THE EFFECTS OF CLASS WIDE PEER TUTORING ON 7TH GRADE STUDENTS' MATH COMPUTATIONAL FLUENCY

By

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CERTIFICATION OF PROJECT WORK

We, the undersigned, certify that this project entitled, ***The Effects of Class Wide Peer Tutoring on 7th Grade Students' Math Computational Fluency by Brandi LoBianco Weidright***, Candidate for the Degree of Master of Science in Education, Department of Curriculum & Instruction, is acceptable in form and content and demonstrates a satisfactory knowledge of the field covered by this project.

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Abstract

The present study examined the effects of Class Wide Peer Tutoring (CWPT) on the math computational fluency of a group of 41, 7th grade students in a small, rural junior/senior high school in Western New York. Three target students (i.e., high, average, and low performers) were selected for formal data collection. All pupils were randomly paired students and placed on either the orange or purple team each week over the course of the investigation. Students participated in 20-minute, reciprocal tutoring sessions each day and their performance was examined under both baseline and intervention conditions a day. Points were earned for correct answers and making appropriate error corrections, and individual point totals were aggregated into daily competing team scores. Each week, the team with the most points was formally recognized for their performance. Results showed that CWPT improved all three target students' math computational fluency rates, and all pupils rated the intervention quite positively. Implications for research and practice are offered.

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The Effects of Class Wide Peer Tutoring on 7th Grade Students' Math Computational Fluency

Good math performance is very important for all students and strong computational skills provide the foundation for future mathematical understanding and success (Topping, Campbell, Douglas, & Smith, 2003). Unfortunately, daily observations and empirical research also suggest that many students do not have good computational skills. It is common, for example, to find students using cell phones and/or calculators to make change or to figure out how much purchases will cost them. They struggle as well when trying to divide pizza or cake slices into equal numbers of parts. Good computational skills are important for success in both school and everyday life. These skills include being able to do basic math problems without the aide of paper, calculator, or other instructional aides. Adding, subtracting, multiplying and dividing are important life skills that are used daily to solve countless basic and complex problems. From telling time to adding money, computational skills guide us through life, and as educators we must help our students master these skills at an early age. How can educators improve students' math computational skills? Which teaching methods have empirical support that they can improve *all* students' math scores on computational assessments? One promising intervention may be Class Wide Peer Tutoring (Delquadri, Greenwood, Whorton, Carta, & Hall, 1986; Greenwood, Delquadri & Carta, 1999).

Class Wide Peer Tutoring (CWPT) was developed in the early 1980s in collaboration between a team of researchers at the Juniper Gardens Children's Project in Kansas City, Kansas, and a general education teacher who was attempting to "mainstream" students with special needs into her class (Delquadri, Greenwood, Stretton, & Carta, 1983). Since that initial study, CWPT has been subjected to empirical investigation for over 25 years (Maheady, Mallette, & Harper, 2006). For the most part, this research line has found that CWPT can significantly improve pupils' performance in basic academic skills such as reading, math, and spelling (Greenwood, Terry, Delquadri, Elliot, & Arreaga & Mayer, 1995), content area coursework at the elementary and secondary levels (Bell, Young, Blair, & Nelson, 1990), and to enhance pupils' interpersonal relationships and attitudes toward school and tutored subject matter (Maheady, Harper & Mallette, 2001; Maheady et al., 2006).

Twenty-nine years ago, Chion-Kennedy (1984) found that CWPT, when combined with computerized drill-and-practice activities, was four times more effective than reducing class size or increasing instructional time in mathematics. This finding suggested that instructional strategies may be more important variables than the amount of time allocated to instruction. In other words, it may be more important how particular math skills are taught instead of how much time is allocated for their instruction. Without good computational skills, students will continue to struggle with basic math facts hidden within more complex real-life problems. Without a proper foundation to solve more in-depth, complex problems, our students are at risk for failure in school and life, particularly within an increasingly complex global and technological world (Walker & Karp, 2005).

Although a number of CWPT research studies have been conducted involving math vocabulary and pupils' self-esteem in math (e.g., Topping et al., 2003), very few studies were located that focused specifically on math computational skills. Given the success that CWPT has garnered in other subject areas (e.g., reading, spelling, social studies and science) there is reason to believe that this intervention could improve math computational skills as well. Basically, CWPT requires *all* students to become actively involved at the same time and while doing so they are providing and receiving immediate positive and corrective feedback from one another

(Maheady et al., 2006). In addition, CWPT includes between-team competition and weekly recognition certificates to motivate pupils to increase their daily math performance.

In one recent study, CWPT was used to improve student interactions around mathematics, as well as their overall confidence and self-esteem (Topping, et al., 2003). There is even evidence that despite race, ethnicity, gender, socioeconomic status, and age, CWPT improved student performance when used properly (Robinson, Schofield, Ward, & Steers-Wentzell, 2005). Students who were English as Second Language (ESL) learners even improved their English competence while using CWPT (Greenwood et al., 1999). CWPT has also been shown to work in elementary mathematics (Robinson et al., 2005) as well as at the collegiate level (Carmody & Wood, 2007).

