EFFECTS OF COMPUTER-ASSISTED PEER TUTORING ON ACQUISITION, MAINTENANCE, AND GENERALIZATION OF TIME TELLING WITH PRIMARY STUDENTS WITH DEVELOPMENTAL DELAYS

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ABSTRACT

This study was designed to investigate the effects of a computer-assisted, peer tutoring program on the acquisition, maintenance, and generalization of time telling skills with students with developmental delays. Tutoring was modified from Cooke, Heron, and Heward’s (1983) procedures, with the addition of using a computer to replace tutor huddle. Results showed increases in acquisition for all students, but maintenance was limited and generalization to untutored times was mixed. Overall, the results also indicated computer-assisted tutoring is a viable replacement for tutor huddle. Limitations of the study, implications for classroom teachers, and recommendations for future research are given.
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CHAPTER 1
INTRODUCTION

We live in a time of rapid change. According to the National Council of Teachers of Mathematics (NCTM), "the need to understand and be able to use mathematics in everyday life and in the workplace has never been greater and will continue to increase (2000, p. 4). The NCTM has outlined the principles and standards that they believe are necessary to achieve a high-quality mathematical education. Measurement is one such standard. "The study of measurements is important in the mathematics curriculum...because of the practicality and pervasiveness of measurement in so many aspects of everyday life" (NCTM, p. 44).

The ability to tell time to the hour and half hour is an important mathematical skill for children to develop during the early school years. This importance is noted by the inclusion of telling time as a curriculum goal for kindergarten and first grade students. In addition, telling time is important to develop as a life skill as well. Knowing the correct time will help the student be punctual for school activities and have a relative understanding of the length of the school day. When the students become older, telling time accurately will allow them to report to work on-time.

Individualized instruction in Special Education became a mandate in the 1970s. The Education of the Handicapped legislation of 1975 was written with the central provision
that all children with disabilities are entitled to a free appropriate public education
designed to meet their needs. "Congress clearly indicated that the requirement for
individualized programs was essential to achieving the ambitious goals of the special
education legislation (McLaughlin & Thurlow, 2003, p. 436-437). These individualized
programs were required to be designated in a document titled Individual Education
Program (IEP). In 1997, the reauthorization of IDEA, commonly known as IDEA 97
brought further refinements to the IEP and required that students with disabilities be
included in school and state-wide assessments with modifications. The law also required
that states establish goals and indicators for students with disabilities and report their
progress toward these goals. The recent reauthorization of Title 1 of the Elementary and
Secondary Educations Act (No Child Left Behind Act of 2001) has shifted accountability
in Special Education from compliance to accountability. Although the legalities are not
quite clear, it appears that children with disabilities will be expected to perform at grade
level standards since they are taking the same assessments as their nondisabled peers
(McLaughlin & Thurlow). Individualized programs of instruction will become more
crucial in helping students meet these lofty goals.

   Peer tutoring is an effective method of individualized instruction (Arreaga-Mayer,
1998). There are two configurations of peer tutoring to consider for tutoring the majority
of students in a classroom, classwide and cross-age. In classwide tutoring, all the students
in the class work simultaneously in pairs. Cross-age tutoring features older or more
knowledgeable students tutoring less knowledgeable students.

   There are some concerns regarding both types of peer tutoring documented in the
literature. Cross-age tutoring can have significant logistical problems in coordinating
schedules. A major concern with classwide tutoring is that it is not possible to pair every student with someone who is capable of providing appropriate and accurate feedback with respect to accuracy. This issue has been addressed in another study by an arrangement termed tutor huddle (Heward, Heron & Cooke, 1982). During a tutor huddle, the students confirm their knowledge of the answer and receive feedback from other students prior to tutoring their partners. When the group is unable to identify a word, the teacher is asked to supply the word for the huddle. However, using tutor huddle is not feasible when the classroom targeted for classwide peer tutoring is a self-contained classroom for children with cognitive disabilities. In this situation, the students are performing at approximately the same academic level and are unable to provide the feedback necessary for successful participation in tutor huddle. The huddle would require teacher assistance at virtually every instructional trial, and therefore defeat the purpose of the huddle or the tutoring system. The current study sought to address this problem. A computer program, with a speaker for the tutor to hear the correct answer, was substituted in place of the tutor huddle.

Statement of the Problem

This study modified a structured, research-based tutoring system to allow same-age students with developmental delays to participate fully in the tutoring system in the role of tutor as well as tutee.

This chapter consists of a literature review that summarizes effective teaching practices featuring peer tutoring and computer application, the rationale for the study, and research questions pertinent to this investigation.
Literature Review

This review is organized into six main categories: effective teaching practices, tutoring systems, computer applications in teaching, maintenance, generality, and social validity.

Effective Teaching Practices

Instructional time in schools is limited. To ensure that the limited instructional time is well used, effective practice strategies should be employed. According to Heron and Harris (2001), effective teaching practices are those approaches that meet the Daubert standard meaning that they are reliable, valid, and state of the art. They have been proven through research and are not popular fads. According to Peters and Heron (1993) best practices should have a sound theoretical base, consensus with existing literature, desired outcomes, and finally, meet standards of social validity.

Effective teaching practices can be categorized by responsibility for instruction into teacher directed, semi-independent, or peer mediated. Teacher directed practices are those where the “teacher handles primary tasks of delivering instruction and providing the prompts, cues, reinforcement and feedback during each learning trial” (Heron & Harris, 2001, p. 43). Four methods of teacher directed teaching will be discussed; direct instruction, cognitive behavior modification, active student response methods, and mnemonics.

Teacher Directed

Direct instruction. Direct instruction describes programs characterized by careful sequencing, teaching to mastery, and a systematic, highly interactive approach to teaching (Gersten & Keating, 1987). Two hallmarks of direct instruction, according to
Van Houten (1994), are the explicit teaching of rules and strategies and the correction of rule misapplication by prompting use of the rule. Advantages of the fast paced, small-group instruction format are that it requires frequent student response, guarantees immediate feedback, and contains specified effective procedures for correcting errors.

Many studies have been conducted to research the effectiveness of direct instruction techniques. For example, one study, Project Follow Through, studied 20 innovative programs of instruction from various universities and concluded that Direct Instruction was the most effective in teaching academic skills in math, reading comprehension, and language. Curriculum taught in the scripted step-by-step process of Direct Instruction increased the scores (i.e., achievement levels) of economically disadvantaged students (Jenkins & Jenkins, 1981) to national norms in basic skills (Carnine 1983; Gersten & Keating, 1987). Despite these findings, critics of DI contend that although there is accelerated academic achievement in the early years, the early academic focus harms students in later years, especially in the area of social behavior (Gersten & Keating). In an effort to dispel this criticism, Gersten and Keating investigated whether direct instruction in primary grades had an effect on students’ high school careers and found that positive long term effects in achievement and drop out rates were stronger for those who started DI in kindergarten as opposed to first grade.

Results of studies using special education populations have shown that Direct Instruction is effective across setting and populations. Student achievement exceeded usual expectations that were held for various disabled populations (Carnine, 1983). A summary of research has proven that the most effective instruction teaches preskills first, is made up of overt steps, applies to a broad range of examples, requires learners to attend
to relevant dimensions of the task, and provide feedback (Carnine; Stein, Silbert & Carnine, 1997).

*Cognitive behavior modification.* Cognitive behavior modification is based on the premise that emotional and behavioral problems are the result of problem thinking and the program modifies the faulty thought processes (Martin & Pear, 2003). Since human behavior is mediated by cognition, the primary focus of therapy is to make a fundamental change in the student's cognition. The cognitive components try to change thought but often behavior changes are part of the treatment. Behavior modification focuses on observable behavior.

Cognitive behavior therapy can be considered from three perspectives: self-statements and self-instructional methods to modify self-statements, problem solving techniques, and learning strategy approaches. One method is Ellis' Rational-Emotive therapy (Martin & Pear, 2003). It is based on the premise that what a person says to him or herself is close to what the person feels. In this therapy, people are taught to counteract irrational self-statements with positive realistic statements. A second method, Beck's Cognitive Therapy (Martin & Pear), is similar to Ellis' but uses a technique of reality check or hypothesis testing to counteract negative self-statements.

A third method is problem-solving. This technique teaches people to proceed through logical reasoning to come to satisfactory conclusions. D'Zurilla and Goldfried (1971) outline five general steps in problem solving: general orientation, problem definition, generation of alternatives, decision making, and verification. The goal of treatment using problem solving techniques is to teach problem solving skills instead of just feeding the student a "never ending series of solutions" (p. 120).
A fourth method is a learning strategies approach. This approach was designed to mediate limited basic skills, study skills and strategies, and social skill deficits. It teaches strategies for skills and how to learn. The five essential features to prepare students to function in the general education setting include; learning in a variety of environments with different teachers, specifying clearly specifying the roles of all involved, planning and discussing results cooperatively with all instructors, planning for generalization of strategies, and providing support to ensure success in the general education environment (Deshler & Schumaker, 1988). These are four of the most effective strategies for cognitive behavior modification.

*Active student response methods (ASR).* Active student response occurs when a student makes an observable response to an instructional antecedent. Methods comprise instructional strategies where students produce an observable measurable response (Heward, 1994). Strategies to increase ASR have been proven to be effective learning strategies. Research shows that learning is enhanced by students engaging with relevant instructional materials. Engagement with content is correlated with academic achievement. Benefits of high ASR methods include generating more learning, providing important feedback to the teacher, and increasing on-task behavior.

There are three main types of teacher-led ASR strategies. They include choral responding, response cards, and guided notes. Choral responding requires each student in the class to respond in unison to a question asked by the teacher (Heward, 1994). Research has shown that choral responding increases student response rates and involvement in the material being presented (Heward, Courson & Narayan, 1989; Sainato, Strain & Lyon, 1987). Choral responding has been shown to decrease off-task
behavior (Sterling, Barbetta, Heward & Heron, 1997) and is more effective than passive learning (Heward).

Response cards are "cards, signs, or items held up simultaneously by all students to display (the) response to (a) question or problem presented by the teacher" (Heward, 1994, p. 299). There are two forms of response cards: preprinted and write-on. Response cards also increase student response, increase involvement in the material being presented, and reduce off-task behavior (Armendariz & Umbreit, 1999; Heward, Gardner, Cavanaugh, Courson, Grossi & Barbetta, 1996). Response cards have one advantage over choral responding, the teacher can detect responses of individual students. Research has also shown that using response cards to review is superior to class discussion alone (Heward, 1994).

Guided notes are teacher prepared handouts that guide a student through a lecture with standard cues and spaces to write key facts, concepts, or relationships (Heward, 1994). The advantage of guided notes over student versions of notes is that guided notes allow students to take notes that are more accurate and complete. Guided notes have been proven to increase test score when used to study. (Kline, 1986; Pados, 1989; Yang, 1988).

**Mnemonics.** Mnemonics is a memory technique that uses organization to improve retention by relating new material to previously learned material. Mnemonics are used in learning to help the student remember factual information, definitions, processes, functions, and structures. Mnemonics work by adding meaningful connections to arbitrary or seemingly unconnected pieces of information by recoding, retrieving, and relating in a meaningful way. Mnemonic strategies include using pegwords, acronyms,
acrostics, phonetics, or key words (Carney, Levin & Levin, 1993; Mastropieri & Scruggs, 1991). Most research has been conducted in the areas of English and foreign language vocabulary, science, history, geography, and social studies (Mastropieri & Scruggs). Research has shown mnemonics to be an effective, powerful technique to improve academic learning (Mastropieri & Scruggs, 1994).

Semi-Independent

Semi-independent practices are those that the student, aided by a computer or special teacher made devices, assumes the primary responsibility for delivering his/her own instruction (Blackhurst, 1997). Two kinds of semi-independent strategies will be discussed; assistive technology and computer-assisted instruction.

Assistive technology. Assistive technology is “any equipment or system developed, modified, or available commercially that can be used to improve the independent functioning of students with disabilities within the environment” (Blackhurst, 1997, p. 44). The types of assistive technology available run the gamut from low-tech to high technological methods. For example, to help a student write, a low-tech device would be a pencil grip and a high-tech device would be a personal computer. Use of assistive technology should be based on the individual needs of the student. Practitioners should start with low-tech solutions and move up the continuum by trials until a successful solution is achieved.

Computer-assisted instruction. Computer-assisted instruction is comprised of many hardware and software applications. Hardware can be as complex as a computer or as simple as a chip placed in a device. Simple devices can help a student with a single learning task or skill. Examples of these simple devises include Twist and Shout for
spelling, addition, or multiplication; a *Coinulator* calculator that adds money amounts; the *Leap Pad Learning System* of reading, phonics, and math computer workbooks. These simple devices are all interactive devices using processing chips that a student can use to learn a skill. Software includes all applications that have been specifically written and are intended to be run on a computer. Common educational applications for younger students include *Kid Pix*, the *Jump Start, Clue Finders*, and *Reader Rabbit* series; and *Hyperstudio*. Educational applications for older students include *Inspiration, Co: Writer* and the *Astro Math* series. The common element of software is that it requires the student, aided by the computer, to be in charge of completing the instruction.

