Coteaching in Inclusion Classrooms Using Core-Plus Mathematics Materials: A Research Study

David Pugsley
St. John Fisher College

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MS in Mathematics, Science, and Technology Education

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David Pugsley
St. John Fisher College
April 16, 2003
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Abstract

This study's focus is on how a math teacher and a special educator can be more effective working together in a ninth-grade inclusion classroom using NSF-funded, reading-intensive, Core-Plus mathematics material. The study is focused on eight components of effective coteaching partnerships. A coteaching rating scale is used to evaluate the working relationship between two pairs of coteachers before and after a series of seminars. The seminars focus on helping the mathematics teacher address students' reading difficulties, on the one hand, and, on the other, helping the special educators become more familiar with the technology required in the classroom.
INTRODUCTION

The success of all students, including students with disabilities, to achieve in mathematics is a national goal and priority. According to the Third International Mathematics and Science Study (TIMSS), American eighth-graders score well below the International average, and outperform only seven other nations. Moreover, American 12th graders, also, score below the international average (Gagnon & Maccini, 2000).

Mathematics reform is being discussed in high schools all over the country along with state and national assessments in order meet the national goal. The NCTM Standards are being used as guidelines for curriculum. The NCTM (2000, 2) has established the following five instructional goals in mathematics: “(1) becoming a mathematical problem solver; (2) learning to communicate mathematically; (3) learn to reason mathematically; (4) valuing mathematics; (5) becoming confident in one’s ability to do mathematics.” The NCTM suggests that traditional lecture based teaching will not achieve these goals. It suggests a constructivist’s approach. Again, all students must reach these goals.

The Penfield school district, where I teach, has made mathematics its focus. The district has become part of the Eisenhower grant through the University of Rochester. The Eisenhower grant has allowed Penfield to adopt the NSF funded Core-Plus Mathematics Project (CPMP) curriculum to help all students meet the state and national standards and the New York state assessment, the Math A exam. This curriculum, which is being implemented by grade level in the high school, is much different from traditional materials. It uses a constructivist’s model of learning. It puts a strong emphasis on students working in-groups to explore and discover different concepts through “real-life”
models. The reading that the students have to do and understand is more extensive then what is in traditional text.

Along with the development of new curricula, standards, and assessments, the amount of special education services is decreasing. This is due in part to the reauthorization of the Individuals with Disabilities Education Act (IDEA), "a major shift in the concept of least restrictive environment has required that students with disabilities be included in general education settings to the maximum extent possible.(Fennick, 2001, 67)." Because of this special education students spend less than one - fifth or less of the day in a special education setting. This means the majority of special education students day is spend in a general education classroom. The number of inclusion classrooms rises every year. With the pressure of meeting the state and national standards, many districts have implemented a co-teaching model of teaching in the inclusion classrooms.

In Penfield School District inclusion classes are of the norm. In Penfield, the special educator and general educator are supposed to coteach. Almost every, ninth-grade Math A class consists of a mix of non-special education and special education students. As a result, co-teaching is supposed to be occurring within the inclusion classrooms. Coteaching consists of "the collaboration between general and special education teachers for all of the teaching responsibilities of all student assigned to a classroom (Gately & Gately, 2001, 67)." This is what is supposed to be occurring on daily bases in the classroom.

In my five years as a teacher, I have had an inclusion classroom every year. Within these classes there is a special educator with whom I am supposed to coteach. I have not once planned with or prepared a lesson with these teachers. The special
educators are not assigned to the same classroom every period of the day. When they are, their role is more or less acting as an “aid”. They do not provide instruction during a lesson or during an activity. One reason for this is the special educator is not familiar with the content or text in the math class. The special educator I currently work with is not familiar with mathematics, let alone familiar with the new NSF-funded Core-Plus curriculum the district where we teach adopted. This model, as it is being implemented currently, is not effective. The main reason is that we, the special educator and I, are not using each other’s expertise to benefit the class.

My worries lie with the achievement of special education students. These students are going to be the ones most affected by the new standards, state and national assessments, and curricula. They are “labeled” as special needs students for various reasons. If they are only involved in a special education setting one-fifth of the time they are not getting the support they need. It is my belief that the needs of the special education students could be better met if the general educator and the special educator worked together more effectively. This brings me to the core of this thesis: How can general and special educators be more effective in a ninth-grade inclusion mathematics classroom using the intensive-reading Core-Plus materials?

A Review of the Literature

INTRODUCTION

In order to meet the needs of all students in inclusion classrooms, Penfield school district, where I teach, has implemented a coteaching model. It is the direction my district has taken because research has proven it to be effective. It is suppose to benefit all students, those with disabilities and those without disabilities. In my classes at Penfield it has not been an effective model. It has not benefited me or my students in
anyway. The coteacher I work with and I have a comfortable relationship, but for various reasons we are not meeting the expectation of coteaching. Coteaching is occurring in very few, if any, inclusion math classrooms at the secondary level in the Penfield school district. The major reasons the coteaching relationship between teachers is not occurring is due to lack of knowledge special educators have in math, the new state standards, and of the implementation of the Core-Plus curriculum, a NSF-funded curriculum that meets the NCTM standards (Hunt, Lannin, John. & Martin, 2002, 545).

The concept of coteaching, two teachers working together, is not new (Dieker, 2001, 14). Some teachers refer to it as team teaching, cooperative teaching or collaborative teaching. However, even though inclusion in the classroom has grown, research has not been focused at the secondary level (Dieker, 2001, 14). Among the articles that exist on how the process or components of coteaching relate to coteaching in an inclusion classroom is Lisa Dieker’s “What are the Characteristics of ‘Effective’ Middle and High School Co-taught Teams for Students, with Disabilities.” This study details five components of effective coteach that are incorporated in Susan and Frank Gately’s “Understanding coteaching,” which provides a more comprehensive framework for an effective coteaching relationship. They suggest eight components (see Appendix A), each of which is comprised of three stages. In addition, these authors also recommend a coteaching rating scale evaluation form (see Appendix B & C) that they developed for teachers who want to evaluate their coteaching relationship in terms of the eight components.

The literature is somewhat limited in terms of coteaching in a reformed mathematics classroom using an NSF-funded curriculum. The NCTM’s document,
*Principles and Standards for School Mathematics* (2000), the standards for which the Core-Plus curriculum is aligned, does not contain any information as to how coteaching should be practiced in inclusion classrooms. The NCTM does say, however, that "students with special education needs must have the opportunities and support they require to attain a substantial of important mathematics (2000, 12)." The opportunities and the support that the NCTM is referring to for students with special needs are the responsibility of state and school districts.

Given the scarcity of documented research on coteaching at the secondary level using reformed curricula, coteaching teams must use the available literature on components that have proven effective in building a coteaching relationship. I will now review relevant articles that define coteaching, define the components of coteaching, and evaluate coteaching relationships.

**Coteaching**

The inclusion model in education has been developing since the early 1990s and, in part, has grown out of a response to the Individuals with Disabilities Act (IDEA). This act calls for "a major shift in the concept of least restrictive environment, which requires that students with disabilities be included in general education settings to the maximum extent possible (Fennick, 2001, 67)." Inclusion refers to the teaching of students with disabilities and without disabilities in the same classroom. Because of this, there has been an increase in the number of schools implementing a coteaching model. IDEA led to Collaboration. (Brownee & Walther-Thomas, 2002)

It is important to first define coteaching in order to establish the components that exist within coteaching. Although, Coteaching has been defined in many ways (Fennick,
Walther-Thomas, Bryant, and Land define coteaching as "an educational approach in which general and special educators or related service providers jointly plan for and teach heterogeneous groups of students in integrated settings (Bryant, Land & Thomas, 1996, 256)." The only responsibilities they mentioned are planning and teaching. The authors do not define the roles within coteaching. Lisa Dieker (Dieker, 2001, 15) says "Co-teaching has been described in the research as a model that emphasizes collaboration and communication among all members of the team to ensure that the needs of all students are met." It is the responsibility, she asserts, of the teachers involved to ensure that needs of students are met. Susan and Frank Gately (Gately & Gately 2001, 47) define coteaching as, "the collaboration between general and special education teachers for all of the teaching responsibilities of all students assigned to a classroom." This definition recognizes the fact that it is not solely the responsibility of the classroom teacher to provide instruction to a class, but it is also the responsibility of the special educator too. The Gatelys' definition implies that other responsibilities, such as assessment, classroom management, and curriculum planning are also part of the coteaching relationship. This definition of coteaching specifies what the relationship must entail for a coteaching team to be effective.

**Components of Coteaching**

In order to develop an effective coteaching relationship some type of theoretical framework must be agreed upon. The following components of coteaching will be used in this study in order to determine the effectiveness of a coteaching relationship (Gately & Gately (2001); Bryant, Land & Walther-Thomas (1996); Arguelles, Hughes & Schumm (2000); Duchardt (1999));
• Compatibility
• Common planning time
• Flexibility
• Risk taking
• Communication skills

Communication, though only one of the components, is the "glue" for the whole relationship. If it does not exist neither do the other four components. Moreover, if one person in a coteaching relationship is not flexible or willing to take risks the coteachers will not be able to develop sufficient compatibility to make the relationship work over an extended period of time. Planning time must be available in order for both teachers to be able to communicate and work towards an effective coteaching relationship.

Susan and Frank Gately’s, "Understanding Coteaching Components,” define eight components of coteaching as:

• Interpersonal Communication
• Physical Arrangement
• Familiarity with the Curriculum
• Curriculum Goals and Modifications
• Instructional Planning
• Instructional Presentation
• Classroom Management
• Assessment

Before the authors introduce and describe these eight components, they point out that an effective coteaching relationship is developed over time. It is important, they insist, to
recognize that coteaching is a developmental process and that a coteaching relationship is not going to necessarily run smoothly from day one. It takes time to develop an effective relationship.

Since coteaching is a developmental process, Susan and Frank Gately break each component into three stages: Beginning stage, compromising stage and collaborative stage. In the beginning stage of each component the teachers are cautious and unsure when communicating with each other. In the compromising stage the teachers realize they have to give a little to receive a little. The communication is developing to a point where the teachers begin to see the benefits in the process of coteaching. In the collaboration stage the communication is comfortable and open, and the teachers are willing to compromise in order to benefit the students (Gately & Gately, 2001).

The Gatelys incorporate the five components described earlier in this section, and also recognize that assessment, familiarity with the curriculum, and physical arrangement are important factors in the coteaching relationship. Familiarity with the curriculum, however, is of particular importance at the secondary level especially in the mathematics classroom. If one teacher in the relationship is not comfortable with the curriculum then he or she will only be able to share in the coteaching responsibilities in a limited capacity. It is a theoretical premise of this study that these components, when they are being met to the best of each teachers ability, will create the best possible coteaching relationship. Of special interest to this study is the communication component, which is assumed to be of particularly importance for all the other components. That is, the key to a successful coteaching relationship is an open line of communication between the teachers in the coteaching relationship.
Evaluating Coteaching

At the beginning of this study, the coteachers will evaluate their relationship according the eight components listed above. This study will begin with an evaluation of each teacher to find out where their relationship exists in the 8 components. Susan and Frank Gately (Gately & Gately, 2001) emphasize the need to determine the current effectiveness of a coteaching relationship. To this end, they have developed a coteaching rating scale (see Appendix B & C) to determine each coteachers effectiveness in the classroom. The coteaching rating scale can also be used to help teachers determine which of the eight components are problematic for them (Gately & Gately, 2001). The coteaching rating scale, if used correctly, could speed up the developmental process of becoming effective coteachers.