Given the documented success of CWPT in improving basic academic skills in general and math computation in particular, this study was designed to see if similar results could be found among a group of culturally and linguistically diverse learners in a small urban setting. The purpose of this study, therefore, was two-fold. First, to examine the effects of Class Wide Peer Tutoring on pupils' math computational skills using existing, district-wide adopted, curriculum-based assessment measures (i.e., Digits Correct Per Minute; AIMSWEB). Second, the study examined the social acceptability of Class Wide Peer Tutoring by asking pupils to rate the intervention in terms of: (a) the importance of intervention goals, (b) the acceptability of CWPT procedures, and (c) their satisfaction with intervention outcomes. It was predicted that not only would CWPT improve students' math computational fluency, but that they will enjoy using CWPT in their classroom.

Method

Participants and Setting

Participants included 41 students (17M, 24F) in a small, rural junior/senior high school in Western New York. Students ranged in age from 11 to 13 years of age and all but one was Caucasian. No students were retained in grade level or identified as English Language Learners (ELLs), but seven had IEPs or 504 plans. This small rural school system was identified as a *district in poverty* with above 30% of students receiving free or reduced meals (NY State School Report Card, 2012). The study took place in a 7th grade math class that was split into two, 42-minute periods during the day. All students participated in the investigation however formal data were only collected on three target individuals. Tyler (pseudonym), a Caucasian male, was identified as a *high performer* based upon baseline math computation fluency rates that were over 30% higher than the class average. Ashlee (pseudonym), a Caucasian female, was identified as an *average performer* given that her baseline fluency levels were right at the class average, while Morgan (pseudonym), a Caucasian female, was selected on the basis of *low baseline* scores with a mean of 28% or about 40% below the class mean.

The primary investigator was a 29 year old Caucasian female in her sixth year of teaching Math 7. She was responsible for developing study-related materials, training students to use Class Wide Peer Tutoring, implementing the intervention, and collecting and analyzing pupil outcome data. In addition, she was responsible for regularly scheduled math instruction. A second adult, a Caucasian female with seven years of teaching experience who was also the 7^{th} grade ELA teacher participated in the investigation by conducting inter-rater reliability and fidelity of treatment assessments.

Dependent Variables

The two primary dependent variables were: (a) the number of digits correct per minute (dcpm) on math computation problems and (b) pupils' social validity ratings of CWPT. Digits correct per minute (dcpm) were derived from one-minute quizzes given at the end of each instructional session. Seventh grade assessments, while focusing more on algebraic concepts, rely heavily on fluency of basic integer operations; that is addition, subtraction, multiplication and division problems of positive whole numbers and their opposites. Students were given one minute to complete as many math computation problems as they could. Each problem was scored for the total number of correct digits in the appropriate position. For example, in the problem 12 + (-14) = -2, the students received two digits correct; one for the correct digit "-"sign, and another point for the digit "2". If students had written 2, then they would receive one digit correct for missing the negative sign but having the "2" correct. Similarly, if they had the correct sign but incorrect digit (- 4) then it was scored as one correct digit. The total number of correct digits completed was divided by one minute to derive a math fluency rate of digits correct per minute.

To ensure that pupil outcome data were being collected reliably, a second adult, the 7th grade ELA teacher (i.e., middle school team member) *independently* scored math assessments during 25% of randomly selected sessions across all experimental conditions. The same scoring criteria were used by both raters. Independent ratings were then compared on a *digit-by-digit* basis. That is, if both raters scored a digit in the *same* way (i.e., both scored digit as accurate or inaccurate) then it was marked as an agreement (A). If raters *differed* in their independent evaluations (e.g., one scored a digit as correct, while the other scored it incorrect), then the item was marked as a disagreement (D). Inter-rater reliability was then calculated by dividing the number of agreements by the number of agreements plus disagreements times 100%. Inter-rater reliability coefficients averaged .94 over the course of the investigation (range = .88 to 1.00).

The second dependent variable was student ratings' on a 20-item, Likert-style, CWPT consumer satisfaction survey that were completed *anonymously* and *independently* right after the study was completed (see Appendix A). The survey asked students to rate, using a 7-item Likert-type scale, the (a) importance of intervention goals (e.g., how important is it to do well on CNA vocabulary quizzes and get along with classmates?); (b) acceptability of CWPT procedures (e.g., how much did you like being on a team, earning points, doing corrections, and earning team of the week certificates?); and (c) satisfaction with CWPT outcomes (e.g., how much did CWPT help you learn CNA vocabulary and get along better with peers?). Individual student ratings were aggregated by item and were displayed in tabular fashion.