*Peer Mediated*

Peer mediated practices are those where, after training, “the students themselves take on the primary task of delivering instruction; providing prompts, cues, reinforcement, and feedback during learning trials” (Heron & Harris, 2001, p. 451). Two types of peer mediated strategies will be discussed here; cooperative learning and peer-tutoring systems.

*Cooperative learning.* “Cooperative learning is a set of instructional strategies that encourages cooperative student-to-student interaction over lesson content” (Goor & Schwenn, 1993, p. 7). The premise of cooperative learning is that students are rewarded for ensuring that all other members of the group have learned the material. The role of the teacher in the cooperative learning process changes from that of presenter of material to facilitator. The key to making cooperative learning productive learning time is training the participants to perform their role. It is also essential that students be trained in the social skills necessary to make interactions within the group positive. Goor and Schwenn
have outlined steps to effectively implement cooperative learning groups. Teachers must start by making instructional decisions related to the content and objectives. These should be explicitly conveyed to the students. Teachers must also make conscious decisions as to how the groups will be structured and how the role of each student in the group will be assigned. The students must be prepared for their role in the group prior to participation in group activities. Teachers also must establish systems that will help the student maintain focus on the activity. This can be accomplished through recognizing and rewarding the group for good work. The teacher must also evaluate the outcomes on an on-going basis. Evaluations should include both formative outcomes, or how the students are learning; as well as, summative outcomes, or what has been learned.

Cooperative learning has shown that students make academic gains as well as form positive relationships. Positive relationships have been shown to form between students with disabilities and their regular education peers and that these relationships have generalized to unstructured classroom and school situations (Johnson, Johnson, Warring & Maruyama, 1986).

Tutoring Systems

A tutoring system is “any formal and comprehensive approach to teaching students to prompt, praise, test, and chart the academic, social, or non-traditional skills of their partners on a daily basis” (Heron & Harris, 2001, p. 452). The following section will describe five types of tutoring that are empirically proven to derive from the tutoring experience.

Classwide peer tutoring. The defining feature of classwide peer tutoring (CWPT) is that all the students in the class work in pairs simultaneously. The goal of CWPT is often
to improve the basic skill performance of low achieving students within the classroom setting. One way this is achieved is through increasing the opportunity to respond (response rate) of the student being tutored. It is also possible to tailor the academic materials to a particular student’s needs.

There are several well-researched CWPT systems. One system was developed by researchers at the Juniper Gardens Children’s Project. The project was a collaborative effort between regular classroom teachers and Juniper Gardens’ researchers that was devised to improve instruction for children with learning disabilities and children from minority or disadvantaged backgrounds. CWPT was used to increase student opportunity to respond. The daily procedure takes a 30 minute block of time. It is divided into 10 minutes of tutoring, 10 minutes of receiving tutoring, and 5 to 10 minutes to post individual and team scores. A defining feature of the system was the introduction of team competition. Students were assigned randomly to a team every Monday and competed together for a week before new teams were chosen. The random assignment assured that every student eventually was part of a winning team. The team approach set this model apart from others. The system has been used with “textual oral reading, answering comprehension questions, reading workbook practice, practicing spelling word lists, practicing math facts, and practicing vocabulary words, their meanings and definitions” (Delquadri, Greenwood, Whorton, Carta & Hall, 1986).

The classwide peer tutoring model by Cooke, Heron, and Heward (1983) is based on the premise that greater student achievement can be attained by individualizing instruction. The authors determined that a “workable solution is to use the students themselves as instructors” (Cooke, Heron & Heward, p. 2). In this CWPT system, a key
feature is the tutor huddle. The tutors meet prior to a tutoring session for approximately five minutes. The tutor holds up the word cards to be used that day, one at a time, to the group. The tutor reads the card to the group and receives feedback for correctness. Following the huddle, the tutors join their student to practice for a five-minute period. Tutors then give the student a test of the practiced material. After an item is identified correctly during 3 consecutive sessions, it is removed from the teaching cycle. The tutors then record results on a cumulative graph. This system has been used in studies of sight word acquisition and basic math skills.

A variation of the CWPT system developed by Fuchs and Fuchs at Peabody College at Vanderbilt is Math PALS. PALS stands for peer assisted learning strategy. Two 35-minute peer tutoring sessions are planned every week. The sessions are used to remediate or review curriculum already presented. Math PALS extends the Juniper Garden’s program by having the tutor model and fade verbal instruction, providing step-by-step feedback with explanation, and adding written interaction. The structured interaction is the defining feature of Math PALS. Once a week, debriefing sessions were conducted to determine the extent of helpful explanations. Math PALS has been designated an effective practice by the Program Effectiveness Panel of the U.S. Department of Education based on evidence of effectiveness (Fuchs & Fuchs, 2001).

**Cross-age.** The defining feature of cross-age peer tutoring is that older or more knowledgeable students tutor younger less knowledgeable students. It is not a reciprocal tutoring arrangement. The role of tutor and tutee are defined from the onset of tutoring. The rationale for this arrangement lies in the following assumptions “(1) the older children can provide the younger child with a model of appropriate behavior, (2) the
older child can profit from the tutoring relationship, in that the responsibility given to him often serves indirectly to increase his own motivation and academic performance, and (3) the trained older tutor can effectively teach many skills that require more time and attention than the classroom teacher has available” (Johnson & Bailey, 1974, p. 223). The effectiveness of these assumptions has been tested many studies including math skills (Barbetta, Miller, Peters, Heron & Cochran, 1991), social skills (Gumpel & Frank, 1999) and sight word vocabulary (Barbetta, Miller, Peters, Heron & Cochran, 1991). Cross-age tutoring does present logistical problems that would need to be worked out. Jenkins and Jenkins (1981) suggested that to overcome these problems, the teacher should determine who would benefit from the tutoring and enlist the cooperation of the principal and other teachers who would be involved. A time that would be the best for all involved should be mutually set. Finally, the responsibility for supervision and management of the system should be determined.

**Small group.** There are two variations of small-group tutoring. The first is to use tutoring during seatwork time to remediate deficient skills. The second variation is for the whole class to participate but in a rotation with teacher-led small group instruction (Heron & Harris, 2001). Jenkins and Jenkins (1981) identify two problems with small group tutoring: learners still do not learn at a consistent rate, and it takes time and opportunities to respond away from others in the class. Using students as tutors solves some of the difficulties in small group instruction but still “does not solve the problem of individual leaning differences” (Jenkins & Jenkins, p. 7).

**One to one.** One to one tutoring involves some students participating in tutoring in a pair arrangement. This type of tutoring has the advantage of accommodating individual
differences in learning that is not otherwise feasible by a classroom teacher. One on one tutoring is useful in remediating a deficient skill of an individual student. The teacher's time in working with the class is not usurped by the needs of an individual student. An especially effective use of this method is conducting cross-age tutoring using an unstructured program where the tutor must invent instructional content as well as teaching methods. This requires the tutor to spend considerable time studying subject matter. If the tutor was deficient in the subject matter prior to tutoring, this is an effective method of learning for the tutor (Jenkins & Jenkins, 1981).

*Home based tutoring.* The defining feature of home based tutoring is that parents serve as the tutors. Parental involvement in the educational process is essential for achievement (Barbetta & Heron, 1991; Heron & Harris, 2001). According to Carnine (1983), parents can support children's learning in many ways including encouraging them to do well in school, providing academic experiences at home, and taking political action to ensure the quality of education. Of the three actions providing academic experiences at home is the most difficult for parents. Sometimes parents need to be supported through training to provide assistance and support. Training programs can be broad based and teach parents general principles or they can be specifically focused on a skill (Elksnin & Elksnin, 1991). Home based peer tutoring is a skill based program that is used to remediate or maintain a skill. One such program, Project SHINE provided help parents become effective educators with little professional support required (Barbetta & Heron). Project SHINE was developed to provide an effective, efficient method of home instruction to assist learners to assess, implement, evaluate, monitor, and reinforce the child's performance. The results show that parents can facilitate substantiated learning if
they use a program that they are comfortable implementing (Barbetta & Heron). A
general conclusion that can be drawn from the study is that parents can be effective
teachers if they receive proper training.

Benefits of Tutoring

There are many benefits for tutoring students with disabilities. A study in 1990 by
Schrader and Valus note benefits such as; self-esteem, reinforcement, relearning,
 improvement of skills, enhanced motivation, enhanced awareness of others, and
 enhanced learning time. The following section will present research on seven benefits
 including; academic, opportunity to respond, social, self-esteem, tutor vs. tutee, time, and
cost.

Perhaps the most widely researched area of peer tutoring is the effect on academic
performance. Many studies have examined academic performance and have found
positive effects (Cohen, Kulik & Kulik, 1982; Frager and Stern, 1970; Johnson & Bailey,
1974). Scruggs and Richter (1985), for example, examined academic individualization
and found positive effects of individualizing academic content to learners of differing
needs. Many studies have focused on one academic skill and have reported positive
results in spelling (Maheady, Harper, Mallette & Winstanley, 1991), math (Fuchs &
Fuchs, 2001; Pigott, Fantuzzo & Clement, 1986), and sight words (Barbetta, Miller,
Peters, Heron, Cochran, 1991; Heron, Heward, Cooke & Hill, 1983).

There has been a positive correlation reported in the literature between improved
academic performance and opportunity to respond (Greenwood, Hart, Walker & Risley,
1994). Opportunity to respond is the interaction between teacher-formulated instruction
and student responding. This definition assumes that the variables of practice and time on
task are included in the instruction and interaction dyad. It implies that the focus is on active versus passive student responding. This strategy is consistent with the formulae for peer tutoring and may help to explain the increased academic achievement noted with peer tutoring.

Social benefits of peer tutoring have also been noted by researchers. In a meta analysis by Osguthorpe and Scruggs (1986), it was noted that tutors had more self-confidence and a greater sense of responsibility after peer tutoring. After reviewing the mostly anecdotal research, they reported mixed results, but concluded that there was the perception among teachers and parents that peer tutoring increased self-esteem. The students themselves reported no change. It was hypothesized that the discrepancy may be due to students having high self-esteem prior to the study. In studies of students with behavioral disabilities, enhanced personal/social development was noted (Giesecke, Cartledge & Gardner, 1993). Cohen, Kulik, and Kulik (1982) also investigated self-esteem in a meta analysis, and concluded that there were mixed results on self-esteem for tutors and tutees but that “dramatic changes appear to be atypical” (p. 246).

Studies have also examined the benefits of tutoring from the perspective of tutor versus tutee. Osguthorpe and Scruggs (1986) concluded that students with various disabilities can be effective in the role of tutor and that the disability is not a critical factor in how much the tutor or tutee benefit from tutoring. They also concluded that when tutors and tutees alternate roles, all the students showed gains in the content area tutored. An additional meta analysis conducted by Cohen, Kulik, and Kulik (1982) came to the same conclusion. There are academic performance gains and positive attitudes
toward the subject matter for both tutor and tutee in the majority of studies that were analyzed.

An additional benefit to be considered is the time required for training and implementing a tutoring program. When Osguthorpe and Scruggs (1986) reviewed this variable in their meta analysis, they found that training time reported by researchers varied substantially, occasionally exceeding the tutoring itself. In most studies, training required from one to three hours. They found variation in time to be a function of the focus of the sessions. It varied from actual academic content to tutoring skills. They also surmised that the students' disabilities had an effect on the time required. Students with more severe cognitive disabilities required the most time and students with only behavioral disorders the least. They concluded that teachers must “weigh the time required to train the tutors against the expected benefits to be derived by tutors and tutees” (Osguthorpe & Scruggs, p. 23).

Cost effectiveness is an additional consideration in implementing peer tutoring systems. A study by Levin, Glass, and Meister (1984) explored cost effectiveness for four interventions; reducing class size, increasing instructional time, peer tutoring, and adult tutoring for reading and mathematics. They concluded that the differences in cost effectiveness are substantial, with peer tutoring showing the best result.

Peer tutoring has been a well researched method of individualizing instruction. Benefits have been shown through research for achieving academic gains, increasing opportunity to respond, social and self esteem enhancement, and cost and time effectiveness.
Computer Applications for Teaching

Computer Assisted Instruction (CAI) is defined as the use of the computer to teach students directly (Edward, Norton, Taylor, Weiss & Dusseldorp, 1975). The following section will examine four modes of implementation for CAI; drill and practice, tutorial, problem solving, and simulations (Heron & Harris, 2001).

Drill and practice. Learning through repetitive response to a stimulus is the most common use of computers in education (Majstek & Wilson, 1989; Wilson, Casella & Wilson, 1989). Drill and practice software programs “present questions, prompt for answers, evaluate input, and indicate correct or incorrect responses. The purpose of these programs is to promote mastery and to help the student in developing a rapid response time (Wilson, Cassella & Wilson).

The drill and practice format is best suited for repetitive practice to achieve mastery, increasing ASR rates to develop automaticity, and to provide immediate feedback for responses (Cosden, 1988; Schmidt, Weinstein, Niemic, & Walberg, 1985-1986). The student needs to be able to retrieve the answer from memory before CAI is used for drill and practice (Rieth & Semmel, 1991).

