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# THE EFFECTS OF A MATH RACETRACK WITH TWO ELEMENTARY STUDENTS WITH LEARNING DISABILITIES

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*A classroom intervention employing math racetracks was carried out to teach math facts to two elementary students with learning disabilities. A math racetrack is a drill and practice procedure where known and unknown facts are placed on a sheet of paper like an oval racetrack. The effectiveness of using math racetracks was evaluated with a multiple baseline design across problem sets. The results indicated that math racetracks were successful in increasing the skill sets of both participants in math. This provides a novel replication of employing a racetrack procedure that has been effective in reading, to elementary students in math. The practical implications of employing racetrack like procedures are discussed.*

Before a person can master difficult mathematical concepts it is important to be able to solve basic mathematical problems. Multiplication facts are a fundamental part of the primary math curriculum. It has been shown through research that students with learning disabilities often use counting strategies (e.g., finger counting and touch math) to solve basic mathematical problems (Ozaki, Williams, & McLaughlin, 1996).

According to Curico (1999), *Learning basic facts is not a prerequisite for solving problems, but learning the facts becomes a necessity to solve problems that are meaningful, relevant, and interesting to learners* (p. 282). Mastering basic skills is necessary for students to be able to more efficiently solve difficult problems. Approaches focused around avoiding basic skills have often resulted in school and student failure (Curcio, 1999).

*Whole math,* a form of instruction in which kids are encouraged to develop their own methods of multiplying and dividing, often producing answers that are *close to correct are good enough*, has been embraced enthusiastically around the country (Cheney, 1998). Many schools are now focusing on the concepts of math rather than the basics, often replacing memorization with calculators. This form of education was thought to be helpful to woman and minorities. However, in 1995, when schools were introduced to *whole math* test results revealed the program benefited almost no one, regardless of race or gender. The Department of Defense discovered that a year after the introduction of *whole math* into the Departments middle and elementary schools, the results were contrary to their expectations – 37,000 students took the *Comprehensive Test of Basic Skills* and scores dropped across all racial groups (Cheney, 1998; 1997).

Removing emphasis from computation lowered the Department of Defense's school's scores more than anything else. It was in that area that the Department of Defense discovered a 9 point drop for third graders; 12 for fourth graders; 11 for fifth graders; 10 for sixth graders; 10 for seventh graders; and 4 for eighth graders (Cheney, 1997). Through such studies the importance of mastering basic skills of computation has been shown. *Building fluency (i.e. improving speed),* *as well as increasing accuracy in math should improve the likelihood of a student's future academic and social success* (Ozaki et al., 1996).

In programs such as The Morningside Model of Generative Instruction, it has been shown to be wise to focus the curriculum on learning basic facts before preceding to more difficult concepts. On a course pretest of problem solving with fractions, four learners' performance ranged from 3 to 7 problems correct out of 14. When tested a second time with significant component skills present that were nonexistent at the time of the pretest, the student's performance was dramatically improved. These repertoires included the elements of problem solving with whole numbers and fractional computation, learner performance on a second test ranged from 13 to 14 correct out of 14 (Johnson & Layng, 1994).

To improve the fluency and skill sets of children with disabilities, we have employed a self drill and practice procedure called copy, cover, and compare (McLaughlin & Skinner, 1996; Skinner, McLaughlin, & Logan, 1997). This procedure allows the student to self-tutor and engage in error correction in a very straight forward and simple manner. Copy, cover, compare has been implemented with a large number of children and across a wide range of academic behavior (McLaughlin, Weber, & Barretto, 2004; Skinner et al., 1997).

Another procedure, which has been used to improve the accuracy and fluency that students read Grade Two Priority Words in isolation, is the *reading racetrack.* With the implementation of the reading racetracks there was an immediate improvement for the number of words read correctly. The reading racetrack intervention was effective in improving frequency of words read correctly, and eliminating almost all errors. This method was shown to be easy to implement and manage (Anthony, Rinaldi, Hern, & McLaughlin, 1997). The reading racetrack also proved to be effective on the fluency of see-to-say words in isolation by a student with learning disabilities in another study by Rinaldi and McLaughlin (1996). The use of the reading racetrack in the study by Rinaldi and McLaughlin (1996) also appeared to positively effect the participants reading fluency while reading orally during the participant's regular reading group. Recent replications of copy, cover, and compare as well as reading racetracks have found that either of these procedures can improve the basic skills of students with and without disabilities (Conley, Derby, Roberts-Quinn, Weber, & McLaughlin, 2004; Falk, Band, & McLaughlin, 2002; Stone, McLaughlin, & Weber, 2002).