Independent Variables

The independent variable was CWPT as described by Maheady, Harper, Mallette, and Karnes (2004). The intervention consisted of four major components: (a) weekly heterogeneous competing teams (b) structured reciprocal tutoring procedures, (c) daily point earning, public posting of scores, and contingent rewards, and (d) direct practice of functional academic skills (i.e., math computational skills). Each week pupils were assigned to competing teams randomly by picking pieces of different colored paper out of a hat. Twenty orange and twenty-one purple pieces of paper with numbers one 1 to 21 written on them were used to determine who would serve on which teams for upcoming weeks. Teams and tutor pairs remained the same for one week and then new teams and partners were picked each week. The second procedural component was a highly structured, reciprocal tutoring procedure. Tutor pairs alternated roles of tutor and tutee for three minutes each during CWPT sessions. Tutees were required to solve and say correct answers for each problem attempted on their math flashcards. Tutors then provided positive ("yes that's right, two points") and corrective feedback ("no, but try once more for 1" or "no, the correct answer is…") in response to each tutee attempt. If tutees failed to correct their errors, then tutors awarded no points and moved on to the next item. While tutoring dyads were working, the investigator moved through the class and awarded "bonus points" (i.e., up to 5 points per student) for all pupils who displayed appropriate tutoring behaviors and who offered supportive feedback to their partners.

Tutoring pairs then totaled their scores, including bonus points, and wrote the totals on top of their math score-sheets. Individual scores were not posted publicly but rather they were kept privately by partners for the week. At the end of each week, partners gave individual scores to the investigator who, in turn, aggregated point totals into daily team scores that were then displayed on a laminated poster board in the front of class. To prevent *score inflation*, the teacher randomly selected one paper from each team and assessed it publicly for accuracy. Pupils were told that they can earn an additional 50 bonus points for accurately totaling their points each day. When pupils' scores matched the teacher's totals then bonus points were awarded to their respective teams for correct point totaling. When point totals did not match, the investigator simply adjusted daily point totals to reflect the correct number of points. Students' names were never revealed if there was not a correct match. Cumulative team totals were calculated and displayed each day. Each day after completing their CWPT sessions, students would individually take one minute quiz. They were also told that they would earn one (1) additional team point for every digit correct on the one-minute quizzes. These points were added on to pupils' daily CWPT point totals. On Friday, team points were totaled and a "winning team of the week" was determined. Winning team members received a free homework pass which they could either use or put into a raffle drawing for one extra credit point added on to pupils' math averages. They also signed math recognition certificates (i.e., copies of scoreboard) which were then displayed prominently in the classroom.

To ensure that CWPT was implemented as intended, the investigator developed a 16-step fidelity checklist that was adapted from the original Juniper Garden's Children's Project (see Appendix B). The investigator used the fidelity checklist as a guide to review CWPT steps with the students. Particular emphasis was placed on student responsibilities as tutors and tutees. Two students then demonstrated CWPT procedures and were provided with positive and corrective feedback. All students were then paired to practice for three minutes in each tutoring role. While students practiced CWPT procedures, the investigator moved about the classroom and awarded bonus points for good tutoring and pro-social behavior. When all students were following *at least* 85% of the procedures as outlined, formal data collection began. It is important that teachers and students use CWPT with a high degree of accuracy because previous research found that pupil performance was much better when students were properly trained and reinforced for completing procedures correctly (e.g., Dufrene, Duhon, Gilbertson, & Noell, 2005). To ensure that CWPT was used with a high degree of accuracy, the ELA teacher also observed 25% of intervention sessions and noted the presence and/or absence of each CWPT step. Fidelity of implementation was then calculated by dividing the number of steps present by the number present and absent times 100%. CWPT was implemented with an average of 95% accuracy over the course of the study (range = .90 to 1.00).

