The Benefits of Observational Learning on the Mathematics Achievement of Fourth Grade Students Involved in Peer Tutoring Sessions

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THE BENEFITS OF OBSERVATIONAL LEARNING ON THE MATHEMATICS ACHIEVEMENT OF FOURTH GRADE STUDENTS INVOLVED IN PEER TUTORING SESSIONS

by

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The benefits of observational learning on the mathematics achievement of fourth grade students involved in peer tutoring sessions

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Many students struggle with mathematical concepts and operations. This leads educators to search for the most effective and efficient means of improving their academic performance. The present investigation sought to determine if a triadic peer-tutoring program would increase the acquisition of basic multiplication facts for fourth grade students. Secondly, this investigation assessed the extent to which students would benefit from observational learning opportunities within the peer tutoring sessions. A multiple baseline design across two peer-tutoring triads was utilized with student performance being assessed by measuring responses to flashcard presentations and completion of three types of mathematics probes. The first type of probe contained material presented to the student. The second contained material presented to the student’s peer. The third type contained randomly selected math problems. All four students demonstrated increased accuracy and fluency as a result of peer tutoring sessions. In addition, three of the four students demonstrated improved performance on probes containing material presented to the peer. These results indicate that observational learning occurred and provide support for the implementation of triadic peer tutoring sessions to increase mathematics achievement.
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CHAPTER 1

INTRODUCTION

Despite the fact that reading disabilities are much more common than math disabilities, the prevalence of learning disabilities in the math area raises concern for the educational needs of many children. In fact, research demonstrates that between 5 and 6% of school age students experience difficulties in math achievement (Fleischner & Manheimer, 1997). This creates the need to evaluate and identify interventions that can be implemented both effectively and efficiently to improve math skills.

Peer-Assisted Learning

Peer-assisted learning is a strategy that has frequently been used within research literature for improving math achievement (Hawryluk & Smallwood, 1989). Peer-assisted learning has been defined as an instructional method in which two or more students engage in a structured interaction to accomplish a specified learning task. The interaction, which is supervised by the teacher, is designed so that some or all of the children will reach a specified academic or social-emotional goal. One of the strategies encompassed within this definition of peer-assisted learning is peer tutoring (Hawryluk & Smallwood, 1989).
Peer tutoring has been defined as the act of one child, the tutor, assisting and attempting to teach an academic skill to another child, the learner (Ehly, 1986). Typically, the tutoring sessions occur on a regular basis for a specified period of time. The teacher’s role is to structure the lessons presented within the tutoring session, to remain in contact with the students, and to provide feedback on the learner’s skills and progress (Hawryluk & Smallwood, 1989).

Peer tutoring is not a new approach to learning. Its use is evident throughout history. For example, Aristotle used peer tutors to assist him in training his charges. Also, older students were often used as monitors and tutors for younger children in one-room schoolhouses in the early twentieth century. This gave the younger children opportunities to learn to read and provided the older child with teaching experience (Enright & Axelrod, 1995). Since that time, researchers have developed and investigated various types of peer-tutoring models. Delquadri and his associates developed one of the most well researched peer tutoring models. This model was entitled Classwide Peer Tutoring (CWPT) and its goal was to improve the academic achievement of students living in a low socioecomic status urban community. Research has demonstrated that this model was successful in reaching its goal (Delquadri, Greenwood, Whorton, & Hall, 1986; Greenwood, Terry, Utley, Montagna, & Walker, 1993). Researchers at Vanderbilt University extended this model and have conducted numerous studies on the topic. Their research provides evidence that CWPT is an effective intervention for improving reading fluency and comprehension skills (Mathes, Fuchs, Fuchs, Henley, & Sanders, 1994; Mathes &
Fuchs, 1994). Another commonly researched peer-tutoring model is reciprocal peer tutoring. While this model recognizes individual achievement, it emphasizes group rewards that are contingent upon group performance (Fantuzzo, Davis, & Ginsburg, 1995; Ginsburg-Blcok & Fantuzzo, 1997). Fantuzzo, King, and Heller (1992) demonstrated that a combination of structured peer tutoring and group-reward contingencies produced greater academic gains than other combinations of peer tutoring and reward systems.

Efficacy of Peer Tutoring

Regardless of the particular model utilized, peer tutoring has repeatedly been shown to be an effective intervention for increasing educational achievement (Ehly, 1986; Enright & Axelrod, 1995; Garcia-Vazquez & Ehly, 1995; Greenwood et al., 1984; Greenwood, Arreaga-Mayer, & Terry, 1992; Heller & Fantuzzo, 1993). Research on peer tutoring provides evidence that academic gains have been demonstrated for various populations of students (Garcia-Vazquez & Ehly, 1995; Greenwood et al., 1984; Hawryluk & Smallwood, 1989) across a variety of skills (Ginsburg-Block & Fantuzzo, 1997; Hawryluk & Smallwood, 1989).

One of the most common skills for which peer-tutoring programs have resulted in increased academic achievement is reading (Greenwood et al., 1993; Kamps, Barbetta, Leonard, & Delquadri, 1994; Mathes et al., 1994). In one example, Fuchs, Fuchs, Mathes, & Simmons (1997) implemented a classwide peer-tutoring program in a large number of classrooms with students identified as learning
disabled, low achieving, and average achieving. The authors concluded that the students taking part in this program made greater academic progress than similar students who did not participate in CWPT. More information regarding the efficacy of peer tutoring programs on the reading performance of students with mild disabilities can be found in a literature review completed by Mathes and Fuchs (1994).

Peer tutoring has also led to academic gains in spelling (Greenwood et al., 1992). For example, Greenwood et al. (1984) measured the academic achievement of students within three classrooms across two phases, either peer tutoring or large group teacher instruction. Academic achievement was measured in spelling and vocabulary on weekly tests. The authors demonstrated that the peer-tutoring phase produced increased levels of spelling achievement when compared to the teacher instruction phase. Other investigations have demonstrated similar increases in spelling performance (Mortweet et al., 1999).

