____	5 +8 ____	5 +9 ____
6 +0 ____	6 +1 ____	6 +2 ____	6 +3 ____	6 +4 ____	6 +5 ____	6 +6 ____	6 +7 ____	6 +8 ____	6 +9 ____
7 +0 ____	7 +1 ____	7 +2 ____	7 +3 ____	7 +4 ____	7 +5 ____	7 +6 ____	7 +7 ____	7 +8 ____	7 +9 ____
8 +0 ____	8 +1 ____	8 +2 ____	8 +3 ____	8 +4 ____	8 +5 ____	8 +6 ____	8 +7 ____	8 +8 ____	8 +9 ____
9 +0 ____	9 +1 ____	9 +2 ____	9 +3 ____	9 +4 ____	9 +5 ____	9 +6 ____	9 +7 ____	9 +8 ____	9 +9 ____

Subtraction Facts with Differences to 19

A.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0
B.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	-1	-1	-1	-1	-1	-1	-0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
C.	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	
D.	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3		
E.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20			
	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4			
F.	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5				
G.	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20					
	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6	-6					
H.	7	8	9	10	11	12	13	14	15	16	17	18	19	20						
	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7						
I.	8	9	10	11	12	13	14	15	16	17	18	19	20							
	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8	-8							
J.	9	10	11	12	13	14	15	16	17	18	19	20								
	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9								

Multiplication Facts 0-9

0 x0 ____	0 x1 ____	0 x2 ____	0 x3 ____	0 x4 ____	0 x5 ____	0 x6 ____	0 x7 ____	0 x8 ____	0 x9 ____
1 x0 ____	1 x1 ____	1 x2 ____	1 x3 ____	1 x4 ____	1 x5 ____	1 x6 ____	1 x7 ____ _	1 x8 ____	1 x9 ____
2 x0 ____	2 x1 ____	2 x2 ____	2 x3 ____	2 x4 ____	2 x5 ____	2 x6 ____	2 x7 ____	2 x8 ____	2 x9 ____
3 x0 ____	3 x1 ____	3 x2 ____	3 x3 ____	3 x4 ____	3 x5 ____	3 x6 ____	3 x7 ____	3 x8 ____	3 x9 ____
4 x0 ____	4 x1 ____	4 x2 ____	4 x3 ____	4 x4 ____	4 x5 ____	4 x6 ____	4 x7 ____	4 x8 ____	4 x9 ____
5 x0 ____	5 x1 ____	5 x2 ____	5 x3 ____	5 x4 ____	5 x5 ____	5 x6 ____	5 x7 ____	5 x8 ____	5 x9 ____
6 x0 ____	6 x1 ____	6 x2 ____	6 x3 ____	6 x4 ____	6 x5 ____	6 x6 ____	6 x7 ____	6 x8 ____	6 x9 ____
7 x0 ____	7 x1 ____	7 x2 ____	7 x3 ____	7 x4 ____	7 x5 ____	7 x6 ____	7 x7 ____	7 x8 ____	7 x9 ____
8 x0 ____	8 x1 ____	8 x2 ____	8 x3 ____	8 x4 ____	8 x5 ____	8 x6 ____	8 x7 ____	8 x8 ____	8 x9 ____
9 x0 ____	9 x1 ____	9 x2 ____	9 x3 ____	9 x4 ____	9 x5 ____	9 x6 ____	9 x7 ____	9 x8 ____	9 x9 ____

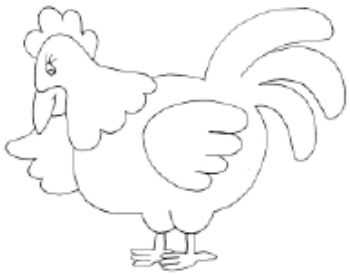
Division Facts 0-9

0 ÷ 0 =	1 ÷ 0 =	2 ÷ 0 =	3 ÷ 0 =	4 ÷ 0 =	5 ÷ 0 =	6 ÷ 0 =	7 ÷ 0 =	8 ÷ 0 =	9 ÷ 0 =
1 ÷ 1 =	2 ÷ 1 =	3 ÷ 1 =	4 ÷ 1 =	5 ÷ 1 =	6 ÷ 1 =	7 ÷ 1 =	8 ÷ 1 =	9 ÷ 1 =	10 ÷ 1 =
2 ÷ 2 =	4 ÷ 2 =	6 ÷ 2 =	8 ÷ 2 =	10 ÷ 2 =	12 ÷ 2 =	14 ÷ 2 =	16 ÷ 2 =	18 ÷ 2 =	20 ÷2 =
3 ÷ 3 =	6 ÷ 3 =	9 ÷ 3 =	12 ÷ 3 =	15 ÷ 3 =	18 ÷ 3 =	21 ÷ 3 =	24÷ 3 =	27÷ 3 =	30÷3 =
4 ÷ 4 =	8 ÷ 4 =	12 ÷ 4 =	16 ÷ 4 =	20÷ 4 =	24÷ 4 =	28÷ 4 =	32÷ 4 =	36÷4 =	40÷4 =
5 ÷ 5 =	10 ÷ 5 =	15 ÷ 5 =	20÷ 5 =	25÷ 5 =	30÷ 5 =	35÷ 5 =	40÷ 5 =	45÷5 =	50÷5 =
6 ÷ 6 =	12 ÷ 6 =	18 ÷ 6 =	24÷ 6 =	30÷ 6 =	36÷ 6 =	42÷ 6 =	48÷ 6 =	54÷6 =	60÷6 =
7 ÷ 7 =	14 ÷ 7 =	21 ÷ 7 =	28÷ 7 =	35÷ 7 =	42÷ 7 =	49÷ 7 =	56÷ 7 =	63 ÷7 =	70÷7 =
8 ÷ 8 =	16 ÷ 8 =	24÷ 8 =	32÷ 8 =	40÷ 8 =	48÷ 8 =	56÷ 8 =	64÷ 8 =	72 ÷8 =	80÷8 =
9 ÷ 9 =	18 ÷ 9 =	27÷ 9 =	36÷ 9 =	45÷ 9 =	54÷ 9 =	63÷ 9 =	72÷ 9 =	81 ÷9 =	90÷9 =