The coteaching rating scale has two forms, one for the special educator and the other for the general educator. After each educator fills out his or her respective form, they then compare results (Gately & Gately, 2001). The coteaching rating scale helps profile each teacher within the coteaching team and, once the profiling is completed, areas of weakness can be discussed and goals set as to how to overcome deficiencies. Using the coteaching rating scale is an effective way to open up lines of communication between two coteachers.
Method

Overview

I recruited two special educators, Linda and Karen, and one math teacher, Jennifer, who participated with me in a series of seminars and activities. This was done to further our understanding and our effectiveness in working together in an inclusive classroom that uses the Core-Plus curriculum. Linda, Karen, and Jennifer understood the need to be more effective in the classroom and out. They were also aware that special educator and math teachers were not using one another effectively as coteaching partners. The four of us participated in a series of seminars held twice a week over a one month period. In these seminars we examined various problems in Core-Plus classrooms. One of the foci was reading, since reading is a major emphasis in the new standards and in the Core-Plus Curriculum. The special educators, Linda and Karen, shared their expertise in reading and their knowledge of the special needs of LD and ED students, with me and Jennifer, the other math teacher. These seminars, however, were not limited to improving reading and fostering a more effective use of technology. Rather, the seminars become the occasion for improved communication and a deepened sense of trust between the coteaching teams.

Setting

This research project was conducted in Penfield central school district at the high school located in Penfield, New York, just outside of Rochester. The school's population consists of sixteen hundred students and the community is classified as middle to upper class. There are nine forty minute periods in a typical school day. For this study of how math teachers and special educators can be more effective in a blended classroom using
Core-Plus materials, I enlisted the assistance of two special education teachers, Linda and Karen, and one math teacher, Jennifer. The two special educators supported students within inclusive mathematics classrooms using Core-Plus. Karen is the classroom teacher for four Core-Plus class made up of special education students only. In addition, she also supports three students in Jennifers Core-Plus class. Linda, the other special educator, is in two of my Core-Plus classes once or twice a week. She supports one student in my second-period class and seven in my eighth-period class. Linda and Karen also support other classes throughout the day. They meet with all their students once a day for forty minutes. During these forty-minute sessions they are working with the students on areas of weakness and concern.

Sequence of Events and Data Collection Instruments

*Overview*

On January 6, 2003, the profiling of the special educators, Linda and Karen, and the math teachers, Jennifer and myself, was done. Karen, Linda, Jennifer, and I filled out a coteaching evaluation form (see Appendix B & C). After the evaluations were filled out, I interviewed and audio taped each teacher. After this was completed, the seminars began. The first seminar was held on January 13th, 2003. We met every Monday and Thursday for five weeks. Each seminar was audio taped. During these five weeks I observed Linda four times and Karen four times in the classroom. Each teacher kept a journal throughout the five weeks.
Data Collection Instruments

Data was collected using the following instruments:

- Coteaching Evaluation Form for general educator (pre and post study)
- Coteaching Evaluation Form for special educator (pre and post study)
- Journal entries of all participants
- Interviews, audio tape
- Observations:
  - Linda in my inclusion Core-Plus class
  - Karen in her special education Core-Plus class
- Audio tapes of seminars

Data Collection

Coteaching Evaluation

The special educators and the general education teacher filled out a coteaching evaluation form that determined what stage each teacher was at according to the eight coteaching components. These eight components of coteaching are (see Appendix A):

- Interpersonal Communication
- Physical Arrangement
- Familiarity with the Curriculum
- Curriculum Goals and Modifications
- Instructional Planning
- Instructional Presentation
- Classroom Management
- Assessment
Each component has three stages: the developmental stage, the compromising stage, and the collaboration stage. This helped in the understanding of what was happening in the classroom between the math teacher and the special educator.

They were asked to fill the coteaching evaluation forms out a week before the seminars began and immediately after the seminars finished. This allowed me to place each teacher within the eight components of coteaching. This was important so that I knew what stage each teacher was in with respect to becoming an effective collaborative coteaching team member.

Journal Entries

The special educators, the other math teacher, and I kept a journal or log of our reactions, understandings, difficulties, and questions. This was done after each seminar. I supplied them with prompts in case they had trouble writing.

Interviews

I interviewed each participant before and after the seminars began and ended. This interview in the beginning was done to get a feel for what each teacher was expecting to gain from the seminars. The interview following the seminars was done to get reactions to the seminars and constructive criticism.

Observations

I observed Linda in my classroom and Karen in her classroom. I did not find it necessary to observe Jen and Karen because the curriculum they coteach is not Core-Plus. This was needed in order to see if the coteaching teams had reached new stages in the eight components of coteaching. I observed both Karen and Linda four times.
The special educators participated in seminars on various topics such as reading Core-Plus mathematics materials, using technology in the classroom, constructivism, the new standards, the Core-Plus curriculum, coteaching, and the current approach to special education in Penfield. The seminars were twenty-five to thirty minutes long and occurred twice a week. They all were audio taped. I was the facilitator for each of the seminars. It was important that each teacher felt comfortable enough to openly express his or her thoughts and feelings. Below are examples of what the first two seminars looked like.

This is an outline of the first seminar held on 28th of January 2003. We discussed Investigation 2 of Lesson 3 in Unit 3 in Course I of Core-Plus (see Appendix D). The problem focused on keeping an equation balanced when solving it and on the use of the “undo operation” approach when solving equations (Core-Plus Mathematics Project, Book 2). The seminar began with me asking one of the special educators to read the problem context aloud. We then discussed what the problem is asking us to do. We then tried to look at the problem from the perspective of a special education student. The following are questions that were used to facilitate discussion:

- What is the first difficulty you see for the students?
- Is the reading too much?
- Should they read it to themselves?
- Should we read it to them? Or have them read it to themselves?
- Will they understand the notation in the reading?
- Will they understand what the questions are asking them to do?
- How do we ensure they are reading and comprehending the situation?


**Timeline**

**Week 1**

Jan 14\(^{th}\) - Fill out coteaching evaluations  
Jan 17\(^{th}\) – Met with Jen and Karen to go over evaluations. Did the same with Linda  

**Week 2**

Jan 28\(^{th}\) – First Seminar  
Jan 30\(^{th}\) - Second Seminar  

**Week 3**

Feb 3\(^{rd}\) – Planned with Linda  
Feb 4\(^{th}\) – Third Seminar and observed Karen  
Feb 6\(^{th}\) – Fourth Seminar observed Karen  
Feb 7\(^{th}\) – Observed Linda  

**Week 4**

Feb 10\(^{th}\) – Fifth seminar and planned with Linda  
Feb 25\(^{th}\) – Sixth Seminar  

**Week 5**

Mar 3\(^{rd}\) – Seventh Seminar and Planned with Linda  
Mar 5\(^{th}\) – Observe Karen  
Mar 7\(^{th}\) – Eighth Seminar  

**Week 6**

Mar 10\(^{th}\) – Ninth Seminar and planned with Linda  
Mar 13\(^{th}\) – Tenth Seminar and observed Karen  

**Week 7**

Mar 17\(^{th}\) – Filled out Coteaching Evaluation forms
Data Analysis

The analysis incorporated all of the data I have collected during the five week period. I looked at where each teacher falls on the Coteaching Rating scale at the beginning of the process (Appendix B & C). This allowed me to evaluate our coteaching relationships before the seminars began. After all data was collected I attempted to analyze the reasons for why the coteaching relationship was not what it should have been. When all the data was collected, I first read over the journals, and observations, looking for signs of trouble, things that did not make sense, situations that did not go well, and things that surprised me. Then I turned to the audio tapes of the seminars looking for the same type of discrepancies. Emerging patterns were noted. The analysis was meant to determine if this model of interaction between special educators and math teachers showed promise for promoting a more effective working relationship in an inclusion mathematics classroom using reading-intensive reform mathematics materials.

Analysis

Coteaching Rating Scale

Analyzees of answers to the coteaching ratings scale showed how coteachers who have a personal relationship initially perceive their coteaching relationship as further along in the relationship than it really is (Appendix K). This was shown in the results to Jen and Karen’s answers to the coteaching rating scale. Their results changed very little as to where they saw their relationship before the seminars and after the seminars. Actually, Karen had the assessment component go from the collaboration stage to the compromising stage. Linda and I did not have a strong personal relationship before the seminars started, which is why, I believe, the analysis showed clear improvement at the
end of the seminars. This existence of a strong personal relationship can be misconstrued into a strong professional relationship.

Seminars

Each seminar occurred twice a week for five weeks. Each seminar lasted between twenty-five to thirty minutes. Linda, Karen, Jen and I were present at each seminar. We met in a room that had few distractions and each was held around a round table.

Seminar 1 (1/28/03)

We discussed the Core Plus text and some of the difficulties the students we share would encounter. I started off talking about how reading intensive the book was. Jen agreed and said that some of her students did have trouble with the reading. I said and the rest agreed that having the students in teams of four helped those students who did not read well. Karen said she really didn’t use the problems in the text because they were too difficult for her students. “What I do,” she continued, “is modify problems so they are getting the same content.” After observing her classes, I verified that this was the case (Karen, observation). Her students lacked the patience to read and follow the text. She did a great job of simplifying the problems in the text to fit the needs of her students.

Linda said there were no actual algebra problems in the book, which she was not use to. This was difficult for her because she was uncomfortable with math. I then explained how the book doesn’t really get into solving equations until year three, which brought up the question of technology. Linda said she thought calculators were a good tool, but wondered if the students got an understanding of the curriculum from using them. She is referred to the students working and developing linear equations with their calculator and viewing a graph or table in order to answer questions that use linear models. I tried to
explain to her that it is the understanding of the linear models, and how they work that is the objective of the text. This led into discussion of how the text used an inquiry-based approach to bring the students to conceptual understanding and application of concepts.

Karen said that a balanced approach was needed to obtain complete understanding. We all agreed. I said it is hard to deliver a balanced approach to the students when we were restricted to the text. Jen said she was afraid to use other materials because of all the talk of what happened last year. Last year the people who questioned the curriculum lost their teaching positions. I agreed with her and said I also was afraid to supplement because we were told it wasn’t necessary. No one acted surprised at this because everyone knew of the events of last year. There is a definite fear in the math department of losing your job if anything is questioned about the Core-Plus curriculum. The administrators rather than the math department faculty have pursued this whole program.

I brought in a problem from the text that I thought had flaws (Appendix D). I had each person read through the problem, just like I would have the students do. Karen and Linda both said the presentation of how to solve an equation would confuse the students. Linda asked if she was having trouble understanding the problems, how would the students. We also discussed the fact that the students would have to know how to combine like terms in order to solve some of the problems. Jen said it seemed that the text teaches some concepts out of order. I agreed with her. We decided that just a simple example of solving a two step equation would be the best way for the students and we could still use most of the questions from the text. Linda said she liked the revision because it was how she would have solved it. Karen said that you cannot give students
too many methods for solving a problem all at once, which was what the book did, because it confused them. After analysis of the problem the group made modifications that would allow students to gain a better understanding of the problem. The fear of standing up to leadership came out in the discussion within the math department.

This was a successful seminar. Reading difficulties, holes in the curriculum, and the existence of fear in the math department were key issues brought out in this seminar. Our ability to communicate as a group was evident when analyzing the problem I presented to the group. Great suggestions were made to make the problem easier for special education students as well as regular education students.

Seminar 2 (1/30/03)

This seminar was cut short because of student interruptions. Communication and how important it is in the coteaching relationship was a topic of discussion. I started by saying that communication I believe was the key to a successful coteaching relationship. Karen agreed saying that communication was needed to make any relationship work and it was of significant importance in teaching. Jen agreed and said that Karen and she communicated well. I said that communication should be focused around the needs of the students and of each teacher. I continued on by saying each teacher in the relationship brings a different expertise and experiences with them, and it’s important to use each person’s ability to the fullest extent. Linda agreed and said that that was the first time she had ever sat down and discussed anything like with a teacher who had her students in class. She continued to say that it was very helpful to know what others are feeling and thinking.
We then finished up by looking at a problem that Karen had brought in (Appendix G). She brought in a group of probability problems, similar to problems on the Math A exam, for us to discuss. She said her students were having a tough time figuring out what to do in each problem. Linda suggested that instead of looking at the problems all on one page that she present them one by one, meaning one problem per page. I said I thought that was a great suggestion. Jen thought it was a good idea because it would eliminate some confusion. I did not particularly like the problems because they really did not fit what I was trying to accomplish, which involves Core-Plus curriculum. However, it was good how we all communicated in order to improve the problems.