Math is another common skill area selected for improvement through peer tutoring. A variety of studies have demonstrated that math achievement increases as a result of peer tutoring (Bentz & Fuchs, 1996; Fantuzzo et al., 1992; Fuchs, Fuchs, Phillips, Hamlett, & Karns, 1995; Schloss, Kobza, & Alper, 1997). These investigations have focused on a wide range of mathematics skills. For example, Fueyo and Bushell (1998) conducted an investigation in which a number line procedure and peer-tutoring program increased the number of correctly completed missing addend problems completed by first grade students. Several investigations
have focused on improving the accuracy or fluency with which students complete basic math operations problems (Fantuzzo et al., 1995; Sharpley, Irvine, & Sharpley, 1983). Still other studies have demonstrated that peer tutoring can be utilized to improve the beginning algebra problem solving skills of middle school students (Allsopp, 1997).

Peer tutoring has been shown to effectively improve the math performance of many different student populations. Fuchs et al. (1995) investigated the effects of a peer-assisted learning program in mathematics for students considered to be average achieving, low achieving, or learning disabled. They concluded various types of learners benefit from peer-tutoring programs. Also of interest, this study examined both basic math computation skills and the generalization of these skills to other math concepts or applications. Positive results were found. In a related area, Schloss et al. (1997) utilized a peer-tutoring program to teach functional math skills to secondary students with moderate retardation. Following implementation of the program students performed the necessary skills, increased the number of correct responses, and generalized the new skills into the community.

In addition to improving basic academic skills, there is growing research on the efficacy of peer tutoring for improving skills in other areas. For example, Gumpel and Frank (1999) utilized cross age peer tutoring to increase the number of positive interactions experienced by four students identified as isolated or rejected by their peers. In another study, the music performance of beginning band students was shown to improve as a result of peer tutoring (Alexander & Dorow, 1983). Still other
researchers have been interested in the efficacy of peer tutoring on higher order thinking skills. Studies been conducted to measure gains in the performance of seventh grade science students (King, Staffieri, & Adelgais, 1998) as well as the performance of medical school students in basic science classes (Walker-Bartnick et al., 1984).

Other Benefits of Peer Tutoring

In addition to the academic benefits of peer tutoring, research demonstrates other benefits to these types of programs (Garcia-Vazquez, 1995). First, children benefit from the social interaction involved in peer tutoring. The research literature shows evidence that increased levels of self-esteem and self-confidence may result from involvement in a peer-tutoring program (Fantuzzo et al., 1992). Additionally, social acceptance ratings may be influenced by the implementation of classwide peer tutoring programs. Ginsburg-Block and Fantuzzo (1997) demonstrated that those students who received training in reciprocal peer tutoring rated themselves as having a greater degree of social acceptance than those students who did not receive training in reciprocal peer tutoring. Not only can peer tutoring increase student reports of social acceptance, but it may also increase the amount of time spent engaging in social interaction with peers. Kamps et al. (1994) implemented classwide peer tutoring to improve basic reading skills and to increase the time that three students with autism spent interacting with general education peers. The amount of time the
students spent engaging in social interaction with their peers increased when
unstructured free time immediately followed the classwide peer tutoring session.

Another benefit of peer-tutoring programs is that they incorporate many of
components of effective teaching. Peer-tutoring programs allow students to progress
and work at their own pace. The work presented within peer tutoring is not
individualized for every student; however, different levels of material can be utilized
to accommodate for individual student instructional levels (Greenwood, Carta, &
Maheady, 1991). In addition, peer-tutoring programs involve large amounts of
academic engaged time such as reading aloud, writing, and responding to questions.
Research has shown that some peer-tutoring sessions involve greater levels of
academic responding than teacher directed instruction (Ginsburg-Block & Fantuzzo,
1997; Greenwood et al., 1984). Peer tutoring also provides frequent and immediate
feedback to students.

Given the incorporation of these components, it is not surprising that research
provides evidence that peer-tutoring programs increase on-task behavior. DuPaul and
Hennington (1993) measured the amount of time that students diagnosed with
attention deficit hyperactivity disorder spent engaged in on-task behavior in peer
tutoring or in traditional teacher led instruction. The results showed that much larger
amounts of time were spent on-task in the peer-tutoring program than during
traditional teacher led instruction.

Another advantage of peer-tutoring programs is that they are cost effective
(Enright & Axelrod, 1995; Kohler & Strain, 1990). Pairing students with one
another, especially simultaneously as in classwide peer tutoring, provides students with large amounts of academic engaged time, but does not require teachers to spend large amounts of time with individual students. For example, in CWPT the teacher's role is to set up the tutoring program, monitor student-tutoring behaviors, answer questions when students require assistance, and record points earned during the tutoring sessions (Greenwood, et al., 1991). Thus, the implementation of peer-tutoring programs provides students with opportunities to benefit from one-on-one interaction without placing unreasonable demands on teacher time and attention. The utilization of other classroom resources minimizes teacher time and workload while maintaining or increasing the provision of many of the components of effective instruction.

Further, many of the cited benefits and advantages of peer-tutoring programs are also strengths of small group instruction. Most notably, research demonstrates that small group instruction allows for increased instructional time as well as increased peer interaction. Furthermore, small group instruction is beneficial in that it is a more efficient use of teacher time when compared to individual or one-on-one instruction (Keel & Gast, 1992). Moreover, small group instruction may surpass individual instruction in that it provides an opportunity for observational learning to occur.

Observational Learning

Observational learning has been defined as the ability to acquire information
by observing the instruction of other members of the group (Browder, Schoen, & Lentz, 1987; Keel & Gast, 1992). Shelton, Gast, Wolery, and Winterling (1991) provide a similar but not exactly identical definition. They define observational learning as the “extent to which the members of a group learn material that is presented to other members of the group as a function of watching them receive reinforcement for their performance. In essence, observational learning occurs when “the observation of a model (M) affects the observer (O) so that O’s subsequent behavior becomes more similar to M’s behavior” (Browder et al., 1987 p. 448).

Independent of the mechanisms of action, investigations on the effects of observational learning have been found in the educational literature for years. While the initial investigations utilized normally developing children as participants, Browder et al. (1987) suggest that observational learning may be especially important when working with students with disabilities. Learning through observation may be critical for these children who do not have all of the necessary skills required to independently excel in a general education environment. They may gain from observing another student’s performance even when they do not complete the task themselves.