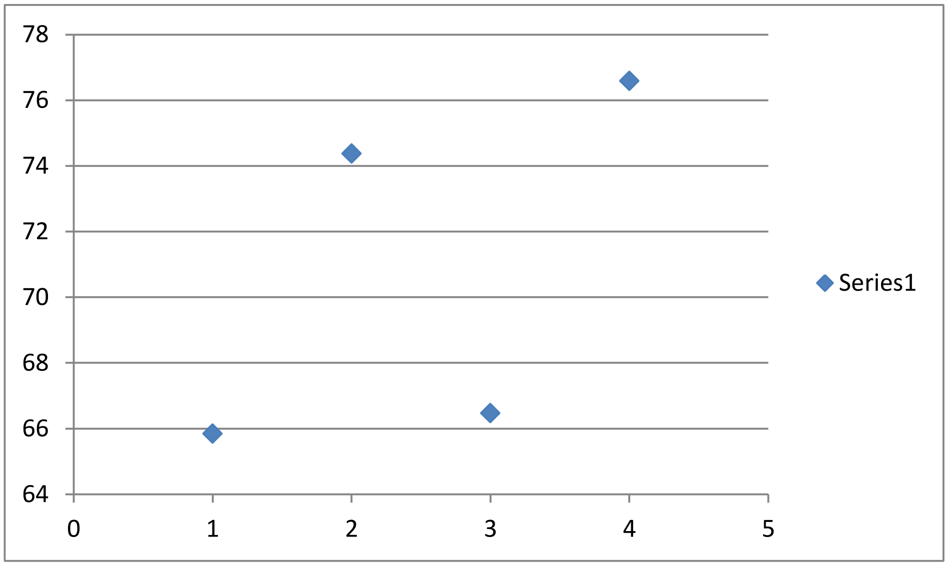
Experimental Design and Procedures

The present study used an A-B-A-B withdrawal of treatment design to examine the effects of CWPT on pupils' math computational fluency. This particular design is capable of establishing a functional relationship by showing that pupil math fluency changed, *when and only when*, CWPT was applied and withdrawn (Kennedy, 2005). During the initial baseline phase, students received normal or typical math instruction from the investigator. Typical 7th grade math lessons were 42-minutes long and focused on a key math standards derived from the Common Core Curriculum (CCC). Each class period began with a one minute quiz on integer operations. Student papers were collected and lessons began. A typical baseline session operated as follows. After the one minute quizzes were collected, the teacher would check and go over the homework. Next, note sheets would be handed out and the teacher would introduce new math concepts and/or skills by writing down key vocab and practicing examples on the board and solving them with students. Finally, students would be assigned independent seatwork before homework was handed out at the end of class.

After student performance stabilized during initial baseline sessions, the investigator trained students to use CWPT during a brief, 30-minute session. CWPT procedures were described and practiced directly using modeling, role-playing, and positive and corrective feedback. After pupils were using CWPT procedures with at least 85% fidelity, formal intervention data collection began. During typical CWPT sessions, students sat across from their randomly assigned tutoring partners. Each pair had a set of 20 flashcards that contained five of each math operation (i.e., addition, subtraction, multiplication, and division) with half positive and half negative solutions. Each tutoring pair also had a score-sheet on which to record daily tutoring points). The investigator began each session by reviewing tutoring rules: (a) talk only to tutoring partners, (b) keep your partner's scores, and (c) use good tutoring behaviors and *pull-up* statements (e.g., "great job, you got the right answer" or "way to go that's perfect". The investigator then set a timer for three minutes, said "begin" and started the timer. Tutees then read problems and solutions out loud for their tutors who then provided the appropriate number of points for each correct and incorrect response. While tutors and tutees were working, the investigator moved around the classroom and awarded *bonus points* for pupils who exhibited appropriate tutoring (i.e., assigning correct number of points, using the error correct procedures, and vocalizing responses while in tutee roles) and pro-social behaviors (e.g., the use of encouragement and pull-up statements). The investigator also used different colored pens each day to award bonus points (i.e., to minimize possibility of cheating) and tried to award comparable numbers of points to each team. After the first three minutes elapsed, tutoring pairs reversed roles and followed the same procedures for an equivalent amount of time. After the second, three-minute tutoring interval, the investigator calculated individual and team totals. The investigator also randomly selected one paper from each team, checked for correct point totaling, and awarded 50 additional points to teams with matching totals. While individual and team points were calculated daily, only cumulative team totals were posted publicly on the CWPT scoreboard. Before returning to regularly scheduled math lessons, students completed their one-minute quizzes. After intervention data were stable, CWPT was removed and typical classroom instruction was re-introduced. After the second baseline data sets stabilized, CWPT was reinstated. Immediately after the final tutoring session, pupils independently and privately completed consumer satisfaction surveys.

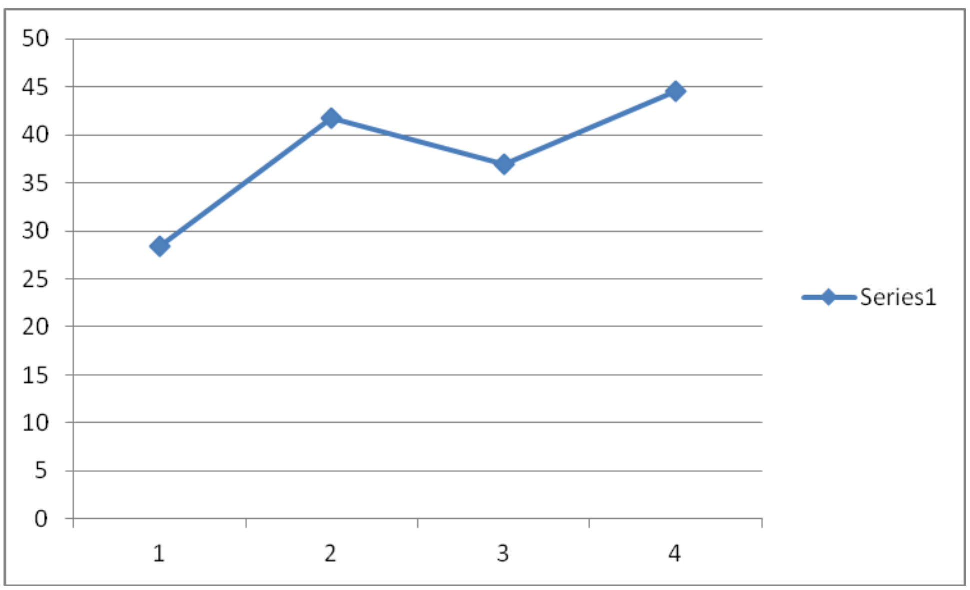
Results

The first research question was: What effects did Class Wide Peer Tutoring have on pupils' math computational digits correct per minute? To address this question, mean digits correct per minute (DCPM) were calculated for the entire class. These data are presented by experimental phase in Figure 1.