There are many benefits that can be derived from a student using CAI for drill and practice. CAI can be used to individualize a program of learning and provide a multi-sensory experience. CAI also reduces the need for direct teacher interaction and supervision (Schmidt, Weinstein, Niemic & Walberg, 1985-1986). It has also been reported that CAI reduces the time needed for instruction (Kulik, Kulik & Cohen, 1982). CAI appears to be most effective with lower levels of learning, such as developing automaticity of basic math skills. It will only help in developing automaticity if students
learn the basic facts first (Hasselbring, Goin, & Bransford, 1988; Edwards, Norton, Taylor, Weiss, & Dusseldorp, 1975).

**Tutorial.** A tutorial computer application takes over the role of teacher to present new skills or concepts to students (Heron & Harris, 2001; Wilson, Cassella & Wilson, 1989). A tutorial is best used to provide a consistent systematic presentation of new skills that has the ability to prompt and provide feedback with explanations. A good tutorial computer application provides alternative explanations, model examples, and guided practice (Wilson, Cassella & Wilson).

An advantage of CAI tutorial programs is that they provide structured basic teaching tactics by presenting material in a precise instructional sequence. The programs contain sufficient task repetition to achieve skill mastery. Tutorials can be combined with drill and practice to develop automaticity (Hasselbring, Goin & Bransford, 1988). An additional advantage is that the student receives immediate feedback for all responses (Rieth & Semmel, 1991). Student performance is enhanced with more elaborate methods of error correction (Majsterek & Wilson, 1989; Woodward et al., 1986).

**Problem solving.** In problem solving CAI, students are given a situation where the solution is not obvious. The student must gain enough information to understand and organize the information. The student is then required to choose a strategy, plan the strategy, implement the strategy, and check to see if it was successful (Wilson, Cassella & Wilson, 1989). A problem solving program can be used to help students develop critical thinking skills. These skills must be taught directly to be effective (Reith & Semmel, 1991). Critical thinking skills include; making an organized list, drawing a picture, breaking a problem into parts, working backwards, recreating a pattern, and trial
and error. These are basic problem solving strategies that may transfer to other content areas once taught and learned (Wilson, Cassella & Wilson).

*Simulations.* A computer simulation program is designed to model some reality (Reith & Semmel, 1991). A computer simulation has the advantage over other simulations by having multi-sensory capabilities. Simulations done in this manner can make changes in the virtual world through dynamic complex processes as the student uses various problem solving strategies. A problem with computer simulations is that it may be possible to solve the problem by using only trial and error. The student may never be required to explore alternative strategies (Reith & Semmel). If a program is designed correctly, students should be able to use the simulations as an opportunity to practice problem solving skills after problem solving strategies have been directly taught (Rieth & Semmel).

Computers have been shown to be effective in the classroom in four modes: promoting mastery by repetitive drill, increasing learning trials in tutorial/drill and practice modes, and helping students develop and use problem solving skills. These learning strategies can help the student to be more successful. The optimal use of CAI in the classroom requires careful consideration of the academic task, the stage of instruction, and the role of the teacher in specific areas of instruction.

*Maintenance*

Maintenance of a behavior change “is defined as the extent to which the learner continues to perform the target behavior after a portion or all of the intervention has been terminated” (Cooper, Heron & Heward, 1987, p. 582).
Assessing the variables that influence maintenance of behavior was a goal of a ground-breaking study by Koegel and Rincover (1977). The results showed that the thinner the schedule of reinforcement used in the research setting, the greater the maintenance of behavior in alternate settings. A second finding of the study was that intermittent use of non-contingent reinforcers caused behaviors to maintain over time.

In 1989, Baer (1989) reviewed literature dealing with behavior problems of children. She found that, although there were many reports of successful behavior changes, there was a much smaller body of literature that contained an active strategy for programming for the maintenance of these changes. The strategies she found in the literature included; teaching social learning principles or self-management skills, extending experimenter contact through phone calls or providing booster sessions, and the use of intermittent schedules of reinforcement. Baer reports that these strategies produced maintenance in these studies. She also found that very few studies assessed long term maintenance.

To increase the likelihood that behaviors changed during intervention will continue, Martin and Pear (2003) suggest four general approaches. The first approach is to plan for natural contingencies of reinforcement to take effect. It is also acceptable, and sometimes well advised, to use "behavioral traps" in contacting natural contingencies. A second approach involves changing the people in the natural environment so that the behavior does not come under the control of a single person's presence. Dependent on the reinforcement and schedule chosen, these people may require training in reinforcement strategies. A third approach is to use intermittent schedules of reinforcement until the behavior comes under the control of natural reinforcers. The last approach is giving the
control of the behavior to the student by teaching self-management techniques or teaching them to recruit reinforcement in the natural environment. Using one or a combination of these strategies while programming behavior change will help to maintain the behavior changes over time.

Generality

In a landmark article by Baer, Wolf, and Risley (1968), a behavioral change was said to have generality if “it proves durable over time, if it appears in a wide variety of possible environments, or if it spreads to a wide variety of related behaviors” (p. 6). There are two types of generality to consider. One form is response generalization. It is defined as the “extent to which a learner performs a variety of functional responses in addition to the trained response” (Cooper, Heron & Heward, 1987, p. 582). The second type of generality is stimulus generality. It refers to the “extent to which a learner improves his performance of the target behavior in environments different from the original training environment” (p. 582).

Baer, Wolf, and Risley emphasized that “generality is a valuable characteristic of applied behavior analysis” and that it is not automatically accomplished. Like maintenance, conditions for generality must be programmed into behavior changes. This programming can be achieved in several ways (Cooper, Heron & Heward, 1987). Behavior should contact natural existing communities of reinforcement. To achieve this, the behaviors either need to be fluent, recruitment of reinforcement needs to be taught or both. A second way to achieve generalization is to teach enough different examples. The examples should be chosen by the general case strategy method to ensure that the examples represent the range of stimuli and response variations that are required in the
natural environment. A third strategy is to program common stimuli from the generality setting in the educational setting. Analysis of the generality setting is necessary to achieve this strategy. All non-critical stimuli should be varied during instruction to reduce the likelihood that any one stimulus would gain control over the behavior being taught. Contingencies that are introduced should be indistinguishable to the learner. The learner should not be able to determine whether the training contingencies are in effect (i.e., whether the game is on or off). This is accomplished by using delayed reinforcement and/or intermittent schedules of reinforcement. The use of some or all of these strategies will make generality of response or setting more likely to occur.

Social Validity

Social validity has been a concern for behavioral researchers since the 1970s. In a landmark article, Wolf (1978) raised the issue of the need for social validity in research. The exact definition of social validity, however, was of great concern. After a great deal of consideration, Wolf concluded that for a behavioral change program to be judged to have social validity, it would need to be validated in three areas: social significance of behavior goals, social appropriateness of procedures used, and social importance of the results. Thus, the goals of an instrument to judge social validity should consider: if the specific goals or behavior are what the consumer and society want, whether the participant and other consumers consider the treatment procedure(s) to be acceptable, and finally, whether the consumers are satisfied with the results.

When Schwartz and Baer (1991) considered the issue of social validity more than ten years later, they came up with similar conclusions. They defined the purpose of social validity as evaluating "the acceptability or viability of a programmed intervention" (p. 24).
It is not a measure of the program’s effectiveness. They further refined their
definition to say that the aim of assessing social validity is “to anticipate rejection of a
program (or treatment) before (it) happens” (p. 189). To achieve this goal, all relevant
consumers of the program or treatment must be queried in some format as to the
programs’ goals, methods, personnel, outcomes, and likelihood of integration into the
consumer’s life.

The article goes on to define four classes of relevant consumers. Direct consumers
are the primary recipients of the intervention. They can affect the program by
participating or refusing to participate at any time. A second category of consumers was
labeled indirect. Indirect consumers are the people who purchase or hire the program for
someone else and are strongly affected by the behavior change of the direct consumer.
They can affect the program by either purchasing or not purchasing more of it and
recommending or not recommending it to other potential consumers. A third category of
relevant consumers is the immediate community. These are the people who interact with
the direct or indirect consumers on a regular basis. They can affect the program by
choosing to interact or not interact with the direct and indirect consumers. The fourth and
final category of consumers that Swartz and Baer identify is the extended community.
This group consists of people who probably don’t know or interact directly with the
direct or indirect consumers but live in the same community. They can affect the program
with their opinions and using their voice to influence opinion in the community.

Given these classes of consumers, as well as goals and aims for social validity
assessments, Schwartz and Baer say that collecting social validity information in a valid,
reliable, cost efficient manner is not just a matter of constructing a sound social validity
assessment instrument. It is a matter of “asking the right questions to the right people in an appropriate manner” (p. 193).

Purpose of the Study

The purpose of this study was to investigate the effects of a same-age computer-assisted peer tutoring procedure on students’ ability to tell time to the hour, half hour, and quarter hour. The tutoring procedure that was used was a modification of the system developed at The Ohio State University by Cooke, Heron, and Heward (1983). The tutoring procedure differed from the Cooke, Heron, and Heward procedures by using a personal computer program to display the time, providing the tutor with prompts and the correct answer during the tutor session, and also tracking the number correct per session. The students still had the opportunity to participate on a daily basis as both tutor and tutee. The study also investigated the students’ retention of knowledge and generalization of time telling skills to untrained times.

Research Questions

1. What were the effects of same-age computer-assisted peer tutoring on the acquisition of time telling skills to the hour, half hour, and quarter hour?

2. What were the effects of computer-assisted peer tutoring on the tutor’s ability to conduct an effective tutoring session?

3. What were the effects of computer-assisted peer tutoring on the acquisition of untrained times?
4. What were the effects of computer-assisted peer tutoring with computer prompting on the short and/or long term retention of previously mastered times?

5. What were the opinions of teachers and students regarding the use of computer-assisted peer tutoring?
CHAPTER 2

METHOD

This section will describe the methods and procedures that were used to conduct this study. Included is a description of the participants, setting, experimenter, materials, procedures, interobserver agreement, and design.

Participants

The participants were five male and one female first grade students assigned to a primary grade resource room that served students with cognitive disabilities. They were chosen because of their cognitive disabilities and regular attendance in the resource room. All six students were seven years old at the start of the study and all but one turned eight during the study. All six students were identified as having developmental delays. Additionally, Student 1 had a speech problem. Student 2 had emotional impairments. Student 3 had a speech problem. Student 5 had severe speech problems and an unnamed syndrome that affected his fine motor skills. Student 6 had a seizure disorder that was not controlled well by medication; see Table 2.1 for a summary of the six participants. The remainder of the students in the class attended the resource room, on an as-needed basis, and were attended to by the special education classroom teacher and aide.
<table>
<thead>
<tr>
<th>Student</th>
<th>Sex</th>
<th>Grade</th>
<th>Age</th>
<th>Additional Disability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>1</td>
<td>8</td>
<td>speech</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>1</td>
<td>8</td>
<td>emotional</td>
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<td>3</td>
<td>M</td>
<td>1</td>
<td>8</td>
<td>speech</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>1</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>1</td>
<td>8</td>
<td>speech, fine motor</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>1</td>
<td>7</td>
<td>seizures</td>
</tr>
</tbody>
</table>

Table 2.1: Summary of Student Characteristics

**Setting**

This study was conducted in a resource room located within a suburban elementary school in Central Ohio. The elementary school housed 615 students in grades kindergarten through fifth grade. The resource room was in the southern wing of the building. It measured 7.9 meters by 8.3 meters. The north and south walls of the classroom were covered by a blackboard and bulletin boards. The west wall was half window, half cinder block, and had a counter and bookshelves running the full length of the wall. The east wall had the hallway to the door, the sink, the coat rack/shelving unit, and portable bookcases. The special carpeted area was in the southeast quadrant. The four 91 cm by 91 cm student work tables were placed behind the rug area. The computer area was in the northwest corner of the room and was located behind the teacher’s desk. This area consisted of two 152 cm by 76 cm tables that held two computers each.
Experimenter

The experimenter was a graduate student at The Ohio State University working to obtain a Master of Arts degree and licensure as an Intervention Specialist. She had a Bachelor of Science degree in Home Economics Education from the Pennsylvania State University and Masters of Business degree from the University of Pittsburgh. She had taught in middle and high schools in Oklahoma and North Carolina for brief periods as a substitute teacher. She held an Ohio 5 year license in Home Economics Education 7-12 and was completing her sixth year substitute teaching, mostly elementary, in a suburban school district in Central Ohio. Her role in the experiment was as the tutor trainer and teacher during tutoring sessions. She also served as the data collector for the study.

Observers

The observers were the resource room teacher and aide. The observers were trained by the experimenter to record the information on the observation forms. The observers were also trained to conduct the daily oral assessment. The observers were not informed of the experimental conditions, but they were present in the experimental setting and observed the study on a regular basis.

Definition and Measurement of Dependent Variables

The dependent variables measured in this study were (a) acquisition of telling time skills, (b) maintenance of telling time skills, (c) generalization of telling time to the whole, half, and quarter hours, (d) tutoring behaviors, and (e) participant and teacher opinions of peer tutoring with computer prompting.