Seminar 3 (2/4/03)

This discussion was geared toward hearing what problems the others in the group thought hindered the coteaching relationship. The answers were not limited to the Core plus text or the classroom.

Planning time and IEPs were the first things that we discussed. Linda said that planning with a regular educator required the teacher to be planned. She was thinking of planning purely as a lesson planning time. I said planning time doesn't need to be just purely about the curriculum, it could include a going over an IEP or just clearing stuff up about a student. Linda asked about discussing the parts of the IEPs that we, the general educators, didn't know about, like the learning and writing strategies. Jen and I both agreed that we didn't know. This was to be expected since no one has ever sat down and gone through all the parts of an IEP with either of us. Jen said we need to get the IEPs sooner. Karen said we are not allowed to give you a copy. This I did not know. Linda
said this was the case because PHS was more interested in process rather than the needs of students. I understood what she was saying. Karen said no one tells me who’s classified in class or who I am supposed to be supporting. She continued and said that she got a list of her kids, but not a list of the other students who need support in the classes she was responsible to be in. She said we get all the information of this. I rarely receive any information on who needs support in each of my class, probably because we are not allowed to have a copy of a students IEP. I also did not realize the special educator was responsible for all the special education students in the classroom. I then suggested a meeting in the beginning of the year to discuss the students they would be supporting. Everyone agreed this would be a great idea. Karen said she was supposed to support two students in a math class when she had a class she teaches. This seemed to be a scheduling problem. It demonstrates another instance where the district seemingly doesn’t care about the students. Linda also had an example of a similar situation.

I asked the question what else hinders the coteaching relationship. Linda said that being able to sit down before school begins to talk about how you run class, how comfortable we are with curriculum, and talk about students we will share, would be helpful, but is not done. She said with the way the schedule was we never get the chance to. This is true there was no time planned into the school year to sit down and talk. She suggested inservice time. I agreed with her and said it would give us a chance to go over classroom procedures, behavior management plans, IEPs and set up planning periods. Karen said the bad part to developing a coteaching relationship was the fact that we may not work together next year. She says, it bugged her because it was not what was good for the kids, but rather what fits into the schedule. Linda said we don’t have any say. I
asked who pulled the strings. The answer was Mary Rapp. This interested to me because this woman has so much power and pulls the strings in our department too. Linda said there was no one for them to go to because they have no department chair to keep these coteaching pairs together. I said we needed continuity to develop the coteaching relationship to it’s fullest potential. We were already at a disadvantage because we were only in the classroom together one or two times a week. Linda said she felt like extra baggage in the classroom. She’d prefer to be in a classroom where she could contribute immediately.

This seminar brought out a lot of important facts that hinder the coteaching relationship at Penfield High School. A need for coteachers to meet before school begins is a must, as is common planning time. Continuity from year to year must occur in order for a coteaching relationship to reach it’s full potential. Leadership in the special education department needs to develop to allow the teachers to be heard. One person, in administration, should not have so much control and influence about what is best for a district. A lot was brought out in this seminar. All of the above issues are frustrating because the problems are out of our control.
Seminar 4 (2/6/03)

We discussed the importance of inquiry-based teaching and its position in the classroom. Everyone’s comfort level and knowledge of inquiry based teaching was present.

I started off by asking how they thought the seminars were going so far. Karen said she loved it, Jen said she loved them but wished other meetings were more productive. Linda liked them and enjoyed them in the morning because they allowed her to focus on the day. She said it was what a collegial circle should be.

I asked the group how familiar and comfortable they were with the inquiry-based approach to the book. Jen said she taught four traditional classes and then one Core-Plus class, and she felt more comfortable with the traditional classes and knew the students better. She said she wasn’t real comfortable with the inquiry-based approach yet. Karen said she liked parts of it, but was caught between the amount of calculator use she should implement in her class. This was because Karen had students who have to pass an RCT with no calculator. She asked if she should follow the Core-Plus the way she was supposed to or should she cut back and do what was necessary. Even Karen seems to have a little fear, and she wasn’t in the math department. We should do what we feel is good for the students. Jen said she doesn’t trust the curriculum to get the students to where they are supposed to be, even though the book says it will get the students to the level of understanding they need. I agreed and asked how are we supposed to not supplement and trust the book if the material the students’ need for the Math A exam was in book four. This was another source of trouble because we were using material developed for Michigan, not the needs of New York State. Jen said she was struggling...
with showing and telling the students to use the calculator every single day. She said that the students couldn’t tell her what they were actually doing, and they were becoming to dependant on it. She said they wouldn’t be able to do anything without it. If they didn’t have one in class, she continued, they would shut down and wouldn’t be willing to do any work. She said the students were not getting the math they were supposed to get because of the use of the calculator. I argued the fact that the goal of the book was to model real world mathematics, using the calculator to form the models that fit the context of a real world problem. I did agree to an extent about the calculator use but believed that there were misconceptions on why we were using them. I continued to say that the text wasn’t trying to teach all of the processes, like factoring etc, but to help them become good problem solvers. I also said that, because the Math A exam contains twenty questions that are skill and drill questions, we couldn’t use just the Core-Plus text to help our students pass the exam. Karen said she had noticed that the students using Core-Plus asked less frequently why they had to this than classes using traditional material. Jen said she would like to see context problems, then drill and skill, context, then drill and skill. I said that would be great but with only forty minutes a day and a time line to follow that was impossible. I also mentioned how the inquiry-based approach made the students more accountable for their learning, where with the traditional approach we were the center and accountable for what the students take from us. It takes a lot of stress off of us and puts it on the students. Linda said the students could see the purpose of learning the material. She said, that it was like a “math in our lives type of program.” She also said that students still need to understand the basics.
It is interesting how supplementing and the fear of doing it kept coming up in the seminars. Even Karen seemed hesitant. This seminar brought out views of each teacher regarding inquiry-based method, which is the primary method of the Core-Plus text. This opened up lines of communication between coteachers on the amount of experience and knowledge each partner had using the inquiry-based approach to teaching. Everyone had his or her own feelings, positive and negative, toward it. I believe this is due to a lack of understanding of the method. It is also taking people out of their comfort zone of traditional teaching. People fear change and look at it negatively. The calculator was another big issue. The question, when do we use the calculator, was asked. The coteachers have to work together on the calculator use. The special educator needs to know and understand how the calculator fits into the curriculum in order to help the students.

Seminar 5 (2/10/03)

This seminar looked at the importance or the unimportance of knowing the standards in state or national standards. I started out asking how familiar everyone was with the standards. No one was really familiar with them. I also found out that there were no special education standards because they are a support service. I asked if it was necessary to be familiar with the standards. Linda said it was not and if she needed to be familiar with the math standards she would have to be familiar with the standards of the other classes she supports. I said it probably was not necessary because the text supposedly meets the standards. We all agreed that standards for our needs were not
important. I brought up standards just to see where everyone stood, and to see if there were any issues with them.

I switched the discussion to supplementing. I said I was going to have to supplement many parts of the geometry unit because there were concepts that weren’t being taught like complementary and supplementary angles. Linda said the book really didn’t teach that. She continued to say that they were important concepts, and asked why were they being left out of the book. Jen said she thought the Core-Plus assumed they already have these basic concepts. Karen said did you receive the email about giving students Math A type questions as a warm up to prepare for the Math A exam. I said I was struggling with this because yesterday we were purely Core-Plus and not supplement and now we are told to supplement specific things. I also said we all knew what would happen if we didn’t listen, or questioned what we were being told to do. I continued to ask how were we supposed to know what we were allowed to do or what we are suppose to be doing. Jen said she did not know what would help the kids. Karen said she had a little more leeway because she taught special education kids exclusively. I said there were so many things it seemed that pull the coteaching relationship a part that even little things like not knowing what we were suppose to be doing on a daily basis affects us. Karen said she didn’t even know who to ask for supplementary material because of trust. She continued to say that she almost needed someone shoving material under her door so they were not caught.

Linda wanted to know what the regular educators' viewed as important pieces to the coteaching relationship. She said she knew the ideal situations would be to have a special educator with math experience, but what else. I said I would definitely want
someone who knew the content, but more than that someone I could communicate well with, have good chemistry with, and someone who I would be willing to offer suggestions on their students or on my teaching, anything. Linda said that the general educators correct all their papers and that she never saw their work. She said she would like to look at the work to see where they went wrong and where they needed work. She continued saying how a general educator has never came to her asking to go over one of her student’s work. I said I would bring some work to one of our, Linda and myself, planning meetings. This, I thought, was a fantastic idea. It was something that could bond the relationship further. Jen thought it was a good idea and said it could help her see things that she may have missed because of things such as student’s handwriting. I admitted that it was something I had not thought about. Jen needed to know more about what she could do to help the students sooner in order to benefit the students. She continued with how Karen has a lot of experience teaching four math classes and I want to know what else she can add to make our class better.

This seminar started with a discussion about standards. We decided they were not important to discuss in our relationship because the standards are being met by the text. Again, discussion of supplementing and the fear to do so came up. People don’t know which way to go with this issue. The math department is being pulled in many ways and it effects the coteaching relationship in and out of the classroom. Something has to be done about this issue. Linda asked what we wanted from a special educator. I did not expect this but it was a good question. Jen and I had similar responses. We wanted to know what we could do better or more to benefit a student or all students. Linda also
Co-teaching suggested looking at student work, which again surprised me, but was another good idea. It was something I had not yet thought of and something that proves to be very useful.

Seminar 6 (2/25/03)

I started wanting to know how we as general education teachers could help improve the special education process, especially by considering what was the best way to reach the students being supported. Linda said she presented a team approach to the building principal and he liked the idea, but the powers that be shelved it. I asked if a reason had been given. Linda said she had sent emails to district office, and had to hear through the grapevine that it wasn’t happening.

I asked what would be the best situation for the special educator, the students, and the general educator. Karen said she would like to have the same special educator handling just her kids. She said she felt like she didn’t know her kids that well this year because her kids were supported by different people depending on the class. I said let’s start at the beginning and asked what was going on right now in the department. Karen said she supported the students in her math classes, and a few others. I asked if she went into other classes with them. She said no, other teachers supported them in other classes, and that she was responsible for all their paperwork such as IEPs. Linda said she saw a group of kids she coordinated for and saw most of them once a day in guided study, and followed them, depending on the day, to other classes. I said that it seemed like they had different special education programs. They both agreed. Linda remarked that there was a third dimension in special education called self-contained. I asked if they thought the system worked as it was, and both, Linda and Karen, said no. Karen said it’s burning the
teachers out because of all the paperwork. Linda agreed and added that the program from the outside looks successful but all the teachers were dedicated and hard working and were burning out. This didn't make a successful program she added. I said the reason I asked was because I didn't know what went on, and it helped me see that sometimes it was impossible to meet, or hard for special educators to make it to my class. Jen asked why there wasn't an instructional support service where someone else took care of the IEPs and other paperwork. Linda said there were still teachers who didn't want special educators in the room. She continued that she used to have to go find teachers that would allow her to come into the classroom. I added that it should are, all teachers', responsibility to improve the learning in the classroom for all students. I continued that it was wrong for people to think otherwise. Linda said it had gotten better as turnover as occurred because the younger people have a different view.