As seen in Figure 1, the class averaged approximately 66 digits correct per minute during initial baseline sessions (range = 24 dcpm to100 dcpm). When CWPT was implemented, the average class' average digits correct per minute increased to 74 dcpm (range = 40 dcpm to 100 dcpm) or about 8 more digits correct per minute than initial baseline levels. It is significant to note as well that there were no overlapping data points between the first baseline and intervention conditions. When baseline conditions were re-introduced during the third week, the class' mean digits correct per minute decreased to an average of 66 dcpm. This was a second replication of intervention effects on the class' math fluency rates. When CWPT was reintroduced during the final intervention phase, the class' average digits correct per minute increased again to a mean of 77 dcpm (range = 40 dcpm to 100 dcpm). This represented a roughly 10% increase in digits correct per minute over the second baseline conditions. Once more, there were only a few overlapping data points across adjacent experimental phases.

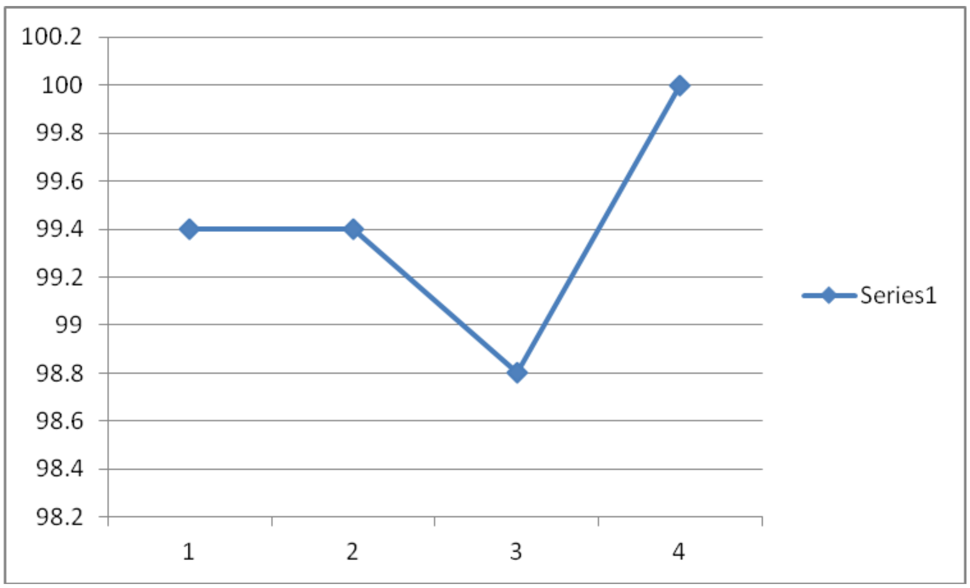
Quite often the use of mean scores (e.g., class averages) can hide the impact of an intervention on individual pupil performance. For that reason, three additional line graphs were constructed to examine the impact of CWPT on the math fluency rates for low, average, and high performing students respectively. Figure 2 shows the effects of CWPT on Morgan a low performing student during initial baseline sessions.



As seen in Figure 2, Morgan's mean performance during initial baseline sessions averaged about 28 digits correct per minute with a range of 26 dcpm to 36 dcpm. Morgan's baseline performance was substantially below the class mean of 66 dcpm during initial baseline. When CWPT was implemented, her math fluency scores increased substantially and immediately to a mean of 42 digits correct per minute (range = 40 dcpm to 46 dcpm). This represented a 14 digits correct per minute or 33% increase over initial baseline levels. There were also no overlapping data points across the adjacent experimental phases. When baseline conditions were re-introduced, Morgan's mean digits correct per minute decreased to 37 dcpm with a range of

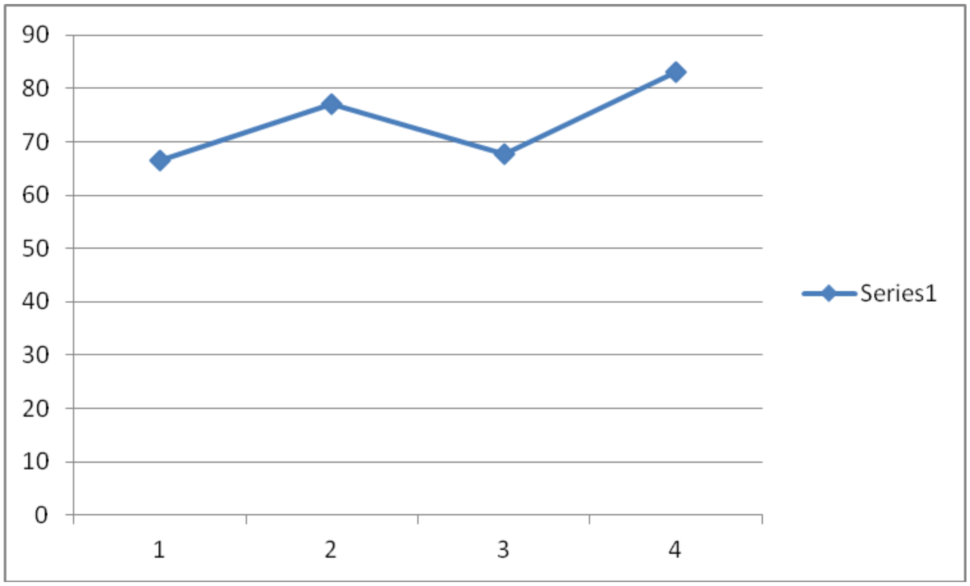
31dcpm to 40dcpm. While this was only five digits correct per minutes less than the first intervention mean, it was about nine digits correct per minute higher than initial baseline levels. When CWPT were reinstituted, Morgan's mean fluency scores improved once more to a mean of 42 digits correct per minute (range = 40 dcpm to 51 dcpm).