Acquisition of telling time skills. Prior to the beginning of the study, students were assessed to determine their knowledge of times to the hour, half hour, and quarter hour. A
correct response for hour and half hour times was defined as the student saying the
correct hour followed by o'clock for hour and saying the correct hour plus thirty for half
hour. A correct response for quarter hour times was defined as the student saying quarter
past the correct hour or hour fifteen and hour forty-five or quarter till hour. Any deviation
from the acceptable formats was scored as incorrect and counted accordingly. Acquisition
described student performance to achieve mastery. Mastery was defined as the student
giving a correct response when shown the time on a Judy clock face, a large plastic clock
with moveable hands, for three consecutive days. A clock time would not be counted for
mastery if the student did not respond correctly on three consecutive days. A set of eight
clock times was considered mastered when a student correctly identified 7 out of 8
individual times (88%) within the set for three consecutive days.

Math maintenance. Maintenance was defined as the extent to which the
participant continues to perform the target behavior after a portion or all of the
intervention was terminated. Maintenance was assessed using probes following
acquisition of each set of eight times and two days subsequent to termination of
the daily peer tutoring procedure. Individualized tests were constructed that
contained times that the student had previously been judged to have mastered. If
the student identified the time on the Judy clock face correctly, the time was
judged to be maintained. If the student did not correctly identify the correct hour
correctly and say the proper subscript (e.g., o'clock, thirty, quarter past) the
time was judged as not maintained.

Math generalization. Each participant was assessed for math
generalization during and following the study. Response generalization was
defined as the extent to which the participant performed a variety of responses in addition to the trained response. In the case of telling time, generality was to the times not directly trained in the peer tutoring session. This was dependent on the times taught directly to each participant in peer tutoring and each probe was individualized to the participant’s acquisition progress at that time. For example, if the initial assessment determined that a student knew hours but nothing else, the tutoring sessions started with the half hour and, depending on acquisition, could continue to the quarter hour. The generalized time assessed for this participant would be telling time to the five minute interval and minute interval, not the half or quarter hour that was used in peer tutoring sessions.

*Tutoring behaviors.* Tutors were scored on their use of specific tutoring behaviors during training and actual tutoring. Tutoring behaviors were the actions and speech that must occur during each step of the tutoring process. Tutoring behaviors included initial prompting, prompting for incorrect response, praise, and printing results. A checklist containing all tutor behaviors was used to determine if the student was correctly conducting the tutoring session. This was assessed by the experimenter and verified by the observers approximately 25% of the time (See Appendix A for checklist).

*Opinions of tutoring.* Opinions of computer-assisted peer tutoring were solicited from the study’s direct consumers (students) and members of the immediate community (classroom teacher and aide). They were asked questions pertaining to the social significance of the program, as well as, social appropriateness of peer tutoring and computer applications. They were also asked a question to evoke satisfaction with the treatment outcome. The students were asked this series of questions orally by a neutral
observer and the answers were recorded in a written format as shown in Appendix B. The teacher and aide responded by completing a second questionnaire (See Appendix C).

**Materials**

Computer—1 per tutoring pair

Computers had “Flash” installed with a minimum of a Windows 98 operating system. A special copyrighted program developed by a doctoral student at the Ohio State University was used for presenting clock times.

Progress chart—1 per student

Graphs were constructed by the experimenter for each student and the experimenter recorded the percentage of correct problems on a daily basis. The graphs were shown to the student at the end of each session.

Observation forms (See Appendix A)

Forms were used by observer to record tutoring behaviors. A laminated version was used to assess interobserver agreement and wiped off and reused after data were recorded on the observer form.

Daily oral assessment forms—1 per student daily (See Appendix D)

Forms were generated by the computer and printed by the tutor at the end of each computer tutoring session. The form was also used to assess a student’s knowledge of telling time in oral form. The form provided a place on which to record daily assessment data.

Data Collection Forms—1 per student for each study phase (See Appendix E)

Forms were used by observer to record results of each tutoring session from Daily Assessment forms.
IOA Data Collection Form—1 per behavior (See Appendix F)

Forms were used by observer to record results of each tutoring where procedural integrity data was collected.

Large Judy Clock

Scripts of Tutor Training Sessions (See Appendices G-K)

 Procedures

 Pre-assessment. The six students participating in the study were assessed individually by the experimenter. Each student was shown all 12 times individually to the hour and 12 times individually to the half hour and in random order using a Judy clock. If the student knew 75% or more of these times three days in a row, the pre-assessment continued using quarter hour times. Responses were recorded on the master sheet as either correct or incorrect following the same criteria as described in the acquisition section.

 Tutor training. The six tutors were trained during a series of seven to seventeen training sessions. The tutors were trained to type in names and start the tutoring computer program, prompt responses, receive a computer prompt if they were not sure of the correct answer themselves, give praise, and print the results. These skills were taught using skill demonstration, teacher modeling, group role playing, and student practice (i.e., a model, lead, test format). Each session lasted approximately 20 minutes and was conducted during the time that has been set aside in the morning for peer tutoring.

 Session 1 training. Session 1 was an introduction and orientation to the computer assisted peer tutoring program. The first session was held as a group. The tutors were told how important their role was in the peer tutoring process. They were shown all the
materials; the computer program, headphones, observation form, computer generated oral assessment form and a hand drawn graph. They had a chance to become familiar with these items. The teacher then modeled a tutoring session playing the role of tutor and the students played the role of tutee. The script for this session is shown in Appendix G.

Session 2 training. This session began with a review of the previous session. The researcher then reversed roles with the group. The students took turns serving in the role as tutor while the group continued to act as tutees. Once everyone had a chance to practice being a tutor with the group, the session ended. A script for Session 2 is found in Appendix H.

Session 3 training. Session 3 started with a procedural review from the previous session. The tutors were then ready to role play in pairs as tutor and tutee. The pairs had the opportunity to act as both tutor and tutee to practice. The experimenter monitored correct procedure and stepped in and modeled correct procedure as necessary. A script for this session is found in Appendix I.

Session 4 training. This training session began with the students going with their partner to a computer to practice an actual tutoring session. They switched roles when finished. The experimenter monitored the tutor for correct procedure usage and provided prompts and modeling as necessary. When the experimenter was satisfied that everyone had demonstrated correct procedure and printed the results, the tutoring session ended. The script is in Appendix J.

Session 5-17 training. The last sessions were student practice for all the steps in a tutoring session from start to finish. The students practiced all the procedures step by step. When they completed the tutoring session, the participant worked with the
researcher one-on-one to orally assess their knowledge of telling time. The aide worked with the remaining students on their morning assignments. The session ended when all six participants worked with the researcher. The script for session 5 to 17 can be found in Appendix K.

_Tutoring sessions._ The actual tutoring sessions began the session following the completion of tutor training and were phased in as follows: pair 1 session 10, pair 2 session 15, and pair 3 session 18. The duration of each tutoring session was approximately 10 to 30 minutes. Each session began with the pairs of students sitting down at the computer, the tutor on the right and tutee on the left. The tutor typed in his/her name and the student typed in his/her name. The tutor then put on the headphones and clicked the start button. The first clock screen appeared. The tutor then asked the student, "What time is it?" The student responded by saying a time. The tutor told the student either “Good Job” or “Try Again” as determined by whether tutee’s response was correct or incorrect. If the tutor was not sure that the student said a correct or incorrect response, he/she had an opportunity to click the mouse on the loud speaker button, shown on the computer screen, to hear the time repeated in his/her headphones. If the student said the wrong time again in response to “What time is it?, the tutor told the student the time and asked them to repeat it, “Say (time)”. The tutor clicked on the green button if the student responded correctly to the time on the first or second try. At approximately the sixteenth session, a new procedure was instituted for the tutee. If the tutor responded to the tutee saying the correct time with “Good Job” a ticket (a 2.5 cm by 5 cm slip of
colored computer paper) was removed from the tutee's hand and placed in a pile on the computer table in front of them. The tutor clicked on the red button if he/she had to tell the student the time and had the tutee repeat saying the correct time. After the green or red button was pushed, the next clock screen came up automatically and the procedure was repeated. The tutor proceeded through 24 time trials. At the end of 24 trials, the result screen appeared. Following session 17 it was determined that twenty four trials was too large a number to produce acquisition at an acceptable rate. The set of twenty four times was separated randomly into three sets of eight times and was used in Sessions 18 to 37. The number of trials was reduced to three sets of eight trials to facilitate the completion of the clock times. The tutor and student then read together “Good Job, (student). You had (#) right. Thank you for helping (tutor). The tutor printed the results and handed the sheet to the researcher. The tutor and tutee then switched roles and repeated the tutoring session. When each student had completed a turn as both tutor and tutee, they came to the table one at a time to work with the experimenter. The other students worked with their resource room teacher or aide. The experimenter conducted an individual oral assessment of the times they had just reviewed in the tutoring session by showing times on the Judy clock and had the student respond. The responses were recorded as correct or incorrect using the same criteria as the pre-assessment and recorded on the computer summary form for each student (See Appendix D). The session was ended for the student after they responded to all the times. The script is found in Appendix L.
Post-assessment. All students took an oral test with the researcher at the conclusion of the study. The procedure was identical to the pre-test, contained the same items, and was scored identically.

Procedural Integrity and Interobserver Agreement

A check of procedural integrity and interobserver agreement of tutor observation forms and daily oral assessment computer summary forms filled out by the researcher was taken at least weekly, approximately 25% of the time, to ensure that procedures for tutoring were being followed and that the data are believable. The observer filled out the (a) observation checklist in laminated form, found in Appendix A, and (b) the computer generated summary form, found in Appendix D, simultaneously with the researcher. The answers were compared and agreement or disagreement was recorded on the researcher’s form. An agreement number was calculated by taking number of agreements divided by number of agreements plus disagreements and multiplying by 100.

Experimental Design

A multiple probe design across skills was used to assess the effects of computer-assisted peer tutoring on acquisition of time telling skills (i.e., hour, half hour, and quarter hour). The study consisted of two phases with probes being taken periodically on previously tutored and untutored times: (1) baseline, in which data were collected on the times the participants had already mastered and (2) staggered implementation of treatment, in which data were collected from an oral assessment and recorded on the computer printout at the end of each tutoring session. The baseline phase was used to predict the participants’ performance of time telling skills if there was no intervention. The implementation of treatment demonstrated that changes in performance of time
telling skills were a result of the intervention. The probes demonstrated the maintenance of previously taught times and generalization to untaught times. Data analyses were conducted visually.
CHAPTER 3

RESULTS

This chapter presents the results of the study, beginning with a discussion of interobserver agreement measures. Next, data for individual students are presented followed by tutoring procedure results. Finally, the chapter concludes with the presentation of the results of a consumer satisfaction questionnaire completed by the students, teacher, and aide.

Interobserver Agreement

Interobserver agreement was obtained for tutoring procedures and daily oral assessment results. Agreement scores were calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100. Procedural reliability of tutors was measured with a checklist of eight items that were completed by the researcher for each tutor during most sessions. An additional observer was trained by the researcher and completed the same checklist in laminated form during 8 sessions or 33% of the time. The results of tutoring procedure reliability, presented in Table 3.1, shows an agreement 94%, range 75% to 100% across participants.
<table>
<thead>
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<th>Student</th>
<th># of Sessions</th>
<th>Agreement or Disagreement</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8 out of 25</td>
<td>8 A</td>
<td>0 D</td>
</tr>
<tr>
<td>2</td>
<td>8 out of 25</td>
<td>8 A</td>
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</tr>
<tr>
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<td>8 out of 26</td>
<td>8 A</td>
<td>0 D</td>
</tr>
<tr>
<td>4</td>
<td>8 out of 24</td>
<td>6 A</td>
<td>2 D</td>
</tr>
<tr>
<td>5</td>
<td>8 out of 23</td>
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<td>0 D</td>
</tr>
<tr>
<td>6</td>
<td>8 out of 23</td>
<td>7 A</td>
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<tr>
<td>Total</td>
<td>48 out of 146</td>
<td>45 A</td>
<td>3 D</td>
</tr>
</tbody>
</table>

Table 3.1: Tutoring Procedure Agreement

An additional measure of interobserver agreement was obtained for the dependent variable, acquisition of times, during the daily oral assessment following each tutoring session. An additional observer was present for 70 of the 198 sessions or 35% of the time. The results, presented in Table 3.2, show 91% agreement, range 67% to 100% across participants.
<table>
<thead>
<tr>
<th>Student</th>
<th># of Session</th>
<th>Agreement or Disagreement</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11 out of 33</td>
<td>11 A 0 D</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>11 out of 33</td>
<td>11 A 0 D</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>12 out of 34</td>
<td>11 A 1 D</td>
<td>92%</td>
</tr>
<tr>
<td>4</td>
<td>12 out of 33</td>
<td>8 A 4 D</td>
<td>67%</td>
</tr>
<tr>
<td>5</td>
<td>12 out of 33</td>
<td>12 A 0 D</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>70 out of 198</td>
<td>64A 6 D</td>
<td>92%</td>
</tr>
</tbody>
</table>