We then looked at a problem from the Core-plus book that Jen had brought in (Appendix H). The lesson as from the beginning of trigonometry and dealt with linkage strips. Jen said that she thought the lesson was fun and could see different engineering concepts, but where was the math? I added that I had seen some to the lesson she is talking about presented by the head of our department, and the head of the department said she was having trouble pulling the math out of the activities in the Core0-Plus text. Jen continued, saying that the time it took to set up the linkage strips for the students was overwhelming and saw engineering in the use of the linkage strips, but where was the math. She thought we could get where the book wants us to be in a much simpler way. I said if that was not getting her where she wanted to go then to cut it or sections of it. I asked what was the objective of the lesson? She said she didn't know, but that they were
supposed to be getting toward trig. I said that I was kind of hesitant about the linkage strips. I continued and said I didn’t know if I would use the linkage strips activity if the goal was to teach triangle side ratios. The seminar ended with me asking Jen to bring in copies of what part of the unit she wanted to discuss.

This seminar was full of great stuff. It seems that the district is not very open to ideas presented by the staff. They do what the powers that be think is right. There is obvious frustration and tension in the special education department. This frustration and tension do effect the coteaching relationship. It puts an added stress on the relationship, and being a new developing relationship this added stress could bring it down. I also found out the actual job descriptions of Linda and Karen. The fact that they both feel burned out half way through the year is yet another issue that hinders the coteaching relationship. Another issue is the lack of cooperation by other general educators. It is the responsibility of all teachers to improve the learning situation for all students. I find it difficult now to see how a teacher would not accept having a special educator in the classroom. The problem Jen presented to the group again brought up the question of supplementing or not supplementing. If the math is not easily visible to any of us then it isn’t going to be to the students.

Seminar 7 (3/3/03)

I brought in Core-Plus Exam for analysis (Appendix F). I actually added questions to the exam that were aimed at questions on the Math A exam. The first thing Linda and Karen said was that there was a lot of reading and writing. I said I wanted to look at question number two. I read the problem to the group. The students were to
describe using \( y = c + dx \) if \( c \) and \( d \), if each line given on the graph were positive, negative or zero. I said that the students had trouble with the \( c \) and \( d \) part of the questions because they had never seen rate of change or \( y \) intercept presented this way. Linda suggested we change the problem by putting in slope and \( y \) intercept instead of \( y = c + dx \). I added that in addition the book uses \( y = a + bx \). Jen said that students always think that \( a \) is the intercept and \( b \) is the slope, and can't make the transition when other variables are used. I asked if anyone had any suggestions to make it better. Karen said using different colors to identify which line is \( L_1 \), \( L_2 \), and \( L_3 \). Linda suggested just changing the \( y = c + dx \) to \( y = a + bx \). I said you could change it, but even the calculator uses different notation for an equation of a line, and some books use \( mx + b \). Linda said leave it there but tell them it is the same as \( a + bx \). Karen said separate the graphs to eliminate the clutter and put numbers on the \( x \) and \( y \)-axis. Linda asked if the students had been given an example of a specific line. I said some did and it was clear that they didn't understand the question or that they were confused by the graphs. Linda asked if I used any of this information before the test. I said I did not use anything different. She said I should use something different like \( y = a + bx \) during my teaching. I said I had used \( y = mx + b \) before. Linda said students have trouble if they only see things one way, like the \( y = a + bx \).

I then asked them to look at question three. I said I thought it gave them too much information in the chart. I added that I didn't grade part \( c \) because very few got it right. I said I thought the reason for this was that they didn't read the problem carefully enough and assumed what the problem asked for. The students had found an equation for stories versus feet, instead of feet versus meters. The question before asked for stories versus meters. I felt this was where the students went wrong. I said many could plot the scatter-
plot, but couldn’t find the equation. Linda said she thought it was a reading problem, and that the students don’t read carefully enough. Karen suggested using a highlighter to highlight height in meters and height in feet, just what the problem wants. Linda said it was a great idea, but it was extra work that they wouldn’t want to do. She said they wanted to be like everyone else, but they’ve not. She added that it was a constant struggle because they had started to become minimalists. Linda says it forces them to read the problem and think about what was important. Karen suggested covering up parts of the table that were being talked about or just eliminating unnecessary information like the city or even the building part of the table.

I enjoy working with this group of people. It is improving our relationship. Everyone has great ideas and isn’t afraid to share them. Going over the exam brought out things about what I could do in my teaching to better prepare the students for the exam. It also alludes to the fact that the book is by no means perfect for all students. Hearing Linda and Karen talk about what the students might struggle with is what should take place in a coteaching relationship. The reading strategies, like the use of a highlighter, are something I would never have thought to do. The challenge is to get the students to use the strategies. Maybe having all students use them would eliminate any feelings of being different than the others if this occurred.
Seminar 8 (3/7/03)

During this seminar we returned to a problem Jen presented to the group in the sixth seminar (Appendix H). The problem was for a Math A/B Core-Plus class beginning to study trigonometry.

Jen started by saying the students would be looking at a triangle, using the linkage strips, with a variable base. The students were to change the length of the base, by move the other sides and measure the angles and the perpendicular distance. I asked what perpendicular distance was. Karen responded with the altitude. Linda said why didn’t they just call it the altitude. One issue Jen had was that the problem got so close to some concepts like the triangle side length theorem, but never said anything about it. I said it looked like we had vocabulary issues such as perpendicular distance, and variable side. Jen said that another problem with the linkage strips was that the students started using them the wrong way, like side AB was placed on the right instead of the left. She said that this caused the students to get false results, and they didn’t realize it. She said this created more work for her. Karen suggested to do the problem on the board as a class activity. I again asked about the goal of the lesson. She said it was to see the relationships between the altitude and the angles. They also saw that as the angle gets bigger the opposite side gets bigger. Karen said she simplified the lesson by just looking at the angles first. I asked how the students with special needs doing with it. Karen responded either they were doing nothing, or asking her for help constantly or letting their partners do all the work. I asked what we could do about this. I suggested labeling the linkage strips with sticky dots to keep the students from switching AB and CB. I asked Linda what suggestions she had. I acknowledged the fact that she had not said
much and I know she felt uncomfortable. Linda said she would be one of those kids who was always asking questions because she was unfamiliar with the math. Karen said she thought they were asking the students to look at too many relationships at once. I suggested splitting up the class up and having one side measure the angles as AC changes and have the others find the perpendicular distance combining the data at the end. Everyone liked the idea. Karen and Linda said it simplified the lesson for the class. I also said that the goal wasn't for the students to be able to measure the angles and perpendicular distance using the linkage strips, so how they get the information is not that important to the lesson. Karen also pointed out that part of the activity is asking more than one question, which was very hard to comprehend. We all agreed that it should be rewritten.

During this seminar I found myself being able to give suggestions that usually Linda or Karen would give. Again we as a group worked well together and were able to make the problem better. One thing that bothers me is the complexity of some of the activities and the fact that the students don't know where the book is taking them. We as a group are identifying various problems the book has like vocabulary inconstancies, and the inability to spell out what it actually wants from the students.

Seminar 9 (3/10/03)

Again Jen brought in another problem from Core-Plus book 2A (Appendix J). Activity 3 was where our discussion started. Jen said the activity wanted the students to multiply a linear equation by a constant and graph the original and the new equations. However, she continued, the equations were not in y = form, so the students would not
know how to enter them into their calculator. I agreed that this was an issue because the students’ algebraic skills at this point weren’t strong enough to solve for y correctly. She thought the work that the book went through in order to get a simple concept could be done in a less time consuming way. The goal of the lesson was to introduce linear combinations. Karen points out that instead of using system of equation the book uses family of equations. Jen said she skipped over many of the activities because it took too long to get there. I asked how long it would have taken to complete the investigation. She said three days. She also said the students don’t have the algebraic manipulation skills to complete much of the lesson. I said if the goal was to solve a system of equations, then this lesson might not be necessary because they already have had at least two methods of doing this. Karen said if you showed her kids too many methods that they found it hard knowing which one to use and which one worked. Jen thought the lesson was out of place because of the lack of algebraic manipulation that had been seen thus far. We all agreed. Karen asked where they learned the algebra. Jen said course three. I said they did some manipulation in book one but it was only four questions, which we all know isn’t enough. I said the lesson was not a good transition from what was presented before it.

We got away from the problem a bit and started talking about the calculator. Karen expressed how she was frustrated when she graphs two lines that were perpendicular and they didn’t look like they were. I said I could see how this was a problem because the students may have thought they were wrong because the calculator wasn’t perfect. Jen said she wished the students understood how to use the window
setting in the calculator better. I said we started using the window feature in the first week of book one.

I think the seminar went well for three out of the four of us. Linda did not add much to this seminar and I did not come out and ask her opinion. She has shown how uncomfortable she is with mathematics. This problem really wasn’t one that needs to be fixed or tweaked in anyway. It needed to be placed in a different lesson of the book. Linda, not knowing much about the concepts or topics, would not have much to add. Maybe this seminar was unfair to her. The book introduces systems of equations for the fourth time in the lesson Jen presented. Systems of equations are present twice in course one. They graph the lines and find where they intersect or use substitution to find the solution. In course two they use matrices to solve systems. This lesson is misplaced in my opinion and should be presented when the students have a better understanding of algebra.

Seminar 10 (3/13/03)

I brought in another Core-Plus problem for discussion for the last seminar (Appendix I). It was an investigation of compound growth. I had each person read the problem. We all agreed that the introduction was great and would hook the students immediately. I mentioned that the students looked at exponential functions at the ninth grade level even though they weren’t part of the Math A exam or curriculum. As to why, I said I didn’t know. I said before question number one the investigation showed examples of how to compound interest for the first two years, then immediately asked them to write an equation to calculate the balance of the deposited money for any year.
Jen said it didn’t show you that over time it would be greater than taking the lump sum. I added the book usually asked for next and now equations and then to find the rule that represents the context of the problem, and the book didn’t do in this investigation. I asked Karen how she thought a special education student would react to this problem. Karen replied they would be totally lost. Both Jen and Karen said question one should be on the same page as the introduction instead of on the back. I agreed with this. Jen said the students needed to see the continuation. Linda added that the terminology needs to stay consistent. I asked if the two examples that were given would allow the students to develop a rule. I added that factoring was also present. I suggested separating the kids into two groups: the kids who understood the two examples and those who didn’t. Jen said she thought the students should go through the problem and find years three and four. I suggested looking at a scatter-plot of at least five points to see if it looked linear or exponential. I said they could then use the exponential regression function to test their conclusion. The group liked this idea.

We did not have time to talk as a group to what everyone thought of the seminars. Again Linda was in the background of the discussion. This really bothered me because I felt like Jen and I were coming up with the majority of the ideas. Karen added positive points but not anything substantial. I think the math concepts are too difficult for Linda to discuss and she does not really know where to add or how to add to the discussion. The suggestions that we discussed I think will be helpful. I also think that through these seminars I became better at breaking down a problem so students hopefully will be able to succeed with them.
Reflections

Linda

In Linda’s reflection she talks about herself as being “the odd man out (Linda, journal entry).” As the seminars progress she proved this to be true because she was hesitant or unable to contribute in the last two seminars. She also mentions the fear the math department has. This I think concerned her because she uses all teacher made materials. She also mentions how she has not gone to any more Core-Plus training sessions. This tells me that she really is uncomfortable with the curriculum and fears it.

She says that the key to a coteaching relationship is time. She continues saying it is hard to get this time if the district terminates the relationship the following year (Linda, journal entry). I believe that if the district were better at keeping the coteaching teachers together her fears would lessen.