The second target student, Tyler, was one of the highest performers in class in terms of his math computational fluency. As seen in Figure 3, Tyler averaged 99 digits correct per minute with a range of 97 dcpm to100 dcpm during initial baseline assessments. This was approximately 33% higher than the class mean and quite stable. When CWPT was introduced initially, his



fluency rates remained relatively stable at 99 digits correct per minute (range = 97 dcpm to 100 dcpm). When baseline conditions were reinstated Tyler continued to work at his previously high fluency rates (i.e., M = 99 dcpm; range = 97 dcpm to 100dcpm). During the final intervention phase, Tyler increased his math computational fluency to 100 digits correct per minute each day of the final phase.

The final target student, Ashlee, was an average performer during initial baseline assessments (M = 68 dcpm; range = 66 dcpm to 69 dcpm). As depicted in Figure 4, Ashlee's



initial baseline performance was quite representative of a "typical" Math 7 student. When CWPT was introduced, her mean fluency rate increased to an average of 77 digits correct per minute (range = 71dcpm to 80 dcpm) which was almost a 10 digit correct per minute increase over initial baseline levels. There were also no overlapping data points across adjacent experimental phases. When baseline conditions were re-introduced, Ashlee's mean fluency scores decreased noticeably to 68 digits correct per minute (range = 66 dcpm to 69 dcpm). Finally, when CWPT was put back into effect, Ashlee's math fluency rate increased once more to an average of 83 digits correct per minute (range = 80 dcpm to 86 dcpm). This represented an increase of 15 digits correct over the adjacent baseline phase and six digits correct per minute above the initial intervention mean. Once again, there were no overlapping data points across the two adjacent experimental conditions.

The second research question examined pupils' feelings about the Class Wide Peer Tutoring intervention. More specifically, pupils were asked to rate the CWPT intervention in terms of the importance of its goals, the acceptability of its procedures, and their satisfaction with intervention outcomes. Data relevant to these questions can be seen in Table 1. Given that

Student, Period 4	Consumer Satisfaction Rating			**Student, Period 8**	Consumer Satisfaction Rating
A	101			T	125
B	90			U	130
C	117			V	75
D	120			W	102
E	119			X	111
F	108			Y	107
G	109			Z	107
H	104			AA	72
I	120			BB	110
J	116			CC	86
K	122			DD	90
L	110			EE	117
M	89			FF	112
N	100			GG	132
O	115			HH	122
P	99			II	128
Q	92			JJ	124
R	123			KK	115
S	129			LL	120
				MM	80
	109.3414634				

the highest possible positive rating was 134, most 7th grade students rated CWPT quite favorably (M = 110; Range = 72 to 132). Students felt, for example, that it was important for them and others to do well in math, to be good teammates and to get along well with others, and thought it was good practice to do CWPT in math class. They enjoyed being on a team, serving as tutors and tutees, and earning points and weekly certificates. The lowest scoring strand of the rubric was “how important is it for other students in your class to do well in math”. They reported that CWPT improved their abilities to do math, and they preferred it over regular class time norms with paper and pencil. They noted as well that CWPT seemed like something that should be done in school and that very few, if any, things that they did could be harmful to students.

Discussion

The present findings suggest that Class Wide Peer Tutoring was an effective intervention for improving the math computational fluency rates of 7th grade students from a small rural school district in Western New York. The class’ math fluency rates increased noticeably each time that CWPT was in effect and decreased slightly when it was removed. Performance changes were immediate and there were few, if any, overlapping data points across adjacent experimental phases. These results are consistent with a number of empirical studies showing the academic benefits associated with the use of CWPT (e.g., Bell et al., 1990; Buzhardt et al., 2007; Chion-Kennedy, 1984; Greenwood, Delquadri, & Hall, 1989; Greenwoo, et al., 1984; Greenwood et al., 1987; Maheady, Harper, Mallette, & Winstanley, 1991; Robinson, et al., 2005). These findings are important for at least three reasons. First, they showed that CWPT could impact basic math *skills* (i.e., fluency rates) as well as performance deficits. That is, students were actually working faster and more accurately when CWPT was in effect. Quite often, it is more difficult to change skill as opposed to performance deficits (e.g., Alberto & Troutman, 2009). Second, these performance increases occurred with very small doses of CWPT. The intervention was only used for about six minutes per day for a few weeks and yet was able to produce noticeable improvements in the class' math fluency rates. Finally, CWPT produced similar beneficial effects on three target students representative of the entire range of achievement in the classroom. The average and lowest performing students clearly showed the most noticeable gains as a result of CWPT instruction. Although the highest performer maintain above average performance across all experimental phases, his progress was most likely impeded by ceiling effects. The fact that CWPT improved performance of pupils at differing achievement levels should add to its potential usefulness for practitioners. It is unclear, however, whether student performance increases were due to between-team competition, structured tutoring procedures, point earning, public posting, daily timings, and/ or a combination of these things.