Appendix H: Math Goals Data Probes

Name: _____

KidZone.ws
Math Worksheets



832 + 258	772 + 556		
544 + 699	939 + 301	793 + 830	849 + 793
672 + 945	569 + 762	903 + 965	393 + 958

0 1 2 3 4 5 6 7 8 9

Name: _____

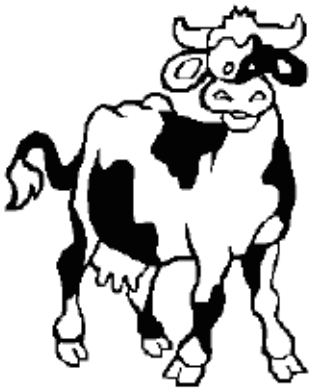
KidZone.ws
Math Worksheets

39 - 18	47 - 38		
83 - 12	95 - 52	26 - 11	56 - 29
29 - 27	97 - 64	98 - 54	72 - 61

0 1 2 3 4 5 6 7 8 9

Name: _____

KidZone.ws
Math Worksheets



501 - 465	168 - 113		
124 - 113	697 - 317	778 - 603	149 - 116
291 - 154	246 - 197	960 - 138	849 - 546

0 1 2 3 4 5 6 7 8 9

Name _____ Date _____

What time is it?

_____

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Name _____ Date _____

What time is it?

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Name _____ Date _____

(Answer ID # 0724115)

Money

Show each amount using the fewest number of coins and bills.

1.	$3.50	___ pennies ___ nickels ___ dimes	___ quarters ___ one-dollar bills	2.	$2.95	___ pennies ___ nickels ___ dimes	___ quarters ___ one-dollar bills
3.	$0.64	___ pennies ___ nickels ___ dime	___ quarters ___ one-dollar bills	4.	$4.37	___ pennies ___ nickels ___ dime	___ quarter ___ one-dollar bills
5.	$1.82	___ pennies ___ nickel ___ dimes	___ quarters ___ one-dollar bill	6.	$1.23	___ pennies ___ nickels ___ dimes	___ quarters ___ one-dollar bill
7.	$4.41	___ penny ___ nickel ___ dime	___ quarter ___ one-dollar bills	8.	$2.76	___ penny ___ nickels ___ dimes	___ quarters ___ one-dollar bills
9.	$0.78	___ pennies ___ nickels ___ dimes	___ quarters ___ one-dollar bills	10.	$3.89	___ pennies ___ nickels ___ dime	___ quarters ___ one-dollar bills
11.	$2.36	___ penny ___ nickels ___ dime	___ quarter ___ one-dollar bills	12.	$1.95	___ pennies ___ nickels ___ dimes	___ quarters ___ one-dollar bill

1. Hannah bought 6 bags of licorice for her friends. Each bag has 5 pieces of candy in it. How many pieces of candy were there in all?

2. Ms. Davis' class planted flowers in front of the school. They planted 15 tulips, 20 pansies, and 18 daffodils. How many flowers did they plant in all?

3. Amber bought 3 boxes of erasers. Each box had 6 erasers. Then she gave 8 erasers away. How many erasers did she have left?

4. Alexandra made 24 cupcakes. She gave 13 to her mother, but got 5 from her grandmother. How many cupcakes does Alexandra have now?

5. Joshua's writing club made 6 posters about Joseph Pulitzer. They put 7 pictures on each poster. They wrote about each picture. How many pictures did they put on the posters in all?

Appendix I: Timed Math Probes

Sheet #1 · Computation 1

Password: ACT

Name: _____ Date: _____

A 0 + 3	B 7 + 3	C 0 + 7	D 54 + 33	E 7 + 2
F 10 − 0	G 9 + 0	H 0 + 9	I 6 − 0	J 8 − 5
K 10 − 1	L 8 − 1	M 10 − 7	N 1 7 + 1	O 6 − 2
P 65 + 23	Q 45 − 4	R 5 + 1	S 8 1 + 0	T 7 − 5
U 8 + 1	V 99 − 8	W 10 − 3	X 9 − 7	Y 9 + 1

Sheet #1 Computation 2

Password: AIR

Name: _____ Date: _____

A 272 − 50	B 20 + 24	C 6 + 9	D 17 − 9	E 2 1 + 8
F 16 − 8	G 85 − 66	H 7 + 9	I 13 − 3	J 9 + 9
K 10 − 6	L 70 − 3	M 14 + 9	N 30 + 6	O 8 + 7
P 4 + 6	Q 31 23 + 33	R 12 − 3	S 57 − 8	T 3 − 2
U 22 − 11	V 11 − 6	W 4 + 2	X 21 + 69	Y 14 − 7

Sheet #1

Computation 3

Password: ALL

Name: _____ Date: _____

A $7\overline{)28}$	B $5\overline{)35}$	C 98 − 19	D $1\overline{)4}$	E 6 × 6
F 5 × 4	G 400 − 114	H 1 × 0	I 73 × 5	J 3 × 2
K 710 + 779	L $4\overline{)4}$	M 97 + 97	N 54 × 4	O $4\overline{)32}$
P 373 − 83	Q 8 × 2	R 0 × 2	S 596 + 53	T 9 × 8
U 8 × 3	V 1 × 4	W 44 − 37	X 308 − 141	Y $1\overline{)6}$