Given this rationale, many of the investigations of the effects of observational learning have involved students with disabilities including mental impairments. For example, Varni, Lovaas, Koegel, & Everett (1979) investigated the extent to which children with autism learned new behaviors through observation. Favell, Favell, and McGimsey (1978) demonstrated the effectiveness and efficiency of observational
learning when they conducted an observational learning study in a residential facility with participants who suffered from severe mental impairments. In another example, Schoen and Sivil (1989) studied the extent to which preschool children with developmental delays would benefit from observing other children prepare snacks using two prompt fading procedures. Keel & Gast (1992) measured the observational learning gains for increasing the sight word vocabulary of children diagnosed as learning disabled.

**Benefits of Observational Learning**

The research literature does not consistently report the extent to which achievement improves as a result of observational learning; however, a large number of studies provide support for its utility. Many of these studies have focused on increasing basic skill areas. Keel and Gast (1992) worked with students diagnosed as learning disabled to complete a study that involved the presentation of a unique set of multisyllabic basal vocabulary words to each of three students. The authors hypothesized that if observational learning had occurred, each student would learn his or her own words, as well as the words presented to the other student. The authors reported that each student learned all of the words presented each group member. In a similar study, Schoen and Ogden (1995) used a constant time delay procedure in a small group setting to increase the sight word vocabulary of three first grade students. They found that all of the participants learned their own target words and a large percentage of their group member’s target words. Similar results were found when
students with and without disabilities were taught math facts in a small group setting using a constant time delay procedure. The results showed that all students reached the set criterion of math facts and they each learned a mean of at least 83% of the other students' math facts (Whalen, Schuster, & Hemmeter, 1996).

In addition to improving basic skills, many studies have demonstrated that observational learning can impact the acquisition of functional skills. Doyle, Gast, Wolery, Ault, and Farmer (1990) investigated the effects of observational learning on the acquisition of information about federal service and government agencies. Other students were taught to recognize community-referenced words (Farmer, Gast, Wolery, & Winterling, 1991). Still other studies demonstrated that observational learning could positively impact the acquisition of response chains (Werts, Caldwell, & Wolery, 1996; Wolery, Ault, Gast, Doyle, & Griffen, 1991).

Peer Tutoring and Observational Learning

Extensive research has been conducted on the implementation and use of peer tutoring programs (e.g. Garcia-Vazquez, 1995; Hawryluk & Smallwood, 1989) as well as the benefits of observation learning for students participating in small group instruction (e.g. Browder et al., 1987). While both of these strategies have been shown to be effective and efficient methods of instruction, even stronger or more beneficial instructional strategies may exist. The implementation of a combination of two or more known effective strategies may prove to be even more effective or efficient than the implementation of either strategy alone.
One possibility of a more efficient and effective teaching method may involve utilizing a peer-tutoring strategy while increasing the opportunity for observational learning to occur. For example, pairing one tutor with two learners may provide more opportunity for observational learning to occur and increase academic achievement, social gains, and time efficiency. This method may take advantage of the reported strengths of peer tutoring and observational learning.

The purpose of this investigation was to examine the effectiveness of combining peer tutoring and observational learning. This investigation was designed to assess the effects of a peer-tutoring program and observational learning strategies on the mathematics performance of fourth grade students. Observational learning strategies were incorporated into the peer-tutoring program by involving two learners and one tutor within each group to form peer-tutoring triads. The specific research questions were:

1. Does peer tutoring involving one tutor and two learners result in increased mathematics achievement?

2. Does observational learning occur for the nontargeted student during the tutoring sessions?
CHAPTER II

METHOD

The purpose of the current investigation was twofold. First, this study was developed to determine the effectiveness of triadic peer tutoring sessions on the mathematics achievement of fourth grade students. In other words, does one tutor presenting information to two students result in increased academic performance? Second, this study sought to determine if observational learning would occur in such an arrangement. In addition to learning the material presented to them, will students learn the material that is presented to their peers during the tutoring sessions?

Setting and Participants

This investigation took place in a Midwest urban elementary school. Six fourth grade students served as project participants. Three of the students were African American and three of the students were European American. Four of the six participants were female and served as learners. The other two participants were male. They participated in the project as tutors. The students ranged in age from nine - ten years old. All of the participants were selected for inclusion within this investigation based on their classroom teachers' recommendations and their performance on several mathematics worksheets administered by the teacher. The
learners earned scores that ranged between 50 and 70 percent correct on these worksheets. The tutors earned scores ranging between 70 and 80 percent correct.

Materials

Several materials were utilized during this investigation. These materials included mathematics probes, multiplication fact flashcard sets, graphing materials, and stopwatches.

Probes

A variety of mathematics probes were developed. The probes were designed to assess single digit multiplication skills. Two types of probes were developed. The first type included only single digit multiplication problems from the same fact family. These were referred to as “single fact family probes.” The second type of probe included single digit multiplication problems from several different fact families. These probes were referred to as “multiple fact family probes.” All probes were developed using guidelines presented within Academic Skills Problems (Shapiro, 1996). Sample mathematics probes can be found in Appendix A.

Flashcards

Each peer tutor was provided with two flashcard sets, one for each student. Each set contained ten flashcards on which a multiplication or division problem had been clearly printed. The problem and the answer were clearly printed on the back of
each the flashcards. An example of a flashcard has been included in Appendix B.

Each of the flashcards within a set was a part of a particular fact family. For example, one student’s set contained multiplication facts involving the number three. Another student’s cards were those multiplication facts involving the number five. Additional flashcard sets were provided for the students as they mastered their original sets.

Measures of student performance on single fact family probes were utilized to aid in the determination of which fact families to present to individual students during triadic peer tutoring sessions. Efforts were made to select fact families in which both learners within the triad performed at an instructional level. An instructional level has been defined as 20-30 digits correct per minute (DCPM) and 3-7 digits incorrect per minute (DIPM) (Shapiro, 1996).

**Graphing Materials**

Students were provided with colored pencils and graphs to record their performance during tutoring sessions. Learners graphed the number of correct flashcard responses per round. Tutors graphed the number of correct responses provided to learners during each round. For example, they graphed the number of times they provided positive feedback when the learner provided the correct response. Tutor and learner graphing sheets have been included in Appendix C.
Dependent Variables

This investigation assessed changes in math performance by measuring accurate and fluent responding to the presentation of basic math problems. Each student's progress was measured with respect to the material that was directly presented to her as well as the material that she observed during the tutoring session. For each student, presented material included any math problem to which she was expected to respond within a specified time frame. Observed material was any math problem presented to the second student within the tutoring triad, for which the first student was expected to attend, but not respond.