Linda also reflects on how she feels guilty that she has not sat down with me to plan. She says she has in other classes, but not mine. Again this comes down to her fear of the curriculum. She compares her behavior to that of her students (Linda, journal entry). She does notice she is avoiding math just like her students would do. She reflects on how our individual meetings have helped her, and she wonders why we never did this sooner (Linda, journal entry). At this point I feel she is beginning to feel more comfortable working with me and isn’t afraid to show her lack of knowledge of the subject. She reflects how going over an IEP was the first time she had ever done this with a general educator (Linda, journal entry). She, as I do, thinks it is necessary that we know our students as best as possible.
In her last reflection she says she doesn’t feel any more confident in assisting in the classroom, but much more comfortable around her cooperating (Linda, journal entry). This is great. It was one of the goals of the seminars. This tells me that our relationship has gotten stronger over the ten seminars.

Karen

Karen’s reflections on the seminars were simple and highlighted a lot of what was talked about in the seminars. She does feel coteachers need planning time before presenting a lesson, instead of the fly-by-the-seat-of-your-pants approach (Karen, journal entry). She also mentions issues regarding behavior management in her classes. I thought when I observed her that she handled all of the students very well. She has a very calm demeanor during her teaching and a soothing voice that the students respond well too.

She did find it reassuring after Jen presented a problem in seminar eight that regular education students struggled as much as her kids did. It must be hard for her to only teach LD and ED students. I think the seminars have put her at ease about whether or not she is doing the right things in her class.

The most interesting thing she reflected on came out in her last reflection (Karen, journal entry). She talked about how she felt comfortable discussing school and the math curriculum without fear of reprisal of any kind. This goes back to the fear factor. It’s not just the math teachers that fear losing their jobs, but also some special educators. This is a scary situation at a school having so many people fear for their jobs.
Jen

Jen, as well as Karen, believes that as she and Karen begin to spend more time planning together on a regular basis they will have a much more productive classroom. As I observed her I noticed a need for better planning (Jen, observation). The lesson was all of the place and the students experienced too much down time. I think that the lesson I saw was not prepared with Karen in mind. This I can understand, because she is a first year teacher who has much to learn as do the rest of us.

*Weekly Meetings* (with Linda, every Monday during 9th period)

First Meeting: We discussed plans for the next two weeks. She decided it would be best for her and her students to look ahead and ask me questions before the lessons were actually taught. We looked at different functions on the Ti-83 graphing calculator. We cleared the memory, entered data into a list, looked at a scatter plot of the data, and found a best-fit line. She was going to have to practice to become more efficient with the calculator.

Second meeting: Today we looked at graded work for the students she supports. We also talked about how the students view what I do versus what other teachers do. It became clear to her how when using the Core-Plus curriculum math teachers do not have the option of supplementing. This brought us to discussing how our potential, as teacher, is limited.
Third Meeting: Today we looked at one of our student’s IEP. This brought about discussion of the fact that she can meet either directly in the classroom with me or indirectly outside the classroom with me. These meetings only have to be done twice a week.

Fourth Meeting: We again looked at calculator use and wrote up a list on what functions the students should be able to do (David, journal entry). The list was for her use as well as her students.

Results

Planning time

The need for weekly common planning, once or twice a week, was expressed in both the seminars and journal entries. In the beginning Linda, Karen, and Jen thought of planning time as an opportunity to collaborate on lessons for class. As the seminars progressed, however, they began to see that it was an opportunity for much more than just planning. Having common planning time could involve going over a student’s IEP. This would be beneficial especially to the general educator. It is another way to get to know the students, not only about his or her learning disabilities, but also strategies on how to cope with the disability. Personal information is also contained on the IEPs and is valuable when talking to a student on a one to one level. They know you care if you can talk to them about something of importance to them. Planning time is also a time to set up classroom procedures and rules. This obviously should be done in the beginning. We also discussed the need to know who we will be working with before the year starts and
who the students are that we will be working with. Being prepared to manage the needs of all the students in the class from day one is the goal. Behavior and modification problems could be handled proactively if we were able to start working together in the beginning of a school year. I proposed an in-service day, which would take place before school opened to students in the summer, so that coteaching teams could get to know each other and discuss classroom procedures, the students, the level of content knowledge each person has, and technology issues. This I believe is necessary in order to establish a comfortable coteaching relationship.

Politics

The seminars brought out much frustration with what the administration is doing to the math and special education programs. This is such a big issue because what the administration does affects our attitude, our potential, student learning, and student success. It's hard enough to develop a good coteaching relationship, but harder with the stresses that the administration put on us.

The seminars brought out issues that math and special education are forced to deal with every day. These issues all stem from administrative decisions. Karen and Linda both talked about the fact that they don't have a department head. They feel it doesn't allow them to voice any concern for what is going on in the department or where the department is going. Linda mentioned that she had proposed a teaming program to the administration and never heard anything about implementation. She even went as far as to find people who were interested in working with her on the program and still nothing was done. The administration puts the special educators and the students in the special
education program wherever they fit into the schedule. Both Karen and Linda feel their positions are based on where they fit into the schedule. Given this fact, continuity in a coteaching relationship is short lived. One year is not enough time for a coteaching team to develop the relationship to its fullest potential.

In the mathematics department, Jen and I informed the group on how the district mandated the Core-Plus curriculum to be used in grades nine through twelve. There is no other option. Math teachers are told that they should not have to use any other resource to meet the students’ need. Few people have expressed their concerns for the curriculum in regards to what the students need because of fear of losing their job. The math teachers, in my opinion, should be the ones who decide what is best for the students’ learning not the administrators. Another reason we are restricted to this curriculum now is that the district has spent money on books and all the supplies that are needs when using Core-Plus.

The seminars brought out issues that special educators would not know about the math department or math educators would know about the special education department. Like it or not, what is done behind the scene in each department affects how we do our job and how we as a coteaching team work together. Once the group knows each departments’ situation, a plan of attack can be talked about on how to improve departmental situations, which in return will have a positive effect on the coteaching relationship in the long run.
Calculator Usage

Questions of when, how and why the calculator is so important in a Core-Plus classroom were brought out and discussed in the seminars. Karen, teaching an all special education class using Core-Plus, questions when to use it. Her question is a valid one because her students take an RCT at the end of the year where they are not allowed to use a calculator. The Core-Plus curriculum requires daily use of the calculator. The only suggestions that were given were to use the calculator when necessary, but always try problems with out it first. Linda was caught up on why the students had to know how to use the calculator. Jen and I tried to explain that it is a huge part of the curriculum, which she has witnessed, and the students can use it on the Math A exam. Linda is used to seeing math done simply by hand and with the help of a four-function calculator. She asked these questions because she has not adapted to the state changes yet.

The need that both teachers in the coteaching relationship be able to use a graphing calculator was not one that was directly discussed, but is an important issue. I think since it is used every day that it is part of the curriculum and content. The special educator has to be fluent enough with the calculator to help all students in class.

Fear

Fear is never directly stated in the seminars or the journal entries, but is alluded to throughout both. What I mean by fear is the fear of losing ones' job or being reprimanded for doing something different than told. A situation occurred last year that affects the math teachers and special educators of the current year. The fear is that if a person speaks out against the curriculum or questions the curriculum they will be
reprimanded or asked to resign. Because the math department has so many untenured teachers, this fear is prevalent. Even Karen expressed fear in her journal entries when talking about having to modify the curriculum for her students.

The existence of this reality affects the coteaching relationship immensely. The potential for what can be done for students in the classroom and out, as far as modifications and assessments, is limited. This limits the math we can teach and the strategies we can use in order to bring understanding to our students.

Content Knowledge

Jen and I expressed our needs for a special educator with basic content knowledge to be in a coteaching relationship. In addition, a special educator having knowledge of math helps the students in and out of class, and the coteaching relationship. Being able to help students in and out of class puts the coteachers in equal roles. If a special educator has content knowledge he or she is also more able to offer suggestions on modifications of curriculum and assessments.

Linda expressed being uncomfortable with the math content. She reflects in her journal on how she is not good with math and how she develops material for every other class but math. I also observed during the seminar that during discussions on how to modify Core-Plus problems that her thoughts were either limited or non-existent. This is understandable since she is uncomfortable with the subject. She did, however, during one of our one-on-one meetings show me material she made up for her students to use (Appendix L), and also offered to help with review games. In her last reflection she said that she was still uncomfortable with the curriculum, but much more comfortable with
me. I think that this feeling of comfort will lead Linda to a better understanding of the content and ultimately lead her students to the same place.

Core-Plus

The Core-Plus curriculum is another topic of discussion. It is a big issue because in order for a coteaching relationship to work everyone needs to be on board with the curriculum being used. I believe the main problem with the curriculum is that it is not based on the NYS standards. This curriculum was not developed to help students pass the Math A exam, which most students will take in their sophomore year. If it were, all topics in book one of Core-Plus would be topics that meet the Math A core standards. It doesn’t though. Topics like exponential models are studied extensively in book one and are not part of the Math core standards. This is just one piece of evidence that shows how Core-Plus is not a curriculum meant to meet the needs of the students in NYS.

Other issues are with the consistency of vocabulary in the book. For example when the book addresses altitude of a triangle it presents it as the perpendicular length. It does this type of thing throughout the curriculum. Students need to understand so much vocabulary already that it confuses students if the curriculum gives more than one word the same meaning.

The purely inquiry-based approach of the curriculum was another issue that was addressed in the seminars and journal entries. Jen felt that she did not get to know the students as well with the inquiry-based approach. She said she did not feel like she was doing anything or helping the students in any way. Karen and Linda both expressed the need for a more balanced approach. They want the class to be teacher centered and student centered when needed. I agree there is a need for a more balanced approach. Not
all students learn best through pure inquiry, and not all learn best through just lecture based teaching. A successful program, I believe, needs to incorporate both, as well as other methods. Some of the negative feelings in the group about inquiry-based learning come from a lack of knowledge, and a lack of knowledge of the goals of the curriculum. For example, the need to teach algebraic skills before the students junior year, which is where algebraic manipulation is concentrated in Core-Plus, was voiced as a concern. While I agree it is a valid concern, the goal of the book is not to teach the students how to solve equations, but to model real world data with a linear relationship. A lack of knowledge on inquiry-based learning and the goal of the curriculum is something that needs to be talked about in order for a coteaching pair to be on the same level, and so the questioning of why certain topics aren’t studied until later years are not an issue.

The amount of reading and reading level was discussed. When students are in groups reading out of the Core-Plus book it is not a big deal because the students are able to listen and follow along while someone reads aloud. It does become a problem when students work on their own or on assessments. In the seminars we discussed various reading strategies and modification to problems that can help overcome reading barriers. Highlighting, reorganizing the material, and rephrasing questions were discussed in length about specific problems. This is what is supposed to happen in a coteaching relationship; everyone pooling their knowledge to benefit the students.
Summary

During the ten seminars a plethora of information was collected. After careful analysis, I have determined that a cohesive coteaching relationship has to start with communication on a professional level. If communication is to exist, planning time, with each other, needs to be present in each coteacher’s weekly schedule. A coteacher collaboration day needs to be held at the beginning of the school year if not before it begins. This will give the coteachers the opportunity to get to know each other, discuss class rules, behavior management, the students they share, the curriculum and teaching methodology. These are all procedures and knowledge that should be in place before the students arrive to class on the first day of school. Another huge piece of information that affects the relationship is the politics that occur within a building. In our situation the politics in the building play a huge role in the decisions that are made from year to year. Administrators that understand the need and purpose of a quality coteaching relationship are needed in order to be successful. From the information collected, this does not exist in the administration.

Fear is another issue that came from the communication in the seminars. Fears of losing ones job to fear of curriculum exist in everyone who participated. Knowing these fears up front will give coteachers the ability to be able to reflect on the situation, and permits an understanding of where each coteacher is coming from. Through communication and time these fears can be minimized, and hopefully non-existent. Calculator usage is another fear, as far as when to use it, how to use it, and the ability to use it. Knowing this up front can only benefit the students because coteachers can decide together when and how, while learning together how the calculators work. Content
knowledge was a fear for Linda. Just knowing that she fears the content made me aware of how far in depth she and I would have to go when planning for a topic or discussing a topic in our one-on-ones. While knowing the content is important, being comfortable with your coteacher is more important because comfort will lead to a stronger understanding of the content.