Table 3.2: Oral Assessment Agreement

**Student Results**

Six students completed this study. In the first phase, data were collected from each student for all 12 hour and 12 half hour times and are reported as percentage correct. If a student achieved a score of 75% or above, data were collected for 24 quarter hour times and are also reported as percentage correct. If a student did not achieve a score of 75% correct for hour and half hour, data continued to be collected for only hour and half hour times until the student pair was trained successfully to tutor and the second phase, peer tutoring, commenced. During the second phase, data were collected on tutoring times by the researcher following the tutoring session. These data were also recorded as percentage correct. Periodic probes of trained and untrained times continued during this phase of the study. The last phase was a post-test administered two days prior to the completion of the study. Data are again reported as percentage correct.
Student 1. Figure 1 shows a three tier multiple probe design across 38 sessions for Student 1. The top tier shows data for hour times. During baseline, the mean score for sessions 1 through 3 was 94.7%, range, 92% to 100%. Seven probes of hour times were conducted during the course of the study; each showed 100% accuracy. The middle tier shows data for half hour times. During the three session baseline phase, the mean score was 80.3%, range 75% to 83%. Seven probes were conducted during the course of the study for half-hour times, showing a mean score of 89.3%, range 75% to 100%. In effect, an increase of approximately 9% from baseline levels was evident. The bottom tier shows data for quarter-hour times. During baseline, all data points were 0%. Data collected on quarter hours during the tutoring phase had a mean score of 73.9%, range 8% to 100%. Data for the post-test were 100% for hours and half-hours and 92% for all quarter hour sets, set range from 88 to 100%. Data were extremely variable for Student 1 during the 24 time set of quarter hours. When tutoring trials were changed from having 24 time example items per set to having three sets of 8 example times per time set, data reflected a more consistent progression of acquisition for Student 1. For instance, in Set 1, the student’s mean score was 81.5%, range 75% to 100%. In Set 2, the student’s mean score was 90.8%, range 75% to 100%. In Set 3, the student’s mean score was 81.8%, range 63% to 88%. Overall, as compared to zero percent correct during baseline, Student 1 reached 81.8% correct by Set 3 as a function of tutoring. A weak functional relationship is evident with the data from Student 1. That is, performance on quarter-hour times did not improve until tutoring was in effect (see tier 3).
Figure 3.1: Student 1 Three Tier Graph
Student 2. Figure 2 shows a three-tier multiple probe design across 38 sessions for Student 2. The top tier shows data for hour times. During baseline, the mean score for sessions 1 through 3 was 100%. Seven probes of hour times were conducted during the course of the study; each showed 100% accuracy. The middle tier shows data for half-hour times. During the three session baseline phase, the mean score was 100%. Seven probes were conducted during the course of the study for half-hour times; each showing a score of 100%. Student 2 maintained his knowledge of hour and half-hour times during the course of the study. The bottom tier shows data for quarter-hour times. During baseline, the mean score was 89.8%, range 75% to 100%. Data collected on quarter hours during the tutoring phase had a mean score of 99.1%, range 88% to 100%. In Set 1, the student’s mean score was 100%. In Set 2, the student's mean score was also 100%. In Set 3, the student's mean score was 97%, range 88% to 100%. Overall, as compared to a mean score of 89.8% correct during baseline, Student 2 reached 97% correct by Set 3, a 7.2% increase. Data for the post-test were 100% for hours, half-hours, and quarter-hours. There is little evidence to suggest that the performance of Student 2 was affected greatly by the tutoring procedure. Prior knowledge was shown to maintain over the course of the study.
Figure 3.2: Student 2 Three Tier Graph
Student 3. Figure 3 shows a three tier multiple probe design across 38 sessions for Student 3. The top tier showed data for hour times. During baseline, the mean score for sessions 1 through 14 was 56.9%, range 0% to 100%. When tutoring was introduced, all three data points were 100%. Three probes of hour times were conducted during the course of the study; the mean score was 91.7%, range 75% to 100%. The middle tier shows data for half hour times. During the fourteen session baseline phase, the mean score was 32.5%, range 0% to 83%. When tutoring was introduced, the mean score was 80.3%, range 75% to 83%. Three probes were conducted during the course of the study for half hour times, showing a mean score of 58.3%, range 25% to 75%. Data were fairly consistent for Student 3 during the 24 time set of half-hours, and were within the parameters for the definition of acquisition. An increase of approximately 48% from baseline levels was evident from the data. The bottom tier shows data for quarter-hour times. During baseline, all data points were 0%. When tutoring trials were implemented for quarter hours, trials were changed from having 24 time examples per set to having three set of 8 times per time set. Data collected on quarter hours during the tutoring phase had a mean score of 60.8%, range 13% to 88%. Data reflected a consistent progression of acquisition of quarter hours for Student 3. For instance, in Set 1, the student’s mean score was 59.5%, range 13% to 88%. In Set 2, the student’s mean score was 67%, range 38% to 88%. Student 3 did not achieve mastery of Set 2 and therefore, did not begin Set 3 during the study. Overall, as compared to zero percent correct during baseline, Student 3 reached 67% correct by Set 2 as a function of tutoring. Data for the post-test were 75% for hours, 25% for half-hours, and 50% for all quarter hour sets. A weak functional relationship is
Figure 3.3: Student 3 Three Tier Graph
suggested, but not claimed with the data from Student 3. That is, performance on quarter-hour times did not improve until tutoring was in effect (see tier 2 and 3). However, improved performance during baseline conditions for hours and half hours prior to tutoring mitigate against claiming that tutoring was the only variable responsible for the change in performance. The study was terminated prior to Student 3 mastering quarter hour times. Student 3 was just starting to achieve mastery criteria for Set 2 times. Student 3 did not use Set 3 during the course of this study. Student 3 was able to maintain knowledge of hour times, but was not able to maintain his knowledge of half-hour and quarter-hour times at the level required for mastery.

**Student 4.** Figure 4 shows a three tier multiple probe design across 38 sessions for Student 4. The top tier shows data for hour times. Data were extremely variable during baseline. The mean score for session 1 through 14 was 53.1%, range 0% to 100%. After the tutoring procedure was introduced, all data points were 100%. Four probes of hour times were conducted during the course of the study; each showed 100% accuracy. The middle tier shows data for half-hour times. During the fourteen session baseline phase, the mean score was 5.3%, range 0% to 25%. Data collected on half-hours during the tutoring phase showed a mean score of 66.6%, range 8% to 100%. Four probes were conducted during the course of the study for half-hour times, showing a mean score of 84.5%, range 50% to 100%. Overall, an increase of approximately 61% from baseline levels was evident as a result of tutoring (see tier 2). The bottom tier shows data for quarter-hour times. During baseline, the mean score was 35.9%, range 0% to 88%. Data collected on quarter hours during the tutoring phase has a mean score of 78.3%, range
Figure 3.4: Student 4 Three Tier Graph
50% to 100%. Data for the post-test were 100% for hours, 50% for half-hours, and 63% for all quarter hours. Data were extremely variable for Student 4 during Set 1. The student’s mean score for Set 1 was 82.1%, range 50% to 100%. In Set 2, the student’s mean score was 66.7%, range 50% to 75%. Set 2 was started just prior to the conclusion of tutoring. This student never reached a mastery level, and therefore did not receive tutoring on Set 3. Overall, as compared to 35.9% correct during baseline, Student 4 reached 66.7% correct by Set 2 as a function of tutoring. A weak function relationship is evident with the data from Student 4. That is, performance on quarter-hour times improved by approximately 30% while tutoring was in effect (see tier 3).

**Student 5.** Figure 5 shows a three tier multiple probe design across 38 sessions for Student 5. The top tier shows data for hour times. During baseline, the mean score for sessions 1 through 17 was 74.5% range, 17 to 100%. Data collected on hours during the tutoring phase had a mean score of 91.4%, range 75% to 100%. Compared to baseline, a 17% increase in mean score was achieved as a result of tutoring. Two probes of hour times were conducted during the course of the study showing a mean score of 94%, range 88% to 100%. The middle tier shows data for half-hour times. During the seventeen session baseline phase, the mean score was 6.1%, range 0% to 50%. Data collected on half hours during the tutoring phase had a mean score of 65.6%, range 25% to 100%. Two probes were conducted during the course of the study for half hour time, showing a mean score of 62.5%, range 25% to 100%. Overall, an increase of approximately 60% from baseline levels was evident. The data suggest a weak functional relationship is suggestive with the data from Student 5. In other words, performance on half-hour times
Figure 3.5: Student 5 Three Tier Graph
did not improve until tutoring was in effect (see tier 2). Data were extremely variable for Student 5 during Set 3 of hour and half-hour times. Daily scores alternated from 75% to 100% for hour times. After seven such data points, it was determined that Student 5 would not meet the 3 consecutive day criteria for mastery of hour times; for instance, Session 28 (75%), Session 29 (100%), Session 30 (75%), Session 31 (100%). Tutoring on quarter hours was implemented despite not meeting the mastery levels for hours and quarter hours. Tutoring on quarter hours started just prior to the conclusion of the study. The bottom tier shows data for quarter-hour times. During baseline, the mean score was 5.7%, range 0% to 25%. Data collected on Set 1 quarter hours during the tutoring phase had a mean score of 19%, range 13% to 25%. Student 5 did not master Set 1 during the study and was not tutored on Set 2 or 3. There were insufficient data points for quarter-hour tutoring to draw any conclusions for Student 5. Data for the post-test were 100% for hours, 25% for half-hours, and 13% for quarter hours.

Student 6. Figure 6 shows a three tier multiple probe design across 38 sessions for Student 6. The top tier shows data for hour times. During baseline, the mean score for session 1 through 17 was 85.7%, range 0% to 100%. Data collected on hours during the tutoring phase had a mean score of 86.1%, range 50% to 100%. Compared to baseline, a 1% increase in mean scores was achieved as a result of tutoring. One probe of hour times was conducted during the course of the study, which showed 100% accuracy. The middle tier shows data for half hour times. During the seventeen session baseline phase, the mean score was 7.1%, range 0% to 100%. Data collected on half-hour times during the tutoring phase had a mean score of 23.6%, range 0% to 100%. Compared to baseline, a
Figure 3.6: Student 6 Three Tier Graph
16.5% increase in mean scores was achieved as a result of tutoring. One probe was conducted during the course of the study for half hour time which was 0%. Overall, a weak functional relationship is evident with the half-hour data from Student 6. That is performance on half-hours times did not improve until tutoring was in effect (see tier 2). The bottom tier shows data for quarter-hour times. During baseline, all data points were 0%. Student 6 never achieved mastery for half-hour times and therefore never was tutored on quarter hour times during the study. Probes conducted during the course of the study for quarter hours were all 0%. Data were extremely variable for Student 6 during the tutoring phase of the study. For example, hour data points were either seventy-five or one hundred; sessions 25, 26, and 27 were 100%, session 28 was 75%, 29 and 30 were 100%, and 31 was 75%. Tutoring on half hours showed a more consistent pattern of acquisition although there was periodic regression on previously learned times. For example session 30 was 50%, sessions 31 to 33 were 25%, session 34 was 50%, session 35 was 25%, and session 36 was 100%. Data for the post-test were 100% for hours and half-hours and 0% for quarter hours.

_Tutoring Procedure_

The students in this study were able to carry out the physical mechanics of tutoring: mean 99%, range 86% to 100%. Physical mechanics refers to sitting in the correct position, starting the computer independently, typing the names in the boxes, and getting to the clock page.

The actual tutoring protocol; including prompting, praising, correct procedure for a wrong answer, and clicking on the correct button, caused the greatest problems for three
of the six students. Following tutoring protocol for prompting and praising had a mean of 79%, range 36% to 95%. Using correct procedure for a wrong response was a problem as well: mean 73%, range 32% to 100%. Clicking on the correct button at the end of a tutoring trial was correct on average 70% of the time, range 36% to 96%.

In the final step of the tutoring process, the students were required to print the results for the research. The students completed the task successfully 93% of the time, range 83% to 100%. Overall, three students carried out all tutoring tasks correctly over 90% of the time, two students over 80% of the time, and one student over 70% of the time.

In effect, with the exception of Student 4, the participants were able to conduct the trained elements of tutoring as they were trained. If students were trained to do a procedure, they did it. However, even with Student 4, computer mechanics were carried out accurately 99% of the time and tutoring procedures 74% of the time. All components of tutoring were carried out accurately 89% of the time.
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Table 3.3: Summary of Tutoring Behavior

Social Validity Data

After the conclusion of tutoring and prior to the post-test, the students, teacher, and aide were asked to fill out a questionnaire (See Appendices B and C).

The student questions were designed to evoke opinions of the tutoring experience, specifically working with an assigned partner and preferences for the role of tutor and
tutee. Students were also asked their opinion of the role of computer tutoring in helping them be a better tutor and helping them learn to tell time. The final question was intended to determine satisfaction with the entire computer tutoring experience.

Four out of the six students responded that they liked working with their partner. The two students that responded negatively were not paired for the procedure. When asked which role, tutor or tutee, was preferred, four students responded, tutor. The other two student's responses were split, one student liked both roles equally, and the other preferred being the student. All six students agreed that using the computer helped them be a better tutor. Five out of the six students felt that the computer helped them learn to tell time. When the students were asked what they liked best about computer-assisted tutoring, three responded by saying “using the computer”. Other student responses were; working with the researcher, learning to tell time, and being rewarded for using proper tutoring procedure. When asked what they did not like about tutoring, three students stated they didn’t like cleaning up the tickets and three said nothing—they liked it all. When asked if they would like to do tutoring again, all but two replied that they would. The two that said they would not like to do it again were the same two who reported that they did not enjoy working with their partner. Compatibility of tutoring teams appears to influence satisfaction with the tutoring procedure.