Accuracy measures

As a measure of accuracy, the number of correct responses per "round" was recorded. A round was defined as the presentation of all of the flashcards in a set. Correct responses included verbal responses provided within the specified amount of time following the presentation of the flashcard that accurately answered the presented problem. Incorrect responses included any verbal response that did not accurately answer the presented problem or any failure to provide a verbal response within the specified time after the presentation of the flashcard. Refer to page 21 for further clarification on time limits that were utilized. Observers recorded the number of correct and incorrect responses on a recording form at the end of each round. The data recording form has been included in Appendix D.
Fluency measures

Fluency involves measures of both accuracy and rate of responding and was defined as the number of digits correct per minute (DCPM). DCPM was selected as the unit of measurement based on its sensitivity to change. Support for the utilization of DCPM can be found within the educational literature pertaining to curriculum-based assessment. See Shapiro (1996) for further explanations. Directions for the administration and scoring of mathematics probes have been included in Appendix E.

Fluency measures were taken on single fact family probes and multiple fact family probes throughout the investigation. Student performance on single and multiple fact family probes was assessed prior to the implementation of the peer tutoring sessions. Thereafter, single fact family probes were administered each time the student reached the accuracy criterion. The accuracy criterion was defined as ten correct responses per round during both flashcard rounds per session. Multiple fact family probes were administered weekly throughout the intervention phase.

Experimental Conditions

Baseline

During baseline, all students were instructed within their usual general education mathematics curriculum. Classroom assignments and instruction was not altered. Accuracy and fluency measures were taken at the beginning of the
investigation and again just prior to the implementation of peer tutoring sessions for each triad.

**Intervention**

The independent variable consisted of peer tutoring sessions. Tutoring sessions were conducted four times per week in an empty classroom. Each tutoring session lasted approximately fifteen minutes. Sessions were held at the same time each day and schedules were arranged in conjunction with the classroom teachers.

During the tutoring session, the tutor presented a flashcard to one member of the tutoring triad. That student had a specified amount to time, either five seconds or two seconds, to provide a correct response to the presented material. If the student responded correctly, the tutor provided positive feedback and handed the flashcard to the student. If the student failed to respond within the allotted time or responded incorrectly, the tutor performed a correction procedure. The correction procedure involved repeating the problem, providing the student with the correct answer, and asking the student to repeat the problem and correct answer. Next, the tutor placed the flashcard in an incorrect pile. The second student of the tutoring triad had been instructed to attend to the material being presented. Attending was defined as looking at the flashcard, the tutor, or the other student within the tutoring triad.

Next, the tutor performed the same activities with the second student in the tutoring triad, while the first student was instructed to attend. The process continued until each student had the opportunity to respond to each of the flashcards within her
set. At this time, the number of correct and incorrect responses per round was recorded and graphed by the learners. In addition, the tutor recorded and graphed the number of correct responses that he had provided to the learners. Finally, the entire process was repeated. Two rounds of flashcard presentations occurred during each tutoring session.

Interobserver Agreement and Treatment Integrity

Observers

The first author and two undergraduate psychology students served as observers during the tutoring sessions. There were two observers present during each tutoring session. The observers were responsible for enforcing the specified time limit between the presentation of the flashcard and the verbal response, recording the number of correct and incorrect responses per round, recording the integrity with which the tutor responded to the learners, and administering and scoring all probes.

Interobserver Agreement

Interobserver agreement was calculated independently for measures of accuracy and fluency of responding. To measure accuracy, two observers independently recorded and then compared the number of correct and incorrect responses per round for 30% of the tutoring sessions. An agreement occurred when each observer recorded the same number of correct responses per round. To measure fluency two observers scored 30% of the probes. An agreement occurred when each
observer recorded the same number of digits correct per minute. Interobserver agreement for accuracy and fluency was calculated as the number of agreements divided by the number of agreements plus disagreements multiplied by 100.

Interobserver agreement on accuracy measures reached 100%. Interobserver agreement on fluency measures reached 88%.

Treatment Integrity

Both of the tutors participating in this investigation received training to prepare them to conduct tutoring sessions with at least 90% accuracy. Training scripts were utilized to instruct students on how to conduct tutoring sessions. These scripts provided instructions on how to alternate between the members of the tutoring triad, how to present the flashcards, and how to respond when provided with correct, incorrect, or no responses. These scripts are provided for reference in Appendix F. The first author provided verbal instructions utilizing the scripts individually to the tutors. Then, the observers modeled the procedures for the tutor. Finally, the tutor was asked to practice conducting a tutoring session while the first author and an undergraduate assistant served as learners. Practice continued until the tutor conducted a triadic peer-tutoring session with 90% accuracy. A checklist outlining each of the activities within a tutoring session was used to ensure that the tutor met this level of performance. This checklist continued to be utilized in 10-20% of the trials to ensure that the tutor's performance remained at high levels. Retraining would have occurred if performance fell below 80% accuracy. The need for
retraining did not present itself during this investigation. Treatment integrity for Triad 1 ranged from 90% - 100% with a mean of 99%. Treatment integrity for Triad 2 ranged from 80% - 100% with a mean of 94%. The treatment integrity checklist can be found in Appendix G.

Observers provided verbal feedback on the tutor's performance following each flashcard round. Then, the tutor recorded and graphed the number of correct responses that he had provided to the learners during the tutoring session. Meanwhile, the learners recorded and graphed the number of correct responses they provided to the flashcard presentations.

Experimental Design

This investigation utilized a multiple baseline design across two tutoring dyads involving a baseline condition, as described above, and an experimental condition that consisted of two phases. The experimental condition was in place for seven weeks and was discontinued due to the end of the academic year.

The first phase of the experimental condition will be referred to as TPT-5 seconds. This condition involved the implementation of triadic peer tutoring sessions as previously described. During these sessions, students were allotted five seconds following the presentation of the flashcard to provide the correct response. TPT-5 seconds was implemented for the additional tutoring triad when at least one student within the previous triad provided a correct response to eight flashcards within a set
during two rounds per session. This criterion was determined prior to the implementation of peer tutoring sessions.