It was interesting to note as well that CWPT's impact was most noticeable during the first intervention phase. During this time period, the entire class and two of three target students increased their digits correct per minute by over one digit per week. This is considered to be substantial growth in the curriculum-based assessment literature (e.g., Deno, Fuchs, Marston, & Shinn, M. 2001; Fuchs, Fuchs, Hamlett, Walz, & Germann, 1993). The return to baseline condition did, expectedly, show the typical decrease in pupil performance with the exception of Tyler. While the return to CWPT produced additional gains in the class and target students' math fluency rates, these gains were even better in the second intervention phase.

In addition to academic improvements, students really seemed to like CWPT. This was reflected in their responses on the consumer satisfaction survey, as well as through their unsolicited vocalizations in class. Students rated CWPT goals quite highly saying that it was important for them to do well in math class in general and to improve their computational fluency rates in particular. Similarly, pupils were very satisfied with CWPT outcomes noting that it improved their math competence and slightly helped them to get along better with others. The reason for only slightly helping them to get along better might be explained because of their age in seventh grade at the 7-12 building. However, future research should investigate into that further. Although it should be noted that while the consumer satisfaction survey reflected a slight dislike of getting along better and caring about other students performance, in reality it was observable that they actually did react in a positive manner to bonus points for good behavior, and did make obvious attempts at earning the bonus points. Any interventions that improve pupil performance and are well-liked should be retained in teachers' instructional repertoires.

Perhaps more impressive, however, was how Class Wide Peer Tutoring changed the interpersonal dynamics in the classroom. For example, the investigator gave out bonus points during CWPT sessions to students for a variety of pro-social behaviors such as using kind words and good manners in class. In general, students were just much nicer to one another. They were also much more excited about taking their daily math assessments (one minute quizzes) so that they could see how many points would be added to their team totals. When CWPT was discontinued during the second baseline, students actually begged the adults to do CWPT. They were noticeably upset when they found out that the "math game" as they called it, was not being used. Many students were persistent and asked frequently when they could "play it" again. Finally, students' overall productivity improved greatly when CWPT was in effect. For example, many students were initially reluctant to get started on their work each morning. They preferred to socialize with peers and many failed to complete their homework before class began. When CWPT was used, however, students hurried to get ready for class. They completed their homework more often, turned it in immediately, and usually sat quietly waiting for the game to begin. Every Friday when students picked colored pieces of paper to determine team membership, they would be ecstatic to find out who their new team and partners would be for that week.

The present results have some important implications for teaching math computational skills. First, many "new" math curricula teach computational skills *indirectly* through the use of manipulatives and story problems, yet much less emphasis has been placed on the direct practice of math skills. Locally, many teachers (besides math teachers, but, particularly science teachers) complained that incoming students had poor math computational skills and that they were reluctant to do practice-related activities. This never occurred when CWPT was being used. As such, CWPT provides a powerful and easy way to improve pupils' math skills all within a game-like format. Second, given the increased use one minute quizzes to monitor pupil progress, teachers would benefit from procedures that build accuracy and speed, needed to also show local achievement as well as practice for state assessments. Finally, the CWPT format (i.e., between-team competition, reciprocal tutoring, point earning and public posting) is very adaptable and can be used in a variety of the subject areas and grade levels. Students become more confident and comfortable with their progress and skills. They actually look forward to coming to class and school; an outcome that most teachers would appreciate.

Although the intervention was effective, there were a number of important limitations to the current study. First, it was conducted with a relatively small group of students in only one subject area and for a relatively short intervention period. Due to requirements to complete the Master's Degree, the investigator was unable to conduct more extensive experimental phases. It would have been more convincing, for example, to show that the positive effects of the intervention lasted a few months as opposed to a few weeks. Similarly, no attempts were made to measure the generalization or maintenance effects of CWPT. That is, the investigator is unable to say if any of the improvements noted in math classes "spilled over" into other subject areas. Similarly, it is not known whether the academic gains experienced during the study would be maintained if and when CWPT procedures were faded. Finally, the present results are limited to some extent by the presence of accelerating trends in pupils' initial baseline performance. As might be expected, pupil fluency was already increasing prior to CWPT being implemented. Typically, one would not use a withdrawal of treatment design (A-B-A-B) with target behaviors that are not reversible (Kennedy, 2005). However, the investigator was unable to use another more appropriate design (e.g., multiple baseline or alternating treatments) in this instance. It should be noted, however, that CWPT did increase the acceleration rates (i.e., slope) of pupil performance and there was little if any overlap among adjacent conditions thereby suggesting that CWPT was having the desired effects. Future research should use a more appropriate experimental design.