The teacher/aide questionnaire was slightly different. Questions were asked about computer tutoring as a method of teaching students to tell time, the ease of implementation, and whether they would recommend computer-assisted peer tutoring to other teachers. Both the teacher and aide answered in the affirmative to all three questions. When asked what would make the program more beneficial to the students,
both the teacher and aide agreed that it should be started in the fall to allow for more time to learn during a less hectic time. There were too many special events planned for the spring. The aide also responded that she would like to see a program for other mathematical concepts, specifically money.

The teacher and aide were also asked what they liked most and least about the program. The teacher responded “I loved that the students learned to work as teams and were responsible for themselves and each others progress”. The teacher disliked the fact that the program was implemented in the spring when the schedule is the most hectic. The aide responded “The way they learned to work together” as her favorite part of the program and mentioned interference with the schedule as a problem.

Most participants agreed that they enjoyed and learned from computer-assisted peer tutoring. The assignment of tutoring teams does appear to influence satisfaction and preference for using the procedure again.
CHAPTER 4

DISCUSSION

The main purpose of this study was to investigate the effects of a same-age computer-assisted tutoring procedure on the ability of students with developmental delays to tell time to the hour, half hour, and quarter hour. The study also investigated the students’ retention of knowledge and generalization of time telling skills to untrained times.

This chapter discusses the findings of the study and the congruence with the literature. Included is a discussion of the limitations of the study that may have affected the outcome and implications for teachers. The chapter concludes with recommendations for future research related to computer-assisted peer tutoring.

Research Questions

Question 1: What were the effects of same-age computer-assisted peer tutoring on the acquisition of time telling skills to the hour, half hour, and quarter?

The results for Student 1 show the clearest pattern of acquisition as a result of tutoring. During the pre-test, Student 1 had a firm knowledge of hour and half-hour times. His errors were limited to confusing the numbers eight and ten (part of his described disability) and forgetting the word “thirty”. Once he had minimal exposure to the term, he was able to maintain his knowledge of hour and half-hour times through the course of the study.
Student 1 had no prior knowledge of quarter-hour times. Four straight data points showed zero percent correct on quarter-hour times. Tutoring was started with a 24-trial set of quarter-hour times. Progress was minimal. Once the eight trial set commenced, Student 1 made consistent progress toward mastery. He was able to achieve mastery criteria in six sessions. Set 2 percentage correct began at the same level as Set 1. Student 1 achieved mastery in six sessions again. He was able to achieve mastery in four tutoring sessions for Set 3.

The pre-test for Student 2 showed mastery for hour and half-hour times. He also met mastery criteria on quarter hours during baseline. Student 2's participation in the study was to assess maintenance of prior knowledge and to act as a tutoring partner for Student 1. His knowledge of hour, half-hour, and quarter-hour times had at least an 88% accuracy level throughout the study. Hence, a functional relationship between the independent and dependent variables cannot be claimed for Student 2.

Student 3 showed little knowledge of hour or half-hour times during pre-testing. However, throughout baseline conditions, his knowledge of hour and half hours progressed to mastery level for hours and within 3 to 6 problems for mastery of half hours even before tutoring was initiated. Once tutoring began, it only took 3 sessions to achieve mastery criteria for half-hour times. Tutoring clearly had a positive influence on his acquisition of hour and half-hour time even without being taught using “proper tutoring procedure”. Most of his acquisition was during baseline when he was still being trained making it difficult to state that his learning was due to tutoring. Stated in other words, the fact that his percentage correct improved for hours and half hours before formal tutoring began reduces the power of any claim that tutoring affected the change.
All probes of quarter hours for Student 3 were zero percent. Acquisition was slow. After 15 tutoring sessions, he had not achieved mastery criteria. Student 3 used Set 2 for the last three tutoring sessions. He was able to learn Set 2 in twelve fewer sessions than Set 1. Tutoring appears to have affected his performance in a positive manner for quarter-hour times, but a convincing functional relationship cannot be claimed.

Student 4's performance was extremely variable scores for telling time to the hour during baseline conditions. He had days where he was reluctant to participate in tutoring. This could have affected his scores. He also exhibited extremely poor tutoring protocol which kept him and his partner, Student 3, from starting tutoring trials sooner. When actual tutoring began, his score for hours rose from 63% to 100% on three consecutive sessions. Data showed mastery of hours. Further, his performance of half-hours increased quickly once tutoring began. From his baseline mean of approximately 5%, he did well enough on Set 1 in two tutoring sessions to start Set 2. He immediately had 2 consecutive scores of 100% for Set 2. During the time he was being tutored on hour and half-hour sets, Student 4 was tutoring Student 3 on quarter hours. Student 4's knowledge of quarter hours increased during this time as shown by a series of probes, session 17 to 25 (see Figure 3.4). There is a reasonable case to be made that tutors learn as part of the tutoring process which supports previous work conducted by Fuchs and Fuchs (2001). Acquisition of quarter-hour times remained at approximately the same level once he started being tutored on quarter-hour times. Student 4 started Set 2 quarter hours just prior to the conclusion of the study. A weak functional relationship between tutoring and the performance levels might be argued based on the dramatic jump in scores for hour times, half-four times, and to some extent quarter-hour times. However, the claim is weakened
substantially by the increase in the percentage of correct responses during baseline for quarter-hour times.

Student 5 was part of the last pair to start tutoring. His partner had an extremely difficult time learning to follow the tutoring protocol. During an extended baseline, phase, Student 5 acquired mastery of hour times. The exposure to the times in tutor training was apparently enough to reinforce prior knowledge and produce mastery. Half-hour times appear to have a different explanation. These times were not in Student 5's repertoire. The word "thirty" was unknown and very hard for him to remember. When prompted, he said the correct hour but always said "o'clock". Correct behavior became more consistent through exposure during tutoring.

Quarter hour terminology was not in the student's repertoire either. He showed very little knowledge of quarter-hour times during repeated baseline probes until he seemingly started to overhear others tutoring. He seemed to pick up on the word "fifteen" which he used for some quarter times. More often than not, quarter hours were "thirty". He seemed to be easily confused by the concepts. This could be due to his disability or to his lack of knowledge about numbers and the concept of half and quarter hours. Mastery of quarter-hour times was never even approximated.

Student 6 had a strong grasp of hour clock times prior to the study. With the exception of two data points, all baseline data points were 100%. Counterintuitively, when tutoring was introduced, her performance became more erratic. There are two possible causes for this phenomenon. One is that the mixed hours and half hour trials confused her. The other explanation was that as her neurological seizures became worse and her medication levels were constantly being increased during the tutoring phase of
the study erratic performance occurred. Toward the end of the study, she was taken off medication. Her constant arguing stopped. She also was able to identify all hour and half-hour times correctly during her final sessions. Anecdotal information suggests that her learning of half hours was affected by her medication.

In summary, when Students 3 to 6 were tutored on hours, all four students achieved mastery. The results for half-hours are not as strong. Students 3 and 4 achieved mastery criteria. Student 5’s acquisition plateaued at 75%. Student 6 was one data point short of the definition of mastery. The claim can be made that computer-assisted peer tutoring helped students 3 to 6 acquire skills in telling time to the half hour, but a convincing functional relationship cannot be claimed.

Tutoring was in effect for telling time to the quarter hour long enough to draw strong conclusions for only two of the six students. Student 1 achieved mastery on two sets and was close to criterion level for Set 3. Student 3’s performance on quarter hours improved during the course of the study. He never achieved mastery. There is sufficient proof to claim that the gains were suggestive of tutoring’s beneficial effect. The gains in knowledge are consistent with research that has concluded that academic gains are achieved for both the tutor and tutee as a result of tutoring (Cohen, Kulik, & Kulik, 1982; Osguthorpe & Scruggs, 1986)

**Question 2: What were the effects of computer-assisted peer tutoring on the tutor’s ability to conduct an effective tutoring session?**

This study never specifically defined requirements for an effective tutor. Effective teaching was defined as being reliable, valid, state of the art, and based on research (Heron & Harris, 2001; Peters & Heron, 1993). However, procedural integrity was
collected on three categories of tutoring behavior. A student's ability to perform these tasks accurately suggests his or her ability to be an effective tutor.

A proper tutoring session was divided into three categories. The first category was mechanics of computer tutoring: sitting in the correct position, typing the names in correctly, and starting the tutoring program independently. The second category was tutoring protocol: prompting, praising, using correct procedure for a wrong response, and clicking on the correct button based on tutee trial response(s). The last category was printing the score page.

The students in this study were able to carry out the physical mechanics of tutoring: mean 99%. Scores for following tutoring protocol were extremely variable: prompting and praising had a mean of 79%, using correct procedure for a wrong response was mean 73%, range, and clicking on the correct button at the end of a tutoring trial was correct on average 70% of the time. In the final step of the tutoring process, the students were required to print the results for the research. The students completed the task successfully 93% of the time, range 83% to 100% and appeared to find it reinforcing. Overall, three students carried out all tutoring tasks correctly over 90% of the time, two students over 80% of the time, and one student over 70% of the time.

The effect of the computer on prompting, praising, and error correction procedure are not as clear. The students were able to do the mechanics of computer tutoring. The tutoring protocol for the computer is similar to that of the program by Cooke, Heron, and Heward. (1983): prompting, praising, and correct response for an incorrect answer. The computer had no role in the above procedures. The student, who was in the role of tutor,
had to implement these procedures. Perhaps the computer could be programmed to do these procedures in future studies.

Clicking on the correct button was a substitute for placing cards in the correct pile. Students in this study performed this accurately 70% of the time. The researcher is not aware of data of this nature in traditional tutoring, so a judgment of effectiveness cannot be made. The computer did an effective job of replacing the tutor huddle (Heron, Heward, Cooke, & Hill 1983); as the correct answer was always available to the tutor. In sum, the computer did not hinder students, but it did not provide extra support to prompt for correct procedure.

**Question 3: What were the effects of computer-assisted peer tutoring on the acquisition of untrained times?**

Untrained times were defined as those that a student had not received during tutoring. When probes were taken on untrained times, most students exhibited no knowledge of the skill. That is the probes were at zero percent correct. Probes of quarter hours for Student 6 were consistently zero percent, even though she tutored Student 5 on quarter-hour times for two sessions. Probes of quarter hours before tutoring began on quarter hours for Student 5 had a mean of 5.6%. Student 4 had zero percent knowledge of quarter-hour times until he had exposure to quarter hours when tutoring Student 3. Student 1 and 3 had zero baseline probes until tutoring began on quarter hours. There was no effect until tutoring started for these times.

Student 1 showed some evidence that knowledge of trained times generalized to untrained times. The mean for the 24 trial set was approximately 42%. His first attempt on Set 1 was 75%. After achieving 100% on Set 1, Student 1’s first trial on Set 2 was
75% again. Set 3 started at 63%. If there was no effect on untrained times, the expectation would be that each set would start at zero. This was not the case.

The same pattern was true for the other students. Student 3 started Set 1 at 13% and Set 2 at 38%. Student 4’s first attempt was 25%, Set 1 data points were 75% and Set 2 data points were 100%. When Student 4 first was officially tutored on these times his initial score was 75%. He stared Set 2 with 50%. Student 5 exhibited similar patterns for half-hour times. Baseline data had a mean score of approximately 6%. Set 1 started at 25%. Set 2 at 75%, and Set 3 at 100%. This gain is supported in the research that has found benefits for both tutors and tutees (Osguthorpe & Scruggs, 1986; Cohen, Kulik & Kulik, 1982).

**Question 4: What were the effects of computer-assisted peer tutoring with computer prompting on the short- and/or long-term retention of previously mastered times?**

The results of retention of previously tutored times was mixed. Student 1 was able to maintain his knowledge of hour and half-hour times completely throughout the course of the study. Short-term retention of quarter-hour times was noted two days following the termination of tutoring. Student 2 showed similar results, except that the maintenance scores were consistently near 100%.

Results of retention were different for Student 3. He was able to retain prior knowledge of hour and half-hour times for 13 sessions. Sometime during the next 8 sessions, his knowledge decreased significantly: 25% for hours and 55% for half hours. His knowledge of quarter hours decreased almost 40% in 2 sessions. The cause for the significant drop is unknown. There were no further probes that would indicate if the loss of knowledge was temporary or permanent phenomenon. One could speculate that it was
an off-day for the student, or it was close to the end of the school year. Follow up results may have shed some light on this issue; however, this study was unable to provide such data due to time constraints. Booster sessions, had they been implemented, may have minimized the loss of performance.

Maintenance data for Student 4 was mixed. He retained knowledge of hour times throughout the course of the study. In eight sessions, his knowledge of half-hour times dropped by half. Knowledge of quarter hours decreased slightly, a little more than 10%, two days after the conclusion of tutoring. This again could be due to a daily coincidence, the end of school, or not having truly achieved mastery. Strategies for intermittent exposure to these trained times should have been in place to help the students maintain newly acquired knowledge.