The second phase of the experimental condition, TPT-2 seconds, was identical to TPT-5 seconds except that students were only allotted two seconds per flashcard to provide the correct response. TPT-2 seconds was implemented on an individual basis for each student. It was implemented after the student mastered two sets of flashcards in TPT-5 seconds. Mastery of math flashcard sets was defined as the provision of ten correct responses to two rounds of flashcards per session occurring any time after the third day of the presentation of that particular flashcard set. The requirement that flashcard sets be presented for at least three days was set to ensure that opportunities for observational learning were provided.

It should be noted that the TPT-2 seconds phase of the experimental condition was developed subsequent to the implementation of the peer tutoring sessions. This phase of the intervention was developed to address concerns arising during formative data analysis. It was hypothesized that the five-second time limit following the presentation of a flashcard was too large to produce measurable gains in fluency. Thus, TPT-2 seconds provided a more stringent time limit to assess changes in performance. Given this rationale, the first set of flashcards used in TPT-2 seconds was the same as the first set that had been used in TPT-5 seconds. Next, students would have been exposed to the second set they mastered during TPT-5 seconds and then a new set. Students would not return to TPT-5 seconds.
Social Validity

Social validity was assessed through an examination of the outcomes of the investigation. Social validity was defined as an increase in student performance from an instructional level to a mastery level on multiple fact family probes. An instructional level was defined as 20-30 DCPM and 3-7 digits incorrect per minute (DIPM). A mastery level was defined as 40 or more DCPM with 2 or less DIPM. The definitions for instructional and mastery levels of performance were taken from literature on curriculum-based assessment (Shapiro, 1996).

Consumer Acceptability

In order to assess the acceptability of this intervention, the participants' teachers took part in a semi-structured interview at the end of the investigation. The teachers were asked to respond to several questions regarding the acceptability and feasibility of the project as well as their satisfaction with it. This questionnaire was developed following the review of several consumer acceptability forms. It was designed to provide a brief summarization of their opinions of the project. These opinions would be beneficial in the development of future interventions or investigations. The questionnaire used for the interview has been included in Appendix H.
CHAPTER III

RESULTS

Efficacy of Triadic Peer Tutoring

One of the purposes of this investigation was to assess the efficacy of triadic peer tutoring on the mathematics achievement of fourth grade students. In response to this question, data were collected on the accuracy with which students responded to flashcard presentations. In addition, the students’ fluency of responding was measured on two types of probes, single fact family probes of presented material and multiple fact family probes.

Accuracy of Flashcard Responses

Figure 1 displays the number of correct responses per round for both tutoring triads throughout the duration of the triadic peer tutoring sessions. In this figure, the first round of a new fact family is represented by a triangle. Circles represent subsequent rounds within TPT-5 seconds. Squares represent subsequent rounds within TPT-2 seconds. Each of the four learners increased the number of correct responses per round provided during triadic peer tutoring. The extent to which the number of correct responses increased varied for each learner.
Figure 1. The Number of Correct Responses Per Round Across Two Peer-Tutoring Triads.

Terry

As the graph demonstrates, Terry quickly met the criterion level of
performance, two rounds of ten correct responses, on the first set of flashcards presented to her. She experienced more difficulty reaching this criterion on the second set of flashcards, but achieved the goal after several sessions. At this point, phase TPT-2 seconds was implemented. Terry reached the criterion level of performance within one week.

Shayla

The second student, Shayla, began the investigation responding correctly to a large portion of the cards presented to her. She reached the criterion performance level in two weeks. She quickly reached the criterion level of performance on the second set of flashcards presented to her. TPT-2 seconds was implemented and she again made good progress. Her correct responses increased from six cards per round to ten cards per round in one week. Unfortunately, data was unable to be collected on Shayla’s performance at the end of the year due to excessive absences.

Elaine

Elaine was the third student. Her performance on the first set of flashcards presented to her increased from six correct responses per round to ten correct responses per round in two and one half weeks. Then, she spent two and one half weeks attempting to meet the criterion level of performance on a second set of flashcards. It should be noted, that Elaine’s errors were inconsistent throughout this time.
Lynn

The fourth student, Lynn, started the investigation correctly responding to most of the cards per round. She quickly reached the performance criterion on the first set of flashcards that was presented to her. She slowly and steadily increased the number of correct responses per round that she provided to the second set of flashcards presented to her. Her performance increased by approximately 4 cards per round.

Fluency of Responses to Presented Material

Table 1 provides a visual display of each of the four students' performances on single fact family probes containing only presented material. Each student improved her performance on these probes. Performance gains varied for each student.

Terry

Terry demonstrated slight fluency increases on mathematics probes containing the digit two and the digit three.

Shayla

Shayla demonstrated large gains in fluency on probes containing the digit four and the digit five.
Table 1

Digits Correct Per Minute (DCPM) on Single Fact Family Probes Containing Only Presented Material

<table>
<thead>
<tr>
<th>Student</th>
<th>Fact</th>
<th>DCPM Baseline</th>
<th>DCPM PT-5 sec</th>
<th>DCPM PT-2 sec</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terry</td>
<td>2</td>
<td>27</td>
<td>32</td>
<td>30</td>
<td>+3</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>10</td>
<td>16</td>
<td></td>
<td>+6</td>
</tr>
<tr>
<td>Shayla</td>
<td>4</td>
<td>32</td>
<td>40</td>
<td>51</td>
<td>+19</td>
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<tr>
<td></td>
<td>5</td>
<td>21</td>
<td>44</td>
<td></td>
<td>+23</td>
</tr>
<tr>
<td>Elaine</td>
<td>9</td>
<td>19</td>
<td>17</td>
<td>29</td>
<td>+10</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>25</td>
<td>29</td>
<td></td>
<td>+4</td>
</tr>
<tr>
<td>Lynn</td>
<td>8</td>
<td>15</td>
<td>20</td>
<td></td>
<td>+5</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>34</td>
<td>67</td>
<td></td>
<td>+33</td>
</tr>
</tbody>
</table>

Elaine

Elaine demonstrated a large increase in the number of digits correct per minute on single fact family probes containing the digit nine. Elaine demonstrated these gains after being required to provide a verbal response within two seconds following the presentation of the flashcard. Elaine demonstrated slight gains in performance on mathematics probes containing the digit six.