Curriculum is the last issue that was discussed. The ten seminars involved strictly Core-Plus based curriculum topics. As the seminars progressed, the difficulties with the curriculum quickly surfaced. For example the difficulty level of the reading and questioning in the book was a topic of concern regarding Core-Plus. As a group we were able to come up with strategies and suggestions that could help our students with the reading difficulties. The modifications made come from both special educators' perspectives and general educators' perspectives, making it as good as it can get.

In conclusion, the key factor to a successful coteaching relationship is communication. It has to exist before the beginning of the school year and continue weekly if not twice a week through out the year. Realizing that it is not just the students that effect teachers and coteaching teams, but also outside factors like, politics and fear, that hold teachers back from building and keeping a quality coteaching relationship.
Recommendation

My research has helped me develop a group professional development workshops on effective coteaching in inquiry-based classrooms, but not limited just to inquiry-based classrooms. The participants will be special educators and general educators who will be coteaching together throughout the year, and a facilitator. The workshop will begin either during the summer or before or after school during the first week of school. This has to happen in order for the coteachers to be effective immediately. The workshop would have to meet at least once every ten weeks to check on progress in the coteaching relationship, to discuss what is going well and what can be done differently. The coteacher will be encouraged to keep weekly journals. This will act as a way to check on the progress of the coteachers.

Components of coteaching will be introduced and discussed as part of the introduction into the seminar. The participants need to see why each component is important to successful coteaching. Many of the coteaching teams will start at the beginning stages of coteaching, while others may be at a different level depending on whether or not they have worked together. Those who have cotaught with each other would fill out the coteaching rating scale. The coteachers will then discuss their responses to each question on the coteaching rating scale. Many issues will arise from the communication that takes place during this time. Things like classroom expectations, rules, classroom management, curriculum goals, and assessments and IEPs would be discussed. These are the issues the teachers who have not cotaught together will discuss. This conversion will come straight from the coteaching rating scale and will be done while the other coteachers fill out the coteaching rating scale. The discussions that will
occur give both coteachers ownership in the classroom from the very start of the year. It should also bring comfort to both teachers being the start of a new year and also being unfamiliar with each other. Open and honest communication has to be stressed. This will be difficult at first especially since some the coteaching teams won’t know each other that well.

The facilitator then presents a problem or activity, from their respective curriculum, to each coteaching team. Each coteacher will then use each other’s expertise, and make suggestions on how to modify the problems. An emphasis will be put on putting themselves in the position of special education students. This will be the first step in the communication process, which is key component to the other components.

The coteachers should schedule planning time once or twice a week. In an ideal situation it should be scheduled into the teachers schedule by the district. During this time communication should occur on what is going well in the class, what can be done better, students in the class, upcoming topics and modification of material. The conversations that take place during planning time should not be limited, but focused on the class and students being cotaught. The facilitator will sit in on one or two planning periods during each ten week period.

The seminars that take place every ten weeks will focus on issues that are hindering or improving the coteaching relationship depending on the coteaching team. Issues that are hindering the relationship will be analyzed and discussed to find ways to overcome or improve upon the issue. The issues for strategies that coteachers are using to improve their relationship will be discussed as to why they are improving the relationship. This is a great opportunity for coteachers to either vent frustration or share
quality ideas. It is not the time for personal issues between coteachers to be shared. This type of situation will be referred to the facilitator. The facilitator hopefully will be able to help the team develop strategies that can get the team back to being a more effective coteaching team. This is also the time keeping a journal could be of great use. The journal would highlight specific instances of concern to the writer of the journal.

The final seminar will be an opportunity to reflect on the year. Things that went well and that did not go well will be brought out. Likes and dislikes will be shared about the seminars as well as what can be done better next year. The information taken from this final seminar will help the facilitator improve the seminars the following year.
Reference


Appendix A

Eight Components of Coteaching

1. Interpersonal Communication

1st Stage (beginning stage)

Communication is uncomfortable, and the teachers seek to interpret both verbal and nonverbal messages. Sometimes very little communication exists.

2nd Stage (compromising stage)

Teachers become more effective communicators. Communication more open and more frequent. Ideas are beginning to be exchanged.

3rd Stage (collaborate stage)

Modeling of effective communication to students exists. Teachers understand and are able to interpret verbal and nonverbal messages.

2. Physical Arrangement

1st Stage

Special Ed. Teacher sits in back of room or takes his or her kids and works solely with them. “Classroom within a classroom.”

2nd Stage

Materials and more of the room are being shared. Sp. Ed. Teacher beginning to feel freer in the surrounding space. Rarely in front of class.

3rd Stage

All students in cooperative groups. Teachers aware of where the other is and of what they are doing. Very “fluid” movement in the classroom.
3. **Familiarity with the curriculum**

   1\textsuperscript{st} Stage

   Unfamiliar with the content and methods

   2\textsuperscript{nd} Stage


   3\textsuperscript{rd} Stage

   Confidence in both teachers grows. More willing to hand over class to Sp. Ed. Teacher.

4. **Curriculum Goals and modifications**

   1\textsuperscript{st} Stage

   Texts and standards drive curriculum goals and modifications. Modifications to curriculum and accommodations for the learners is given only to students with IEPs or 504 plans.

   2\textsuperscript{nd} Stage

   Classroom teacher views modifications as “watering down” curriculum.
   Differentiating of concepts for all students begins.

   3\textsuperscript{rd} Stage

   Differentiating becomes the norm.

5. **Instructional Planning**

   1\textsuperscript{st} Stage

   Sp. Ed teacher acts as assistant in class as classroom teacher instructs the group. Sp. Ed. teacher circulates room to make sure students are on task and behaving.

   2\textsuperscript{nd} Stage
More give and take. Planning starting to be shared. Very little outside planning takes place.

3rd stage

Mutual planning takes place outside and inside classroom. Teachers are modifying lesson during class if on to going well. Goal is to meet the needs of the students.

6. Instructional Presentation

1st stage

Present separate lessons. Sp. Ed teacher to her students (IEP students). Classroom teacher to the remaining students. Or the presentation is by the classroom teacher, and the Sp. Ed teacher is again a helper.

2nd stage


3rd stage

Both teachers all aspects of presenting.

7. Classroom Management

1st stage

Sp. Ed. Teacher manages behavior while classroom teacher instructs. Or the classroom teacher takes on the role of presenter and classroom manager.

2nd stage

Teachers are communicating, and development of roles and routines in the classroom.

3rd stage

Both teachers establish rules, routine, and expectations. Individualized behavior management plans, and other activities to develop a comfortable community are developed collaboratively by both teachers.
8. Assessment

1st stage

There could be two systems of grading. One system of grading is solely the classroom teachers system. The other is to have two, each teacher having their own. Assessments examine solely the student’s knowledge of content.

2nd stage

Alternative assessments explored. More performance measures used to check the student’s progress.

3rd stage

Both teachers know that a variety of assessment tools are necessary. Students IEPs are taken into consideration when assessment necessary.

Source:

Appendix B

Coteaching Rating Scale (general education form)

<table>
<thead>
<tr>
<th>Question</th>
<th>1: Rarely</th>
<th>2: Sometimes</th>
<th>3: Usually</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I can easily read the nonverbal cues of my coteaching partner.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2. Both teachers move freely about the space in the cotaught classroom.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. My coteacher understands the curriculum standards with respect to the</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>content area in the cotaught classroom.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Both teachers in the cotaught classroom agree on the goals of the</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>cotaught classroom.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Planning can be spontaneous, with changes occurring during the</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>instructional lesson.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>6. My coteaching partner often presents lessons in the cotaught class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Classroom rules and routines have been jointly developed.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Many measures are used for grading students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Humor is often used in the classroom.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. All materials are shared in the classroom.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11. The special educator is familiar with the methods and materials</td>
<td>1</td>
<td>2</td>
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</tr>
<tr>
<td>with respect to this content area.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Modifications of goals for students with special needs are</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>fully incorporated into this class.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Planning for classes is the shared responsibility of both teachers.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14. The “chalk” passes freely between the two teachers.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15. A variety of classroom management techniques is used to enhance</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>learning of all students.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Test modifications are commonplace.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17. Communication is open and honest.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18. There is fluid positioning of teachers in the classroom.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>19. I am confident of the special educator’s knowledge of the</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>curriculum content.</td>
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<tr>
<td>20. Student-centered objectives are incorporated into the classroom</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>curriculum.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Time is allotted (or found) for common planning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>22. Students accept both teachers as equal partners in the learning</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>process.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. Behavior management is the shared responsibility of both teachers.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>24. Goals and objectives in IEPs are considered as part of the grading</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>for students with special needs.</td>
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</tbody>
</table>
Appendix C

Coteaching Rating Scale (special education form)

**Figure 3. The Coteaching Rating Scale**

### Special Education Teacher Format

Respond to each question below by circling the number that best describes your viewpoint:

<table>
<thead>
<tr>
<th></th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Usually</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I can easily read the nonverbal cues of my coteaching partner.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>I feel comfortable moving freely about the space in the cotaught classroom.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>I understand the curriculum standards with respect to the content area in the cotaught classroom.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Both teachers in the cotaught classroom agree on the goals of the cotaught classroom.</td>
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<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Planning can be spontaneous, with changes occurring during the instructional lesson.</td>
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<td>I am familiar with the methods and materials with respect to this content area.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>Modifications of goals for students with special needs are incorporated into this class.</td>
<td>1</td>
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<td>Planning for classes is the shared responsibility of both teachers.</td>
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<td>21</td>
<td>Time is allotted (or found) for common planning.</td>
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<td>22</td>
<td>Students accept both teachers as equal partners in the learning process.</td>
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</table>
Appendix D
Solving Equations

INVESTIGATION Quick Solutions

Linear models are common. They are easy to find with or without a calculator or computer. They are also easy to use. In fact, it is often possible to solve problems that involve linear equations without the use of tables or graphs. For example, to solve $3x + 12 = 45$ you might reason like one of these students:

Natasha

I need a value of $x$ making $3x + 12 = 45$, so the left and right sides are balanced.
If I subtract 12 from both sides, the sides will remain balanced.
So $3x = 33$.
If I divide both sides by 3, the sides will remain balanced.
So $x = 11$.

Dejuan

To get 45 I first multiply $x$ by 3 and then add 12.
To find out what $x$ really is, I have to undo those operations.
That means starting with 45, I can subtract 12 and then divide by 3 to get:
$$x = \frac{45 - 12}{3} = \frac{33}{3} = 11$$

1. In your group, try to figure out both students' reasoning.
   a. Natasha and Dejuan both found that $x = 11$. How can you be sure the answer is correct?
   b. Analyze Natasha's thinking.
      - Why did she subtract 12 from both sides? Why didn't she add 12 to both sides? What if she subtracted 10 from both sides?
      - Why did she divide both sides by 3?
   c. Analyze Dejuan's thinking.
      - What did he mean by undoing the operations?
      - Why did he subtract 12 and then divide by 3? Why not divide by 3 and then subtract 12?
Appendix E

Journal Prompts

JOURNAL PROMPTS

How did coteaching benefit the students? Or How could coteaching benefit the students in today's lesson?

What went well? What did not?

Anything out of the ordinary happen in the lesson?

How were behavior issues handled?

What were the roles of the coteachers today?

Any issues you think we should address in seminar?