Tutoring on hour and half hours retained for the duration of the study for Students 5 and 6. Short-term retention was strong for both on hour times. Retention was strong for Student 6 on half-hour times at the end of the study, by Student 5 dropped 50% two days after tutoring ceased. The same causation can be attributed, as above, for this student.

The results on maintenance of tutored times found by this study are consistent with research. There was no strategy in place for programming the maintenance of the behavior change. Reinforcement of learned behaviors was non-existent and the behaviors for the most part deteriorated over a short period of time. Baer (1989) found that few studies contained an active strategy for programming the maintenance of behavior change. Koegel and Rincover (1977), found that that the use of intermittent reinforcers caused behaviors to maintain over time. The results of this study could have been enhanced by the addition of an active strategy for maintenance.

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Question 5: What were the opinions of teachers and students regarding the use of computer-assisted peer tutoring?

Student opinions of peer tutoring were positive, but mixed. Student 1 was always the most enthusiastic tutoring. It is interesting to note that he preferred the role of student, liked using computer-assisted tutoring, and agreed that it helped him learn. He was sorry to see the program end. Student 2 did not care if he was tutor or tutee, he liked both roles the same. He realized that he did not gain additional knowledge, but he believed that the computer-assisted tutoring program taught him to be a good tutor. He was also sorry to see the study end and responded that he would like to do computer-assisted tutoring again. Student 3 enjoyed everything about tutoring and would also like to do it again. He liked the opportunity to use the computer, especially in the role of tutor.

Student 4 was not happy with the tutoring procedure from the start. His attitude was confirmed by the exit questionnaire. He did not like working with his partner and would not like to repeat the experience. During the study he was extremely competitive. His low scores on tutoring procedure had a lot to do with his competitive nature. He wanted the computer to print out a score of 8 out of 8 for his tutoring session, but he also wanted to beat his partner. To achieve this when he was the tutor, he often pushed the red button when Student 3 gave a correct answer. He did not praise his tutee often either. He did, however, like being on the computer and being the tutor. He did report he learned to tell time. The linkage between attitude and learning was not explored in the research completed for this study. Student 4’s attitude appeared to have an effect on learning for himself and possibly for his student.
Student 5 enjoyed everything about the tutoring process and using the computer. He did like the role of tutor better than tutee. This could be due to his partner rarely demonstrating proper tutoring protocol throughout the study. His performance on tutoring may have been affected as well. By not being given the correct time after a trial or being told a correct response was wrong may have added to his confusion. Although Student 5 related well to all his fellow students, pairing him with Student 6 may not have been the best choice.

Student 6 was extremely argumentative during tutoring sessions. She rarely gave her tutee the proper feedback for correct time or pushed the correct button for right/wrong response. During her exit interview, Student 6 reported that she did not enjoy working with her partner and she would not like to do computer-assisted peer tutoring again. She did like to use the computer and be a tutor. She felt that peer tutoring did help her learn.

The opinions of peer tutoring were generally positive. Other studies of peer tutoring have also indicated a high degree of satisfaction with tutoring procedure and performance (Arreaga-Mayer, 1998, Heron, Heward, Cooke & Hill, 1983). All the students and adults believed that computer-assisted tutoring was a useful technique to help the students learn to tell time. The data on acquisition confirm their opinions. The students were able to learn to tell time with the help of the computer.

All of the students agreed that the computer helped them be better tutors. The biggest help was the speaker button that was available to tell them the correct time. Without this, the researcher and teacher would have had to be looking over the students’ shoulders 100% of the time. The computer did not have any function in helping the tutors remember to praise. A ticket system had to be implemented to help with this function.
According to the questionnaires, half the students disliked picking up the tickets after the tutoring session. Perhaps the computer could be programmed to say some thing like "Good Job" when the green button is pushed and say the correct time when the red button is pushed to eliminate the need for tickets. These suggestions would not solve the problems of pushing the correct button. That function would still be the sole responsibility of the tutor. With technology at its present level, there may not be a simple solution to this problem at this time. All-in-all, the computer did not help the tutors be procedurally more effective, but the computer was a viable alternative for the tutor huddle.

An area that was not part of the present study, social implications, was mentioned by both adults as their favorite part of the program. "I loved that the students work as teams and were responsible for themselves and each others progress." This social development has also been noted in the literature (Cohen, Kulik & Kulik, 1982; Giesecke, Cartledge & Gardner, 1983; Osguthorpe & Scruggs, 1986).

During initial meetings prior to the study, the researcher was interested in the social dynamics that would be in play when choosing tutoring teams. The researcher was told by the teacher, that it was an unusual class, in that all the students related well together. The students exit questionnaires however, stand in contrast to this statement. Two of the students were apparently so unhappy with their partners that they would not want to do computer-assisted tutoring again. This has strong implications for pairing partners. Some solutions include letting the students choose, rotating, or doing sociometric testing prior to assigning pairs.
Limitations of the Study

There were several limitations of the study. They included the time of the year the study took place, the change in computer learning trials, mixing hour and half hour trials in tutoring sessions, assigning partners for tutoring, and the students’ lack of basic mathematical number concepts.

Time of year. A major limitation that was mentioned by both classroom staff members was that spring quarter was not an ideal time to conduct a study. Field trips, field day, assemblies, birthdays, and other special events occurred with greater frequency in the spring. Finding a suitable time to run four to five sessions every week was sometimes a problem. The irregularity of tutoring days and times may have contributed to variability in some student’s scores. Tutoring also stopped prior to mastery for some students because it was the end of the school year.

Program trials. Another limitation was the way the computer program trials were done. Initially, one set with 24 trials of hour and half-hour times mixed was used. Although this format was tested with third graders prior to the study, it proved to be too tedious and time consuming for first graders. Third graders were able to complete 24 trials in 10 minutes. It took some of the first graders over 20 minutes. The amount of time spent on tutoring was frustrating to the classroom teacher, as well as the students. Tutoring consumed an inordinate amount of daily instructional time. When sets were introduced with only 8 trials, the process was much smoother. The students were able to complete tutoring in the allotted time.

Mixing clock time sets. In addition to the time consideration, mixing hour and half hour times probably had an effect on results. Most of the students in the study achieved
mastery of hours early in the study. They continued to be tutored on hours when they were actually learning half hours. This may have affected maintenance results for Students 5 and 6. Future studies should separate hours and half hours. The student can then be tutored on one concept at a time.

*Partner arrangements.* Assigning pairs for tutoring was another limitation. Although it was necessary for data reliability, it proved to be a limitation too. Students progressed at different rates and it might have been better to have students tutor and be tutored on the same concept. It could also have reduced conflicts and poor attitudes that two students exhibited during the study. A rotating system that was posted daily on a chart in the room would have been a good solution for this class.

*Student history.* The final limitation to be discussed is the lack of basic mathematical skills the students had prior to tutoring. Most of the students could count to ten and recognize the numerals prior to the study. Recognizing eleven and twelve was not consistent within the group of students. Some students, but not all, could count to twenty. Only Student 2 was capable of counting higher or counting by 15s, 10s, or 5s. The lack of basic tool skill knowledge may have held back mastery on learning quarter hours and certainly would have precluded telling time to the five-minute interval. Students should have a foundation of knowledge on which to build before more advanced concepts are taught.

*Implications of the Study*

The tutoring program was fairly easy to implement in the classroom. The only materials that were teacher-made were data collection charts and graphs. The computer provided a simple data collection sheet for daily testing. The students in this study had
limited knowledge of graphs. It was not within the parameters of this study to teach the
students to graph; however, graphing is a mathematical concept that students should
master. In a classroom setting, students could be taught to correctly graph their own
results daily to take the burden away from the teacher in addition to providing practice on
a skill within the curriculum.

Since there are few materials to make, the monetary cost is low. The time cost can
be consuming. The tutors were initially trained as a group. One team learned the
procedure immediately. A second team required further individual attention. The teacher
spent time with this team providing models and prompts for five more sessions. The third
team took seven more sessions to learn tutoring protocol. Lack of using proper tutoring
procedure did not appear to adversely affect skill acquisition. The researcher is not
convinced that tutors need to be trained to such a high level of compliance before they
can be effective tutors. If students are trained early in a school year, the tutoring system
can be used in many content areas throughout the year. This would be a good investment
of time to achieve individualized instruction.

Recommendations for Future Research

This study did not look at the social implications for tutoring pairs. Based on the
classroom staff’s observations that it taught the students to work together and be
responsible for their own and their partner’s learning outcomes, social implications of
tutoring might be an area to pursue in further research using computer applications in
dyad situations.
This study did not have the public posting component that is a feature in many tutoring systems. Noting the differences in performance, with and without posting daily progress, merits consideration for future studies.

Further studies should explore acquisition when hours, half hours, and quarter hours are tutored separately. A replication of this study could be conducted using 8 tutoring trials per set from the outset. Tutor training could then be conducted using previously learned material. This would allow stronger conclusions as to whether tutoring affected students’ acquisition of times.

Programming strategies for generalization could be implemented during future studies. This study only considered response generalization to untrained times. A probe should be added for each set prior to tutoring to allow for stronger claims for response generalization. Programming stimulus generalization was not used in this study but could be achieved in several ways. Programming common stimuli could be achieved by changing the colors and shapes of the clock hands and faces and varying the type of clock presented (i.e. watch, wall clock, table clock, and backgrounds). Other non-critical stimuli could be varied during the study to reduce the likelihood that any one might gain control of the students’ ability to state the correct time. Examples should be chosen using the general case strategy method to ensure that the samples chosen represent the range of stimulus and response variations that are present in the students’ environments. Further studies could look at the students’ time telling behavior contacting natural contingencies of reinforcement that would help maintain the behavior in other settings.

A final suggestion is to train the class to tutor early in the school year and start the study no later than winter. These changes would allow student to achieve mastery on all
sets of times. Assessing long-term maintenance would be more feasible if the study started earlier.

Summary

The study was designed to investigate the acquisition, maintenance, and generalization of time telling skills. Additional areas of investigation included the effect of the computerized tutoring program on the students’ tutoring behaviors and opinions of the program.

Five male and one female first grade students attending a resource room participated in a computer-assisted peer tutoring program. The study took place in the primary resource room in a suburban elementary school. The students were trained to tutor using a computer-based arrangement that followed a model-lead-test training format.

Upon successful completion of training, tutoring sessions commenced. Each pair started the session seated at their assigned computer, one student in the role of tutor, the other as tutee. The tutor praised the tutee for each correct response, prompted errors, and printed a final results screen after reading it aloud. Pairs switched roles. When the pair was finished tutoring, each student worked individually with the researcher to test for acquisition of tutored times.

Results showed increases in acquisition for five students. Maintenance was achieved for all students for hour-based clock times and two students for half-hour-based and quarter-hour-based clock times. Results of generalization to untutored times were mixed. The results also indicated computer-assisted tutoring is a viable replacement for tutor huddle.
Limitations of the study included varying the number of trials in a tutoring session, the composition of the trials, assignment of tutoring pairs, and timing of the study.

Implications for classroom teachers are given. The program appears to be viable in elementary special education classrooms, due to ease of implement and cost effectiveness. Training can be time consuming, but tutoring can result in quality individualized instruction.

Recommendations for extending and replicating the current study in the future are given including: assessing social benefits, effects of public posting of daily results, and replicating with a uniform number of trials that include only one type.
REFERENCES


APPENDIX A
TUTOR OBSERVATION FORM

Observer: ____________________________
Date: ____________________________
Time: ____________________________
Student: ____________________________

Did the tutor:

1. Sit in the right position? Yes No

2. Start the computer program without help? Yes No

3. Type in the names in the correct boxes? Yes No

4. Get to the clock page without help? Yes No

5. Prompt for answer and praise correctly? Yes No

6. Click on the correct button for the response? Yes No

7. Use the correct procedure if the response is wrong? Yes No

8. Print the score page Yes No

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APPENDIX B

STUDENT QUESTIONNAIRE TO ASSESS SOCIAL VALIDITY

Name ____________________________________________

1. Did you like working with your partner?
   Yes         No         Sometimes

2. Did you like being the tutor or student more, or about the same?
   Tutor       Student     Same

3. Did the computer help you to be a better tutor?
   Yes         No         A little

4. Did using the computer help you learn to tell time?
   Yes         No         A little

5. What did you like best about computer-assisted tutoring?

6. What did you like least about computer-assisted tutoring?

7. Would you like to do computer-assisted tutoring again?
   Yes         No         Maybe
APPENDIX C

TEACHER QUESTIONNAIRE TO ASSESS SOCIAL VALIDITY

1. Was computer-assisted peer tutoring a successful method to teach telling time in your classroom?

2. Was computer-assisted peer tutoring easy to implement in your classroom?

3. Would you use computer-assisted peer tutoring again to teach other content areas in math or reading, if someone was available to write the program or it was commercially available?