Lynn

Lynn demonstrated slight gains in performance on those probes containing the digit eight. She also demonstrated a large fluency increase on single fact family probes containing the digit five.
Fluency of Responses to Multiple Fact Family Probes

Table 2 displays the results of the students' performance on multiple fact family probes. Overall, results were not as favorable as those obtained on presented or observed material.

Table 2

Digits Correct Per Minute (DCPM) on Multiple Fact Family Probes

<table>
<thead>
<tr>
<th></th>
<th>Student</th>
<th>Baseline</th>
<th>Probe 1</th>
<th>Probe 2</th>
<th>Baseline</th>
<th>Probe 3</th>
<th>Probe 4</th>
<th>Probe 5</th>
<th>Probe 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triad 1</td>
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<td>21</td>
<td>11</td>
<td>22</td>
<td>21</td>
<td>16</td>
<td>18</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shayla</td>
<td>36</td>
<td>27</td>
<td>26</td>
<td>33</td>
<td></td>
<td></td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Triad 2</td>
<td>Elaine</td>
<td>23</td>
<td></td>
<td></td>
<td>22</td>
<td>24</td>
<td>26</td>
<td>17</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Lynn</td>
<td>21</td>
<td></td>
<td></td>
<td>18</td>
<td>16</td>
<td>17</td>
<td>14</td>
<td>12</td>
</tr>
</tbody>
</table>

Terry

Across the study, Terry’s performance on multiple fact family probes showed some variability; however, consistent changes were not evident.

Shayla

Once again, excessive absences led to the incomplete collection of data. Based on the data that was collected, no increases in performance were measured.

Elaine

No changes were evident on Elaine’s performance on multiple fact family
probes.

**Lynn**

Lynn also failed to demonstrate changes in the number of digits correct per minute on multiple fact family probes.

**Effects of Observational Learning**

The second purpose of this investigation was to assess the impact of observational learning. To this end, data were collected on the fluency of student responses on single fact family probes containing only observed material.

**Fluency of Responses to Observed Material**

Table 3 displays the fluency rates of student performance on single fact family probes containing only observed material. Each of the four learners demonstrated slight gains in performance on the probes that contained only observed material.

**Terry**

Terry demonstrated a slight increase in the number of digits correct per minute on observed material containing the digit four. She made much larger fluency increases on probes containing the digit five.
Table 3

Digits Correct Per Minute (DCPM) on Single Fact Family Probes Containing Only Observed Material

<table>
<thead>
<tr>
<th>Student</th>
<th>Fact</th>
<th>DCPM Baseline</th>
<th>DCPM PT-5 sec</th>
<th>DCPM PT-2 sec</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>15</td>
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<td>5</td>
<td>21</td>
<td>41</td>
<td></td>
<td>+ 20</td>
</tr>
<tr>
<td>Shayla</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
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<td></td>
<td>3</td>
<td>32</td>
<td>35</td>
<td></td>
<td>+ 3</td>
</tr>
<tr>
<td>Elaine</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td>8</td>
<td>16</td>
<td>20</td>
<td></td>
<td>+ 4</td>
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<tr>
<td></td>
<td>5</td>
<td>35</td>
<td>42</td>
<td></td>
<td>+ 7</td>
</tr>
<tr>
<td>Lynn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>14</td>
<td>30</td>
<td>29</td>
<td>+ 15</td>
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<td></td>
<td>6</td>
<td>23</td>
<td>15</td>
<td></td>
<td>- 8</td>
</tr>
</tbody>
</table>

Shayla

Shayla’s fluency on the probes containing the digit two decreased across the peer-tutoring intervention. In addition, absences prevented the collection of all of the relevant data. Shayla did not complete the single fact family probe containing the digit two. This probe followed Terry’s mastery of the flashcard set containing the digit two in TPT-2. Shayla’s performance increased slightly on mathematics probes containing the digit three.

Elaine

Elaine’s performance increased slightly on math probes containing the digit eight and the digit five.
Lynn

Lynn demonstrated gains on the number of digits correct per minute on probes containing the digit nine. Her performance on the material containing the digit six decreased.

Social Validity

This social validity of this investigation was measured as changes from an instructional level to a mastery level on multiple fact family probes. None of the students demonstrated substantial increases in their performance on these measures. They did not improve their performance to a mastery level of 40 or more DCPM with 2 or less DIPM. Using this definition of social validity, this intervention has not been socially validated.

The aforementioned definition of social validity was selected because completing multiple fact family probes was the task most similar to those that would be expected within the general education curriculum; however, other definitions of social validity were possible. For example, it may have been more appropriate to define social validity as changes in fluency on single fact family probes. Utilizing single fact family probes rather than multiple fact family probes may have reduced the error contained within the measurement tool by limiting the number of problems possible for inclusion on any particular probe. When social validity is defined as increases in the number of DCPM on single fact family probes this investigation
would be considered to be socially valid. Each of the learners improved her performance on single fact family probes of presented and observed material.

Consumer Acceptability

Following the completion of this project, the fourth grade teachers were interviewed to assess their acceptability and satisfaction with the project. Both teachers reported that they were supportive of interventions that provide increased individual attention and practice. In addition, they reported that the intervention was feasible within the classroom schedule. They were satisfied with the results and would implement a similar intervention in the future.
A review of educational research provides substantial support for the implementation of peer tutoring programs (Enright & Axelrod, 1995; Fantuzzo et al., 1995; Fuchs et al., 1995; Kamps et al., 1994; Mathes & Fuchs, 1994). These programs have been shown to effectively improve mathematics achievement. In addition, the benefits of observational learning have been well documented. Several studies have endorsed the provision of opportunities for observational learning to improve academic achievement and use instructional time efficiently (Browder et al., 1987; Doyle et al., 1990; Farmer et al., 1991; Keel & Gast, 1992; Whalen et al., 1996; Wolery et al., 1991). The purpose of the present investigation was to determine if a peer tutoring model combined with increased opportunities for observational learning would improve the mathematics achievement of fourth grade students. Further, this investigation sought to determine the extent to which the students would benefit from the observational learning opportunities.