Anything else...
Appendix F

In Class Core-Plus Exam

In-Class Exam

2. The following table gives heights of eight tall buildings in the United States in stories, in feet, and in meters.

<table>
<thead>
<tr>
<th>City</th>
<th>Building</th>
<th>Stories</th>
<th>ft</th>
<th>m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicago</td>
<td>Sears Tower</td>
<td>110</td>
<td>1,454</td>
<td>443</td>
</tr>
<tr>
<td>New York</td>
<td>World Trade Center</td>
<td>110</td>
<td>1,377</td>
<td>419</td>
</tr>
<tr>
<td>New York</td>
<td>Empire State</td>
<td>102</td>
<td>1,250</td>
<td>381</td>
</tr>
<tr>
<td>Chicago</td>
<td>AMOCO</td>
<td>80</td>
<td>1,136</td>
<td>346</td>
</tr>
<tr>
<td>Chicago</td>
<td>John Hancock Center</td>
<td>100</td>
<td>1,127</td>
<td>343</td>
</tr>
<tr>
<td>New York</td>
<td>Chrysler</td>
<td>77</td>
<td>1,046</td>
<td>319</td>
</tr>
<tr>
<td>Atlanta</td>
<td>Nations Plaza</td>
<td>55</td>
<td>1,025</td>
<td>312</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>First Interstate World Center</td>
<td>73</td>
<td>1,017</td>
<td>310</td>
</tr>
</tbody>
</table>


a. Make two scatterplots, one of (number of stories, height in meters) and the other of (height in feet, height in meters).
1. Three lines $l_1$, $l_2$, and $l_3$ are graphed below. As you learned in this unit, each line has an equation of the form $y = c + dx$.

![Graph of three lines](image)

a. Describe $c$ and $d$ for each of the three lines as completely as you can from the information given in the graph. For example, indicate which values are positive, negative, or zero, and why you think so.

Description for line $l_1$:

Description for line $l_2$:

Description for line $l_3$:

b. Are the values of $c$ equal in the equations of any two of the three lines $l_1$, $l_2$, and $l_3$? Are the values of $d$ equal? Explain your answer.

Values of $c$: Yes ___ No ___

Values of $d$: Yes ___ No ___

Explanation: ___
Appendix G

Karen’s Problem

Multiple Choice

A bag of marbles contains two green, one blue, and three red marbles. If two marbles are chosen at random without replacement, what is the probability that both will be red?

1) \( \frac{1}{5} \)  
2) \( \frac{1}{6} \)  
3) \( \frac{1}{10} \)  
4) \( \frac{1}{12} \)

If one playing card is selected at random from a standard deck of 52 cards, what is the probability of choosing a black card or a king?

1) \( \frac{30}{52} \)  
2) \( \frac{22}{52} \)  
3) \( \frac{28}{52} \)  
4) \( \frac{4}{52} \)

A pencil holder contains six blue pencils and three red pencils. If two pencils are picked at random and without replacement, what is the probability that both are blue?

1) \( \frac{2}{9} \)  
2) \( \frac{6}{9} \)  
3) \( \frac{30}{72} \)  
4) \( \frac{30}{81} \)

A whole number from 1 to 12, inclusive, is picked at random. What is the probability that the number is less than 7 or is prime?

1) \( \frac{1}{2} \)  
2) \( \frac{7}{12} \)  
3) \( \frac{2}{3} \)  
4) \( \frac{11}{12} \)

B. In each case, show how you arrived at your answer by clearly indicating of the necessary steps, formula substitutions, diagrams, graphs, charts, etc.

A letter is selected at random from the word “TRAPEZOID.” Find the probability that the letter selected will have vertical or horizontal line symmetry.

John’s sock drawer contains 10 identical navy blue socks, 14 identical black socks, and four identical white socks with no other socks. If John selects two socks at random from the drawer without replacement, what is the probability that the socks will not be the same color?

A softball team plays two games each weekend, one on Saturday and the other on Sunday. The probability of winning the game scheduled for next Saturday is \( \frac{3}{5} \), and the probability of winning the following game, scheduled for Sunday, is \( \frac{4}{7} \). What is the probability that the team will win at least one of the two games?
Appendix H

Trigonometry Problem

INVESTIGATION Triangles with a Variable-Length Side

In the first investigation of this lesson, you will explore uses of adjustable triangular shapes, with a side that can vary in length.

1. Make a model of a triangle with a variable-length side as illustrated below. Make strip $AB$ 10 cm long and strip $BC$ 16 cm long from endhole to endhole.
   a. What is the maximum length needed for strip $AD$? Make strip $AD$ with holes 2 cm apart (or draw a segment, $AD$, on your paper and mark points 2 cm apart).

![Diagram of triangle with variable side AD]

b. Use strip $AD$ to form $\triangle ABC$ with a variable side $AC$. When you change the length $AC$, what else changes?

c. Adjust the length of $AC$ in equal step sizes. At each step, use a ruler and protractor to obtain and record the measurements indicated in the table below. Share the workload among members of your group.

<table>
<thead>
<tr>
<th>Length of $AC$</th>
<th>Measure of $\angle A$</th>
<th>Measure of $\angle B$</th>
<th>Measure of $\angle C$</th>
<th>Perpendicular Distance from Point B to $AD$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

d. Using the lengths of $AC$ on the horizontal axis, make individual scatterplots of the following data pairs. Describe any patterns you see.

- $(\text{length } AC, \text{ measure of } \angle A)$
- $(\text{length } AC, \text{ measure of } \angle B)$
- $(\text{length } AC, \text{ measure of } \angle C)$
- $(\text{length } AC, \text{ perpendicular distance from point } B \text{ to } AD)$

e. Describe how each of the other variables changes as length $AC$ changes in equal amounts.

f. Compare the scatterplot of $(\text{length } AC, \text{ measure of } \angle A)$ with that of $(\text{length } AC, \text{ measure of } \angle B)$.

g. Compare the scatterplot of $(\text{length } AC, \text{ measure of } \angle C)$ with that of $(\text{length } AC, \text{ perpendicular distance from point } B \text{ to } AD)$. 
Appendix I

Compound Growth Problem

Compound Growth

Every now and then we hear about somebody winning a big payoff in a state lottery somewhere. The winnings can be 1, 2, 5, or even as large as 50 million dollars. Those big money wins are usually paid off in annual installments for about 20 years. But some smaller prizes like $10,000 are paid at once. How would you react if this news report were actually about you?

Kalamazoo Teen Wins Big Lottery Prize—$20,000

A Kalamazoo teenager has just won $20,000 from a Michigan lottery ticket that she got as a birthday gift from her uncle. In a new lottery payoff scheme, the teen (whose name has been withheld) has two payoff choices: One option is to receive $1,000 payments each year for the next 20 years. In the other plan, the game show will invest $10,000 in a special savings account that will earn 8% interest compounded annually for 10 years. At the end of that time she can withdraw the balance of the account.

Investigation—Just Like Money in the Bank

Of the two lottery payoff methods, one has quite a simple rule: $1,000 per year for 20 years, giving a total payoff of $20,000. The plan to put $10,000 in a savings account paying 8% compound interest might not be as familiar.

1. Which of the two payoff methods would you choose, if you had just won the lottery?

2. Which method do you think would give the greatest total payoff?

3. About how much money do you think would be in the special savings account at the end of 10 years?

- After one year your balance will be:
  
  \[ 10,000 \times (1.08^{1}) = 10,800. \]

- After the second year your balance will be:
  
  \[ 10,800 \times (1.08^{2}) = 11,664. \]
During the next year the savings account balance will increase in the same way, starting from $11,664, and so on.

1. Write equations that will allow you to calculate the balance of this deposit
   a. for any year, using the balance from the year before.
   b. after any number of years \( x \).
2. Use the equations to make a table and a plot showing the growth of this special savings account for a period of 10 years.

<table>
<thead>
<tr>
<th>Time (in years)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance ($)</td>
<td>10,000</td>
<td>10,800</td>
<td>11,664</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Describe the pattern of growth in this savings account as time passes.
   a. Why is the balance not increasing at a constant rate?
   b. How could the pattern of increase be predicted from the shape of the graph of the modeling rules?
4. How long would it take to double the $10,000 savings account?
5. Compare the pattern of change and the final account balance in Activity 2 to that for each of the following possible savings plans over 10 years. Write a summary of your findings.

   a. Initial investment of $15,000 earning only 4\% annual interest.
   b. Initial investment of $5,000 earning 12\% annual interest.

Most savings plans operate in a manner similar to the special lottery savings account. They may have different starting balances, different interest rates, or different periods of investment.

3. Describe two ways to find the value of such a savings account at the end of each year from the start to year 10. Use methods based on
   - an equation relating \( \text{NOW} \) and \( \text{NEXT} \).
   - an exponential equation \( y = a(b^x) \).
4. What is the shape of the graphs that you would expect?
5. How will the rules change as the interest rate changes? As the amount of initial investment changes?
6. Why does the dollar increase in the account get larger from one year to the next?

   Be prepared to explain your methods and ideas to the entire class.
Appendix J
Family of Lines Activity

INVESTIGATION Families of Lines

In the previous two investigations, you saw how polygons could be modeled and analyzed by using the coordinates of their vertices. The “DRAW” option of the GEOXPLOR program displayed polygons by plotting and connecting the vertices in order. You were able to use the coordinates of the vertices to calculate lengths, slopes, and midpoints of the sides of these polygons.

1. You also can think of polygons as being enveloped by a family of lines.

Examine this graphics display of lines and the rhombus that is enveloped by them. The scale on both axes is 1 unit for each mark.

![Diagram of the rhombus with equations]

a. On a copy of this display, match each equation given below with the corresponding side of the rhombus. Describe clues you used to determine the matches.

i. $y = 0$
ii. $3x - 4y = 15$
iii. $y = 3$
iv. $3x - 4y = 0$

b. Determine the coordinates of the vertices of the rhombus.

c. The equations in part a describe lines that contain the sides of the rhombus. The equations will describe only the points on the sides if you restrict the input values for $x$ and $y$.

- In the case of the equation for the side determined by the vertices $(0, 0)$ and $(4, 3)$, explain why $0 \leq x \leq 4$ ($x \geq 0$ and $x \leq 4$) and $0 \leq y \leq 3$.

- For each of the remaining equations in part a, describe the restrictions on $x$ and $y$ so that the equation describes just the side of the rhombus.

d. Write equations for the lines containing the diagonals of the rhombus. Describe restrictions on the input values for $x$ and $y$ so that each equation will represent only the points on the corresponding diagonals.

When modeling polygons or investigating geometric relationships in a coordinate plane, it is common to use linear equations in the form $ax + by = c$ rather than $y = \ldots$. This is because the variables $x$ and $y$ vary jointly; one is not viewed as a function of the other.
2. Now examine the family of lines displayed below.

![Diagram of lines](image)

a. Match each line with the corresponding equation given below.

1. $2x - y = 2$
2. $4x + 2y = 20$
3. $y = 4$
4. $x = 3$
5. $2x + 3y = 18$

b. Explain how you could match these lines with their equations by examining the x- and y-intercepts.

c. Describe any interesting features of these linear equations and their graphs.

d. Explain how you could quickly sketch the graph of $2x - 3y = -6$ by using x- and y-intercepts. How is this line related to the given family of lines?

In the following activities you will explore families of lines generated by a system of linear equations. Begin by considering the following system of equations.

$$
x + 2y = 8 \quad 4x - y = 5
$$

Various operations can be performed on one or more of the equations in a system. For example, you can multiply each term in $x + 2y = 8$ by a constant such as 2, or you may combine the two equations in the system.