4. What might make the computer-assisted peer tutoring program more beneficial to your students?

5. Would you recommend a computer-assisted peer tutoring program to other teachers?

6. What did you like most about the program?

7. What did you like least about the program?
APPENDIX D

DAILY ORAL ASSESSMENT

student

tutor

score 8 / 8

time used 51 sec.

date Fri, May 21, 2004

notes: Quarter Hrs. Set 2 includes following trials:

1:15, 2:45, 3:15, 5:15, 8:45, 11:15, 11:45, and 12:45

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APPENDIX E
DATA COLLECTION FORM

DATA COLLECTION—Hour and Half

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APPENDIX G

TRAINING SCRIPT: SESSION 1

Today we are going to see a fun new way to learn. We are going to teach each other to tell time and use the computer to help us. We will work in pairs and take turns being the teacher and student. Did you know that you can learn to be a great teacher? You are going to work teaching one student. This is called a tutor. Can everyone say tutor? (Wait for choral response and PRAISE correct responses. Reteach incorrect responses.) Each of you will get a chance to be the tutor and student every time we work together. We will be using the computer, the headphones, and I will have an extra sheet to use when I work with each one of you at the end of the session. (Show the items to the students, one at a time.) We will start the day by going to the computer. Come over to the computer and have a seat on a chair. (Have six chairs arranged in a semi-circle so that the computer screen is visible from each chair.)

Just for today, I will play teacher or what was it called? (Wait for response—tutor.) All of you will play the student as a group. We will be doing the teaching with the help of the computer. This is the first screen on the program. It has words and two boxes. Today I am going to be the teacher—what is that called? (Wait for response—tutor.) I will type my name in here. (Type in Mrs. M.) You are going to be the students today so I will type in "class" instead of just one name. (Type in class.) When the names are typed in the two blocks, the tutor should put on the headphones, and click here on the word START.
(Move the mouse and click) This is what comes up. What is it? (Wait for choral response—clock.) Does anyone know what time it says? (Wait for response—one o’clock.) I am going to listen in my headphones to hear the correct time to see if you are right. I click on this button (point to the speaker) and it will tell me the time. (Listen in the headphones, and then have one student at a time come to the computer, put on the headphones, and listen by clicking the speaker button.) You were right; it says one o’clock, so I say “Good Job” to my student and click on the green button. (Click on the green button.) What happens next? (Wait for choral response—a new clock). Yes, a new clock comes on the screen. Go through two more clock faces with the procedure for correct response. Then on the fourth clock face, prompt the class to give an incorrect response by saying, “Class, what happens when we make a mistake? On the next clock, let’s make a mistake. Let’s say three thirty. Say “three thirty.” (Wait for class to choral respond, three thirty.) You said three thirty, now I will listen in my headphones by clicking on the button. (Pass around the headphones to listen, one at a time.) The computer said two thirty. That is different, so I will say to you, my student, “try again”. Prompt, “say two thirty.” (Wait for class to choral respond “two thirty”. ) You are right this time, so I say “Good Job, class” and then I click on the green button. (The computer puts a new clock face on the screen. Repeat the procedure for one wrong answer two more times. When a new clock face comes on the screen, tell the class that we are going to see what happens when they make a mistake two times.) I am going to tell you to say a clock time that is wrong two times. “What time is it?” (Cue the students to say eight o’clock—“Say eight o’clock”). Listen in the headphones by clicking the button. Eight o’clock is not what the computer says so what do I say? (Wait for class response, try
again.) Right, “Try again.” (Prompt the class to get it wrong a second time by saying, “say ten o’clock”.) Now I listen again to see if you are right. (Click on the speaker button and listen in the headphones again.) It says nine o’clock, so you were wrong a second time. I now say to the student “the correct time is nine o’clock. Say nine o’clock.” (Wait for the class to say—nine o’clock.) This time you click on the red button because I had to tell you the right answer. (Repeat the procedure for two incorrect responses at least two more times. Go through the rest of the 24 times on the computer, demonstrating the correct procedure for correct answer, wrong once and wrong twice, in a random sequence. The end screen comes up after 24 trials.) We finished the 24 clock times on the computer, now look what it says. (Point to the words and read aloud “Good Job class. You got # right. Thanks for helping, Mrs. M”. Read several times with the class until they sound fluent.) See this? (Point to the button with the P on it.) You need to click here to print the page. When it is done printing, you get the sheet from the printer and hand it to me. Then I will work at this table one at a time with each of you. (Point to the semi-circular reading table. Ask the class to turn around while the teacher goes to the table.) I will use the Judy clock to show you the time and you will tell me what it says. (Demonstrate by setting the Judy clock and have the class respond several times.) I will write your answers on this sheet. (Hold up the sheet that was just printed, Appendix D.) When you have said all the times on the sheet, you will be done working with me for the day.
APPENDIX H

TRAINING SCRIPT: SESSION 2

Review session one completely with the researcher in the role of tutor and the class, the student. After the final computer screen comes up and it is printed, say "Now we are going to switch roles and you will take turns being the, what do we call it? (Wait for response, tutor.) First we do what? (Wait for response—type in names.) Right. We type in the names. Since today you are all going to be tutor and student, I will type in "class" in both boxes. What happens now? (Wait for answer—click in the corner and then the first clock comes up.) Right, the first clock comes up. Now each of you will have a turn sitting at the computer being the tutor for 4 clock times. Student 1, you are first. Come up, sit in this chair at the computer, and put the headphones on. What do you say? (Wait for response—"What time is it? The class responds with the correct time.) We got it right so what do you say? (Wait for response--Good Job.) Where do you click? (Wait for response—on the green button.) Right, on the green button. Now what do you say? (Wait for response-- What time is it? Prompt class to say the wrong time!) Now what do you say? (Wait for response—try again.) Right, "Try again". (Prompt class to say the right time.) Now what do you say? (Wait for response—Good Job.) Right, "Good Job!" Which button do you click on? (Wait for response—green button.) Right, the green button. Now what do you say? (Wait for response—what time is it?) Right, "What time is it?" (Prompt the class to say the wrong time.) What do you do now?
(Wait for response--listen to the time in the headphones by pushing the button.) Is the class right? (Wait for response—NO.) What do you say? (Wait for the response--Try again. Prompt the class to say the wrong time again.) Is the class right? (Wait for student to listen in the headphones for the correct time and respond—NO.) Now what do you say? (Wait for the response-The time is eight thirty, say eight thirty.”) Which button do you push? (Wait for the response--the red.) That is right. (Go through one more time with this student cueing the same responses from the class, so that the tutor can practice two incorrect responses. Change to the next student and repeat the procedure until all the students have had a chance for four trials. At the end, 24 trials, the final screen will come up). Class, what does this say? (Class will choral read—Good Job class. You got 16 right. Thank you for helping class.) Now what do we need to do? (Wait for response--Print the page and then hand it to me.) Thank you all for being such good tutors! This will end session 2.
APPENDIX I

TRAINING SCRIPT: SESSION 3

Review session two completely with the class choral responding in roles of student and each student having 4 chances to play the role of tutor. Now you are going to try it as a pair. Assign the partners, the first student to do the tutor role, and a computer. Who sits where? (Wait for response--tutor on the right, student on the left.) What do you do first? (Wait for the response--type in names.) Now I want you to try a tutoring session as a pair. I will watch and help if you need me. (Researcher, class teacher and aide will monitor tutoring pairs for accuracy following the Tutor Observation Form, Appendix A, and prompt and model when necessary.) Half way through after 12 trials, have the tutor and student switch roles. When they reach the final page, have them read it and then print it. This ends session 3.
APPENDIX J

TRAINING SCRIPT: SESSION 4

Good morning. Today we are going to practice again with your partner from yesterday. Please come to your computer with your partner and have a seat. Let’s double check, is the tutor sitting on the right? (Check to see if the tutor is sitting on the right.) Now what does the tutor need to do first? (Wait for the response—type in the names.) Right, type in the names on the screen. When they get to the first clock on the computer screen, let the tutors proceed by themselves. The experimenter will monitor for correct procedure following the Tutor Observation form, Appendix A, and provide prompts and model as necessary.) When both students have practiced the tutor role for 12 trials and the experimenter has the sheet printed from the computer, the session will end.
APPENDIX K

TRAINING SCRIPT: SESSION 5-17

Good morning. Today I want you to complete a tutoring session from start to finish. Who remembers where to start? (Wait for response—go to the computer.) Right. Now go to the computer and start. The researcher will watch carefully to ensure that correct procedure is being followed.

1. Sitting in the right position.
2. Getting to the program
3. Typing in the names
4. Getting to the first clock page
5. Responding and praising correctly
6. Clicking the correct button for the response given by the student
7. Using correct procedure if the response is incorrect
   a. Try again for first incorrect
   b. Say (correct time) for the second time there is an incorrect
8. Printing the score page

The students will reverse roles and repeat steps 1 to 8. When the partners have completed the session, the researcher will work one-on-one to complete the daily oral assessment. Each student will be shown all 24 times on the Judy clock and be asked to
orally respond to "What time is it? When the student has responded to all 24 times, the session will be ended for the student.
APPENDIX L

TUTORING SESSION

Good morning class. Today we are going to do a full tutoring session. I want you to go to the computer with your partner and start. Can you remember where to sit? (Students respond—tutor on the right and student on the left). That is Great. Tutors I want you to start the tutoring lesson. The tutor will type in his name as tutor and the student will type his name as tutee. The tutor will then put on the headphones and click on the button that says start. A clock face will appear. The tutor will ask the student “What time is it?” The student will respond by saying a time. The tutor can say “Good Job” or “Try Again”, dependent on the student saying a correct or incorrect response. The computer also allows the tutor to press a button and have the time repeated through the headphones if they are not sure of the correct time. If the time is correct, the tutor pushes the green button and the next clock face appears. If the student is incorrect and the tutor says “Try Again” the student will respond with another time. If the second trial is correct, the green button is pressed by the tutor. If the time is incorrect again, the tutor says “The correct time is (time), say (time).” In this case, the tutor presses the red button and the next clock face appears. The tutor does twenty four time trials with the student. The summary page appears after the twenty fourth trial. The tutor and student read the page together, “Good Job, (student). You got (#) right. Thank you for helping (tutor).” The tutor then presses the print button, retrieves the page from the printer and hands it to the
researcher. The tutor and student switch roles and begin another 24 trials in the same manner.

The researcher will monitor the tutoring session. Using the checklist, found in Appendix A, the researcher will check for procedural integrity.

When the pair has completed 24 trials as tutor and 24 trials as student, the tutoring session is completed. The students then wait their turn to work with the researcher individually to complete the oral assessment of clock times, found in Appendix D. The students will work with their teacher or classroom aide on their morning work while they wait their turn to be assessed.
APPENDIX M

PARENT LETTER

Dear Parent or Guardian,

My name is Kathy McKain and I am a master's candidate in Special Education at the Ohio State University. I am also a substitute teacher for Hilliard City Schools. I am in the process of planning my master's research that I will be carrying out at your child's school in Ms. Jones' classroom. I will be conducting the research under the supervision of Dr. Timothy Heron, a faculty member of the School of Physical Activity and Educational Services at The Ohio State University. I am writing to explain my research and ask your permission to include your son as a participant in the study.

My study will use a structured peer tutoring system developed at Ohio State with computer enhancements developed by a doctoral student to teach students to tell time. My research will look at how quickly students learn to tell time using this system and how long they remember what they have learned. As a part of the study, your son will participate in a daily 20 minute session, in Ms. Jones' room. Your son will participate as one in a pair of students taking turns acting as learner and teacher to tell time. The computer will keep track of times they have learned, which will be printed out, and I will conduct a short oral assessment daily. It is my hope that using the computer enhancements will enable your child to be an effective teacher as well as learner. This system follows the format of other well-researched peer tutoring systems, except that I plan to use computer technology as an enhancement.

Your child's name will not be revealed in any publication, document or any other form of report or presentation developed from this research. At the completion of the study, you, your child's teacher, and your child will receive a questionnaire regarding the use of the computer tutoring system. This questionnaire is designed to assess reactions of peer tutoring to determine if it was seen as a useful tool by the classroom teacher and students.

If you grant permission for your child to participate in the peer tutoring program part of this research, I would be most grateful. To do so, please sign and return the attached consent form to school; Attention Ms. Jones.

If you have any questions regarding this research or your rights related to participation in this research, feel free to contact me at 777-5780 or Dr Timothy Heron at 292-7632.

Sincerely,

Kathy McKain
Master's Candidate
The Ohio State University

Lisa Jones
Intervention Specialist
Hilliard Crossing Elementary School
APPENDIX N

CONSENT FOR PARTICIPATION IN RESEARCH

I consent for my child’s participation in research entitled: The Effects of Computer-Assisted Peer Tutoring on the Acquisition, Maintenance, and Generalization of Time Telling Skills.

Timothy E. Heron, Principal Investigator, or his authorized representative, Kathleen McKain has explained the purpose of the study, the procedures to be followed, and the expected duration of my child’s participation. Possible benefits of the study have been described, as have alternative procedures, if such procedures are applicable and available.

I acknowledge that I have had the opportunity to obtain additional information regarding the study and that any questions I have raised have been answered to my full satisfaction. Furthermore, I understand that my child is free to withdraw consent at any time and to discontinue participation in the study without prejudice to me or my child.

Finally, I acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Date:____________________

Signed:__________________________________________
(Principal)

Signed:__________________________________________
(Person authorized to consent for participant)

Signed:__________________________________________
(Principal Investigator)

Witness:____________________________