In conclusion, the present study provides support for Class Wide Peer Tutoring as a powerful tool for improving math computational skills among 7th grade math students. Notable and sufficient gains were recognized with the entire class as well as three target students (high, average, and performers). Students not only learned better but they enjoyed class and school much more, and they slightly improved their social interactions with one another. More research should be completed on the routine and long-term impact of using CWPT on pupils' high stakes test performance.

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Appendix A

CWPT Consumer Satisfaction Survey

Please read each item aloud to your students and ask them to **circle the number** that best represents their feelings about that particular item. Emphasize the importance of completing the rating ***individually and privately***. Thanks!

Part I. Importance of Instructional Goals

1. How important is it for **YOU** to do well on your one minute quizzes?

1_________2_________3_________4_________5_________6_________7_________

not at all somewhat important very important

2. How important is it for **OTHER STUDENTS** in your class to do well on their one minute quizzes?

1_________2_________3_________4_________5_________6_________7_________

not at all somewhat important very important

3. How important is it for students to **GET ALONG WELL** with one another in class?

1_________2_________3_________4_________5_________6_________7_________

not at all somewhat important very important

Part II. Acceptability of Instructional Procedures

4. How much did you like **being on a CWPT team** during math class?

1_________2_________3_________4_________5_________6_________7_________

not at all some a lot

5. How much did you like **BEING A TUTOR** (t**eacher**) within your team?

1_________2_________3_________4_________5_________6_________7_________

not at all some a lot

6. How much did you like **BEING A TUTEE (student)** within your team?

1__________2__________3__________4__________5__________6__________7__________

not at all some a lot

7. How much did you like **USING THE INTEGER FLASH CARDS** with other team members?

1__________2__________3__________4__________5__________6__________7__________

not at all some a lot

8. How much did you like **EARNING POINTS** during CWPT in math class?

1__________2__________3__________4__________5__________6__________7__________

not at all some a lot

9. How much did you like **MAKING CORRECTIONS** when practicing integer operation flash cards?

1__________2__________3__________4__________5__________6__________7__________

not at all some a lot

10. How much did you enjoy **EARNING BONUS POINTS** during CWPT sessions?

1__________2__________3__________4__________5__________6__________7__________

not at all some a lot

11. How much did you like **EARNING TEAM OF THE WEEK CERTIFICATES**?

1__________2__________3__________4__________5__________6__________7__________

not at all some a lot

Part III. Satisfaction with Strategy Outcomes

12. How satisfied are you with **YOUR** overall performance in math?

1_________2_________3_________4_________5_________6_________7_________

not at all somewhat satisfied very satisfied

13. How satisfied are you with your performance on the CWPT teams?

1_________2_________3_________4_________5_________6_________7_________

not at all somewhat satisfied very satisfied

14. How much did CWPT help you to learn integer operations better?

1_________2_________3_________4_________5_________6_________7_________

not at all some a lot

15. How much did CWPT help you to get along better with others in class?

1_________2_________3_________4_________5_________6_________7_________

not at all some a lot

16. Does CWPT seen like something that should be done in school?

1_________2_________3_________4_________5_________6_________7_________

not at all maybe definitely should

17. Could CWPT be ***harmful*** to other students?

1_________2_________3_________4_________5_________6_________7_________

not at all maybe definitely could

18. Did other students think that you were smarter after using CWPT?

1_________2_________3_________4_________5_________6_________7_________

not at all some did everyone did

19. Overall, what did you think of CWPT?

1_________2_________3_________4_________5_________6_________7_________

didn't like at all liked somewhat liked it a lot

20. Which would you rather practice integer operations independently or use CWPT?

1_________2_________3_________4_________5_________6_________7_________

Work alone doesn't matter Use CWPT

Additional Comments: ____

____

____

Appendix B

Juniper Gardens' Class Wide Peer Tutoring

Procedural Fidelity Checklist

Teacher__________________________ Date______________________

Observer_____________________________

D.O. = Didn't Observe

	Yes	No	D.O.
1. Students are assigned to teams.	___	___	___
2. Students are assigned to partners	___	___	___
3. Students sit in close proximity to each other	___	___	___
4. Team Point Charts posted	____	___	___
5. All **Tutees** have worksheets and pencils	___	___	___
6. All **Tutors** have point recording sheets	___	___	___
7. Teacher previews content before session	___	___	___
8. Teacher sets timer for 10 minute session	___	___	___
9. Teacher circulates to reward bonus points	___	___	___
10. Teacher helps pairs when needed	___	___	___
11. Teacher directs students to change roles	___	___	___
12. Teacher resets timer for 10 minutes	___	___	___
13. Teacher computes and records points	___	___	___
14. Teacher commends winning team	___	___	___
15. Teacher encourages losing team	___	___	___
16. Teacher directs collection of materials	___	___	___

Totals: **____/16 = %**