3. With your group, investigate the effects of multiplying each term of a linear equation by a constant.

a. On a coordinate grid, draw the graphs of $x + 2y = 8$ and $2(x + 2y = 8)$, that is, $2x + 4y = 16$. Compare the graphs of $x + 2y = 8$ and $2x + 4y = 16$.

b. Draw the graphs of $x + 2y = 8$ and $4(x + 2y = 8)$ on a coordinate grid.

c. What do you think is true about the graphs of $k(x + 2y = 8)$ for each nonzero integer $k$? Check your conjecture.

d. What do you think is true about the graphs of $k(4x - y = 5)$ for each nonzero integer $k$? Check your conjecture and revise it if necessary.
4. Investigate what happens when you add the two equations of a linear system.
   a. Add the two equations of the system above activity 3 on the previous page. That is:
      \[
      \begin{align*}
      x + 2y &= 8 \\
      4x - y &= 5 \\
      5x + y &= 13
      \end{align*}
      \]
      What geometric figure is described by the "sum" equation?
   b. Graph the original equations and the sum equation on the same coordinate grid.
   c. What, if anything, is special about these three lines?
   d. Multiply both sides of \( x + 2y = 8 \) by 4 and both sides of \( 4x - y = 5 \) by -2. Add the resulting equations.
   e. What do you think is true about the graph of this sum equation? Check your conjecture by graphing the sum equation on the coordinate grid you prepared in part b.
   f. What is special about the four graphs?

5. Let \( E_1 \) be the equation: \( 5x + 2y = 4 \).
   Let \( E_2 \) be the equation: \( x + 3y = -7 \).
   a. Write each sum equation.
      \[
      \begin{align*}
      \bullet ~ E_1 + E_2 \\
      \bullet ~ E_1 + 5E_2 \\
      \bullet ~ E_1 + (-5)E_2
      \end{align*}
      \]
   b. Use the "SYSTEMS" option of GEOXPLOR or similar computer software to graph the original system of equations and each sum equation in part a.
   c. What appears to be true about each of these lines?
   d. What is the solution to the system of equations \( E_1 \) and \( E_2 \)?
   e. Which of the lines in part b is most helpful in finding the solution? Why? To which equation in part a does this line correspond?

6. Next consider the following system of equations.
   \[
   \begin{align*}
   E_1 &: \quad 2x + y &= -3 \\
   E_2 &: \quad 3x + 4y &= 8
   \end{align*}
   \]
   Complete parts a and b by dividing up the work among members of your group. Then share your results and thinking to complete parts c–e.
   a. Write each sum equation.
      \[
      \begin{align*}
      \bullet ~ E_1 + E_2 \\
      \bullet ~ 3E_1 + 2E_2 \\
      \bullet ~ E_1 + (-1)E_2 \\
      \bullet ~ 3E_1 + (-2)E_2
      \end{align*}
      \]
   b. Use "SYSTEMS" to graph the original system of equations \( E_1 \) and \( E_2 \) and each sum equation in part a.
c. What is the solution of the original system?
d. Which of the lines in part b is the most helpful in finding the solution? Explain. To which equation in part a does the line correspond?
e. What relationship, if any, do you see between the original system and the choice of multipliers that produced the equation in part d?

7. Finally, consider this system of linear equations.

\[ E_1: \ 3x - y = 2 \]
\[ E_2: \ x + 2y = 10 \]

Complete parts a and b by dividing the workload among members of your group. Then share your results and thinking to complete parts c–e.

a. Write each sum equation.
   \[ E_1 + E_2 \]
   \[ 2E_1 + E_2 \]
   \[ E_1 + 3E_2 \]
   \[ E_1 + (-3)E_2 \]

b. Graph the original system of equations and each sum equation in part a.

c. What is the solution of the original system?
d. Which of the lines and corresponding equations in part a are the most helpful in finding the solution? Explain.
e. What relationship do you see between the original system and the choice of multipliers that produced the equations in part d? Compare the pattern seen by your group with that found by other groups.

8. \( E_1 \) and \( E_2 \) are equations of lines intersecting at point \((a, b)\). What do you think is true about each linear combination \( mE_1 + nE_2 \) when \( m \) and \( n \) are nonzero numbers?

9. Use an appropriate linear combination of the following equations to find the coordinates of the point of intersection for the corresponding pair of lines. Check each solution by solving the system of equations using another method.

a. \( 2x + y = 4 \)
   \[ x - y = 5 \]

b. \( 2x + 3y = 6 \)
   \[ 2x + y = 4 \]

c. \( x + 3y = -1 \)
   \[ 2x - y = 12 \]

d. \( 3x + 4y = -2 \)
   \[ -2x - 3y = 1 \]

e. The modeling equations you wrote for the diagonals of the rhombus in activity 1 (page 97).

10. Consider the following system of equations.

\[ x - y = 7 \]
\[ 2x - 2y = 5 \]

a. Try to solve this system using a linear combination of the equations.
b. What difficulties did you encounter in part a?
Appendix K

Coteaching Rating Scale Analysis

Coteaching evaluation form

Placement into the eight components:

There are twenty-four questions the rating scale asks each teacher to rate himself or
herself on a scale of one to three. Each question is represents one of the eight
components. Each component has three questions in the evaluation. Here is the
breakdown

<table>
<thead>
<tr>
<th>Component</th>
<th>Coteaching rating scale question number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpersonal Communication</td>
<td>1, 9, 17</td>
</tr>
<tr>
<td>Physical Arrangement</td>
<td>2, 10, 18</td>
</tr>
<tr>
<td>Familiarity with the Curriculum</td>
<td>3, 11, 19</td>
</tr>
<tr>
<td>Curriculum goals and modifications</td>
<td>4, 12, 20</td>
</tr>
<tr>
<td>Instruction planning</td>
<td>5, 13, 21</td>
</tr>
<tr>
<td>Instructional presentation</td>
<td>6, 14, 22</td>
</tr>
<tr>
<td>Classroom management</td>
<td>7, 15, 23</td>
</tr>
<tr>
<td>Assessment</td>
<td>8, 16, 24</td>
</tr>
</tbody>
</table>

To find out where each teacher was in their view of the coteaching relationship I
averaged the three responses of component and then averaged the averages of the eight
components to get an over all perception of where the relationship was.

Before: Listed below each teacher is place into one of three stages in each component
using the coteaching rating scale evaluation forms. The last piece of data is the stage
where the teacher perceives the relationship as a whole. This data was collected before
the seminars began.

David:

<table>
<thead>
<tr>
<th>Component</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpersonal Communication</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Physical Arrangement</td>
<td>Collaborating stage</td>
</tr>
<tr>
<td>Familiarity with the Curriculum</td>
<td>Beginning stage</td>
</tr>
<tr>
<td>Curriculum goals and modifications</td>
<td>Collaborating stage</td>
</tr>
<tr>
<td>Instruction planning</td>
<td>Beginning stage</td>
</tr>
<tr>
<td>Instructional presentation</td>
<td>Beginning stage</td>
</tr>
<tr>
<td>Classroom management</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Assessment</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Stage of coteaching relationship</td>
<td>Between beginning stage and collaboration stage</td>
</tr>
</tbody>
</table>
### Linda

<table>
<thead>
<tr>
<th>Component</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpersonal Communication</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Physical Arrangement</td>
<td>Collaborating stage</td>
</tr>
<tr>
<td>Familiarity with the Curriculum</td>
<td>Beginning stage</td>
</tr>
<tr>
<td>Curriculum goals and modifications</td>
<td>Collaborating stage</td>
</tr>
<tr>
<td>Instruction planning</td>
<td>Beginning stage</td>
</tr>
<tr>
<td>Instructional presentation</td>
<td>Beginning stage</td>
</tr>
<tr>
<td>Classroom management</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Assessment</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Stage of coteaching relationship</td>
<td>Between beginning stage and collaboration</td>
</tr>
</tbody>
</table>

### Karen

<table>
<thead>
<tr>
<th>Component</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpersonal Communication</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Physical Arrangement</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Familiarity with the Curriculum</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Curriculum goals and modifications</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Instruction planning</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Instructional presentation</td>
<td>Beginning stage</td>
</tr>
<tr>
<td>Classroom management</td>
<td>Beginning stage</td>
</tr>
<tr>
<td>Assessment</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Stage of coteaching relationship</td>
<td>Compromising stage</td>
</tr>
</tbody>
</table>

### Jen

<table>
<thead>
<tr>
<th>Component</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpersonal Communication</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Physical Arrangement</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Familiarity with the Curriculum</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Curriculum goals and modifications</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Instruction planning</td>
<td>Beginning stage</td>
</tr>
<tr>
<td>Instructional presentation</td>
<td>Beginning stage</td>
</tr>
<tr>
<td>Classroom management</td>
<td>Beginning stage</td>
</tr>
<tr>
<td>Assessment</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Stage of coteaching relationship</td>
<td>Compromising stage</td>
</tr>
</tbody>
</table>
After: Listed below each teacher is placed into one of three stages in each component using the coteaching rating scale evaluation forms. The last piece of data is the stage where the teacher perceives the relationship as a whole. This data was collected after the seminars began.

David

<table>
<thead>
<tr>
<th>Component</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpersonal Communication</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Physical Arrangement</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Familiarity with the Curriculum</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Curriculum goals and modifications</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Instructional planning</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Instructional presentation</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Classroom management</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Assessment</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Stage of coteaching relationship</td>
<td>Between Compromising stage and Collaboration stage (improved)</td>
</tr>
</tbody>
</table>

Linda

<table>
<thead>
<tr>
<th>Component</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpersonal Communication</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Physical Arrangement</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Familiarity with the Curriculum</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Curriculum goals and modifications</td>
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</tr>
<tr>
<td>Instructional planning</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Instructional presentation</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Classroom management</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Assessment</td>
<td>Compromising stage</td>
</tr>
<tr>
<td>Stage of coteaching relationship</td>
<td>Between Compromising stage and Collaboration stage (improved)</td>
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### Karen

<table>
<thead>
<tr>
<th><strong>Component</strong></th>
<th><strong>Stage</strong></th>
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<tbody>
<tr>
<td>Interpersonal Communication</td>
<td>Collaboration stage</td>
</tr>
<tr>
<td>Physical Arrangement</td>
<td>Collaboration stage</td>
</tr>
<tr>
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<td>Curriculum goals and modifications</td>
<td>Collaboration stage</td>
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<tr>
<td>Instructional presentation</td>
<td>Beginning stage</td>
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<td>Assessment</td>
<td>Compromise stage</td>
</tr>
<tr>
<td>Stage of coteaching relationship</td>
<td>Between Compromising stage (little improvement)</td>
</tr>
</tbody>
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### Jen

<table>
<thead>
<tr>
<th><strong>Component</strong></th>
<th><strong>Stage</strong></th>
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</thead>
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<tr>
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<tr>
<td>Physical Arrangement</td>
<td>Collaboration stage</td>
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<tr>
<td>Familiarity with the Curriculum</td>
<td>Collaboration stage</td>
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<td>Curriculum goals and modifications</td>
<td>Collaboration stage</td>
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<td>Instructional planning</td>
<td>Compromising stage</td>
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</tbody>
</table>
Appendix L

Linda's Problem

Name __________________
Date _______________

QUADRILATERALS

Directions: From the description given on the left, draw the quadrilateral in the box next to the description.

1.

*All properties of a parallelogram
*All sides equal
*All angles 90
*Diagonals are equal
*Diagonals are perpendicular

2.

*Bases are parallel
*Other sides are equal
*Diagonals are equal
*Adjacent angles are equal
3.

*Opposite sides are equal
*Opposite sides are parallel
*Opposite angles are equal
*Adjacent sides are supplementary
*Diagonals bisect

4.

*Opposite sides are equal
*Opposite sides are parallel
*Opposite angles are equal
*Adjacent sides are supplementary
*Diagonals bisect
*Diagonals are equal
*All angles equal 90
Directions: Draw the family tree of Quadrilaterals with the following members:

- Trapezoid
- Square
- Parallelogram
- Rhombus
- Rectangle
- Kite
- Isosceles Trapezoid

FAMILY TREE OF QUADRILATERALS