The results of the present study contribute to the previously mentioned peer tutoring literature base. Similar to past findings (DuPaul, Ervin, Hook, & McGoey, 1998; Fueyo & Bushell, 1998; Harris & Sherman, 1973), the results of this study indicate that the utilization of a peer-tutoring program can improve mathematics achievement.
achievement. Moreover, this study extends the peer tutoring literature, by examining the effectiveness of this strategy on peer tutoring triads. Each of the participants in this investigation demonstrated improved mathematical performance following the implementation of triadic peer tutoring sessions. Performance gains were measured as increases in the number of correct responses provided during rounds of math flashcard presentations and as increases in the number of digits correct per minute on single fact family probes containing only presented material. Each student improved the accuracy with which she responded to flashcard presentations. By the end of the investigation, each of the participants had mastered at least one set of flashcards. Furthermore, three of the four students had mastered more than one set of math flashcards. In addition to increased accuracy, fluency increases were also measured. Three of the four students demonstrated large increases in the fluency with which they responded to basic mathematics probes containing presented material.

Second, the present investigation contributes to the observational learning literature. While the results of this investigation are by no means outstanding, they do provide some evidence that peer tutoring sessions involving three students impacts the academic performance of both students in the learner role. Two students demonstrated improved math fluency on probes that contained material that they observed during peer tutoring sessions. It should be noted that decreases in performance were also measured for these students at other points in time. It is hypothesized that an extraneous variable impacted student performance at these times. For example, social factors may have impacted performance. The student may
have been laughing during the probe administration or attempting to talk to a peer or observer. It is unlikely that the students’ skills actually decreased.

Although all of the students appeared to have made gains during the course of this investigation, none of the students demonstrated improved performance on multiple fact family probes. This measure can be viewed as the task most closely related to those assigned in the general education curriculum. Therefore, it is unfortunate that gains were not evident on this measure. There are several possible explanations for these results.

First, providing verbal responses to the presentation of a flashcard within either five seconds or two seconds is topographically dissimilar to providing written responses on a worksheet. While skills would be expected to generalize across these behaviors, this may not have occurred. This possibility may not be highly plausible, however, given that increases were measured on probes containing only presented material.

A second possible explanation for the lack of increase in DCPM on multiple fact family probes may lie in the measurement tool itself. It may be that the selection of problems included on the multiple fact family probes was too varied to detect subtle improvements from exposure to so few math facts. The students were exposed to at most 40 math problems, yet the multiple fact family probes were constructed by randomly selecting 35 problems out of a possible 100. Thus, it is likely that the students may not have been exposed to many of the problems on the multiple fact family probes during the triadic peer tutoring sessions. If this were the explanation, it
could be hypothesized that the short duration of this investigation prevented the
detection of academic gains. Had this investigation been continued increases in math
fluency on multiple fact family probes may have become measurable.

Furthermore, the length of the measurement tool may have contributed to the
lack of increased student fluency. The multiple fact family probes were rather short.
Students often completed the probe before the time limit expired. While this still
allows for the computation of DCPM, probes containing too many problems for a
student to finish in the allotted time is a much more desirable situation. Additionally,
it is the subjective opinion of this author that some of the students rushed to complete
these probes to avoid being the last student to finish. Different results may have been
found had the number of problems on the mathematics probes been higher.

Limitations

As with all research, there are a number of limitations to this investigation.
First, although the results of this investigation demonstrate gains in academic
performance these gains are not consistent across all tasks. As previously mentioned,
the results of this study are strongest when students are presented with math probes
containing basic math facts from individual families. Students did not demonstrate
large gains in the number of digits correct per minute on multiple fact family probes.

This lack of evidence prompts questions regarding the accuracy with which
the measurement devices reflected learning. What did we teach? Did we measure
what we taught? Did the new skills generalize? Which skill, verbal responding to
presented multiplication facts or providing written answers to a number of math problems is most important? Which of those skills contributes most to future academic achievement and/or functional life skills? Future research in these areas seems warranted.

Second, this investigation is limited in that it was of a relatively short duration. Seven weeks should not be considered a lengthy amount of time given that the school year consists of approximately thirty-six weeks. Students were only presented with two fact families before the investigation came to a close. It would have been desirable to obtain further data on student performance. Relatedly, student absences negatively impacted data collection and subsequently interpretation.

A third factor that limits the results of this study is the small sample size. This investigation only included four participants, limiting the extent to which the results can be generalized. Further research should examine the effectiveness of triadic peer tutoring with a larger number of subjects and possibly as a classwide intervention. More information regarding the utility of this strategy in a large group setting would be beneficial.

Furthermore, the method utilized for subject selection limits the results of this investigation. Teacher reports and teacher administered mathematics worksheets were utilized for subject selection because of their similarity to the performance measures and for convenience. In addition, this is the type of information that is commonly utilized within the general education setting to make decisions about extra practice or remediation. Furthermore, research provides evidence that teacher
judgments about student characteristics and performance levels are often correct (Gresham, Macmillan, Bocian, 1997). Although this method appeared adequate during the planning stages of this investigation and at the beginning of its implementation, it proved to be slightly misleading by the end of the investigation. Despite similar performance on the selection criteria, not all of the participants performed at the same level during the sessions. This study may have been stronger had the subject selection process been more stringent, had the worksheets been exactly the same as the probes utilized during the investigation, or had the selection process included accuracy measures.

Another limitation of this study was that a 70/30 balance between known and unknown flashcards was not always achieved. Research shows that this balance is the most effective for learning new material especially when presented in a drill format (Gickling & Havertape, 1981). The manner in which the present investigation selected material for presentation often prevented this balance from being available. In other words, because this study utilized flashcard sets containing complete fact families to easily differentiate observed and presented material, this balance was not always available. It would be suspected that the results of this study might have been higher for both of the learners within a triad if this balance had been maintained.

This investigation was further limited by a lack of reward contingencies. Incentives for accurate or fluent performance were not provided during peer tutoring sessions. Research has demonstrated that rewards either group or individual are important components in peer-tutoring programs (Fantuzzo et al., 1992). While
participants in this investigation were provided with visual displays of their performance and social praise from peers and observers for their accomplishments, they did not receive tangible items based on accurate or fluent performance. Had tangible incentives been included within the triadic peer-tutoring format the outcomes of this investigation may have been different.

It should also be noted that students were not informed that observational learning measures were being taken. Students were instructed to attend to their peers’ flashcards and were instructed to do their best work on all probes, but formal explanations of the author’s interest in observational learning were not provided. It can be assumed that the participants were aware that their performance was being monitored, however, the extent to which this impacted their observation of their peers’ materials or their performance is unknown. Obviously, data on observational learning is meaningful only when the participant has attended to the material being presented to his or her peer.

Future Research

Several areas of future research have already been mentioned. These areas include (a) the extent to which skills generalize from responding to math flashcards to completing math probes, (b) the determination of which of these skills is most important for general life functioning, (c) the efficacy of triadic peer tutoring in a classwide situation, and (d) the efficacy of triadic peer tutoring sessions that involve incentives or reward contingencies.
In addition, there are a large number of other research questions that should be examined before triadic peer tutoring is highly supported. First, is triadic peer tutoring more or less effective than traditional methods of peer tutoring? Is triadic peer tutoring more or less time efficient than traditional methods of peer tutoring? If triadic peer tutoring does require increased amounts of time to implement, do the observational learning gains make up for the increased time requirement?

While the results of the present investigation are not outstanding, they provide evidence that triadic peer tutoring sessions result in increased mathematics achievement. There is further evidence that participation in such a program not only provides students with increased academic engaged time it increases the available opportunities for observational learning to occur. The provision of these opportunities can result in improved academic achievement for students. Further research on the utilization of peer tutoring models that take advantage of these observational learning opportunities seems warranted.
Appendix A

Sample Mathematics Probes
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</table>
Appendix B

Sample Flashcard
Sample Flashcard

Front of Flashcard

3 \times 3 =

Back of Flashcard

3 \times 3 = 9
Appendix C

Triadic Peer Tutoring Graphing Sheets
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The Number of Responses Correct Per Round
Appendix D

Data Recording Form
# Data Recording Form

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**Learner A**
- Round 1
  - # Correct: __
  - # Incorrect: __
- Round 2
  - # Correct: __
  - # Incorrect: __

**Learner B**
- Round 1
  - # Correct: __
  - # Incorrect: __
- Round 2
  - # Correct: __
  - # Incorrect: ___
Appendix E

Directions for Administering and Scoring Mathematics Probes
1. Hand out probes.

2. Read instructions.

   I have given you a worksheet of multiplication or division problems. You will have 5 minutes to complete as many problems on this sheet as you can. Not everyone will finish all of the problems. Work as quickly as you can working from left to right. If you do not know how to do a problem go on to the next one.


4. If student finishes in less than 5 minutes record elapsed time and collect probe. Go to 6.

5. After 5 minutes, stop students and collect papers.

6. Count the number of digits correct.

7. Count the number of digits incorrect.

8. If the student finished after 5 minutes, divide the number of digits correct by 5. This equals the number of digits correct per minute.

9. If the student finished in less than 5 minutes, divide the number of digits by the total number of seconds and multiply by 60. This equals the number of digits correct per minute.
Appendix F

Training Script for Conducting Triadic Peer Tutoring Sessions
Hi ______. You are going to be a peer tutor. That means you will show some flashcards to other students. This is how we are going to sit when we do peer tutoring. You will sit here and two other students will sit here. Like this. Model.

There are several steps to tutoring. I will explain them. Listen.

Step 1. Show a flashcard.
   What is the first step?
   Let’s practice.
   My turn.
   Your turn.

Step 2. Check the answer.
   What is the second step?
   Let’s practice.
   My turn.
   Your turn.

Step 3. Keep the card or give it away.
   If correct, say “good” and give the student the card.
   If incorrect, say problem and answer and put card in a pile.
   What is the third step?
      If correct?
      If incorrect?
   Let’s practice.
   My turn.
   Your turn.

So, step 1 is show the flashcard. Step 2 is check the answer. Step 3 is keep the card or give it away. What are the first three steps?
Let’s practice all three together.
My turn.
Your turn.
Repeat if necessary.

Step 4. Show the other person a flashcard.
   What is the fourth step?
   Let’s practice.
   My turn.
   Your turn.

Step 5. Check the answer.
What is the fifth step?
Let's practice.
My turn.
Your turn.

Step 6. Keep the card or give it away.
If correct, say "good" and give the student the card.
If incorrect, say problem and answer and put card in a pile.
What is the sixth step?
If correct?
If incorrect?
Let's practice.
My turn.
Your turn.

So, Step 4 is show the other person a flashcard. Step 5 is check the answer. Step 6 is put the card in a pile. What are steps 4, 5, and 6?
Let's practice steps 4, 5, and 6 together.
My turn.
Your turn.
Repeat if necessary.

Let's review all 6 steps.
1) show a flashcard
2) check the answer
3) keep the card or give it away
4) show another flashcard
5) check the answer
6) keep the card or give it away
What are steps 1 through 6?
Let's practice all of the steps together.
My turn.
Your turn.
Repeat if necessary.
Appendix G

Treatment Integrity Recording Sheet
Student A: 
Student B: 

Round 1

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Comments

# Steps Possible: 
# Steps Completed Accurately: 

% Treatment Integrity
Appendix H

Consumer Acceptability Interview Form
Consumer Acceptability Interview Questions

1. Did you find the peer tutoring intervention acceptable?

2. Did you feel that the time the students spent engaged in the peer tutoring was beneficial/appropriate?

3. Do you feel the intervention would be feasible in a general classroom setting?

4. Do you think the students benefited from peer tutoring?

5. Would you be willing to have students participate in a similar program in the future?

6. Do you have any other comments or suggestions about the peer tutoring program?
Appendix I

Protocol Clearance From the Human Subjects Institutional Review Board
Date: 7 April 1999

To: Kristal Ehrhardt, Principal Investigator
    Trisha Parish, Student Investigator for thesis

From: Sylvia Culp, Chair

Re: Changes to HSIRB Project Number 99-01-03

This letter will serve as confirmation that the changes to your research project “The Effects of Peer Tutoring and Observational Learning on Mathematics Achievement” requested in your memo dated 5 April 1999 have been approved by the Human Subjects Institutional Review Board.

The conditions and the duration of this approval are specified in the Policies of Western Michigan University.

Please note that you may only conduct this research exactly in the form it was approved. You must seek specific board approval for any changes in this project. You must also seek reapproval if the project extends beyond the termination date noted below. In addition if there are any unanticipated adverse reactions or unanticipated events associated with the conduct of this research, you should immediately suspend the project and contact the Chair of the HSIRB for consultation.

The Board wishes you success in the pursuit of your research goals.

Approval Termination: 3 March 2000