The purpose of this study was to replicate what has already been done with *reading racetrack*, but with the basic multiplication and division facts. The procedure aimed to determine whether the procedure could be used to teach multiplication facts to children with learning disabilities and whether or not the procedure could be successfully invoked in a school setting?

## Method

*Participants and Setting*

The participants were two boys, one in third grade, Mike, and the other in sixth grade, Jason (names have been changed for confidentiality). Each participant attended math class and at least one other class in the resource room. All of the participants had been diagnosed with a learning disability. The experimenter has used these participants because the teacher suggested these students due to their low skills in math.

The setting was a resource room located in a large Department of Defense elementary school in the Pacific Northwest. The classroom had up to three certified teachers in the room at one time, each teacher with their own students in a different corner or space of the room. The teacher that the experimenter worked with had three students in the room while sessions were completed. The amount of students there at one time, changed part way through the project, so the experimenter then had each student individually on a different day. The participants were in the room for 25 to 30 minutes for each math session the experimenter was there. For many of the math periods the experimenter would test one session per period, towards the end of the project two sessions may be tested in one period. During the later part of the study there were a maximum of six other children in the room, these children were separated from the participants by a four-foot high bookshelf. The noise level was very low, the children were used to having to be quiet with other students in the same room, and the participants and the experimenter easily ignored the little noise there was. The project was part of an ongoing research program employing students from Gonzaga University and documenting part of the NCATE and the Washington State Standard. This Standard requires teacher candidates provide documentation of their ability to positively affect student behavior (McLaughlin, Williams, Williams, Derby, Weber, Bjordahl, 1999).

*Materials*

The materials requires were a math racetrack, a testing sheet with all the multiplication or division problems, a testing sheet with the seven unknown problems, a point record sheet, and two timers. The experimenter used a token reward system. The token system used points that were traded in for edible treats (M & M's, Mini Oreo Cookies, and Starbursts, etc.)

**Table 1. Multiplication Problems for Jason's Baseline and Math racetracks.**

Multiplication Facts

| | (0-7) | (8-9) | (10-12) |
|---|---|---|---|
| Set One | 3x8; 7x9 | 8x7; 9x2; 9x9 | 12x3; 12x8 |
| Set Two | 7x6; 7x8 | 8x9; 9x8 | 12x5; 12x6; 12x9 |
| Set Three | 7x7 | 8x8; 9x6; 9x7 | 12x2; 12x4; 12x7 |

**Table 2. Division Problems for Mike's Baseline and Math racetrack.**

Division Facts

| | (0-7) | (8-9) | (10-12) |
|---|---|---|---|
| Set One | 24÷3; 18÷6 | 24÷8; 72÷8; 81÷9 | 110÷11; 96÷12 |
| Set Two | 32÷4; 40÷4 | 36÷9; 63÷9; 72÷9 | 60÷12; 120÷12 |
| Set Three | 48÷6; 60÷6; 35÷7; 84÷7 | 40÷8; 64÷8 | 110÷10 |

*Dependent Variable*

The dependent variable was the total number of math problems the participants completed correct during each session. For example a correct answer would be 5x6=30, an incorrect answer would be 5x6=25. The total number of math problems available to complete during each session was seven during baseline and twenty on during intervention. The time it took for each participant to complete the math racetrack each session was also recorded.

*Data Collection and Interobserver Agreement*

There were two different data collection systems used. First a permanent product data collection method using event recording of each math problem answered correct was measured with a tally. The participants were given sheets with math problems on it and told to complete them to the best of their ability. The math sheets were scored and recorded by the experimenter, data collection sheets. Second, a duration recording system was used to time the length of time it took the participant to complete the math racetrack. This was recorded starting after the experimenter said *start the first problem* to when the participant completed the last problem on the math racetrack.

The mean agreement for Mike's data was 98.5% (range 95% - 100%) and the mean agreement for Jason's data was 98.5% (range 95% - 100 %). All of the data collection sessions were employed to determine interobserver agreement. This data were collected by making copies of the completed math sheets and two individuals scoring a different copy with out any marking.

*Design*

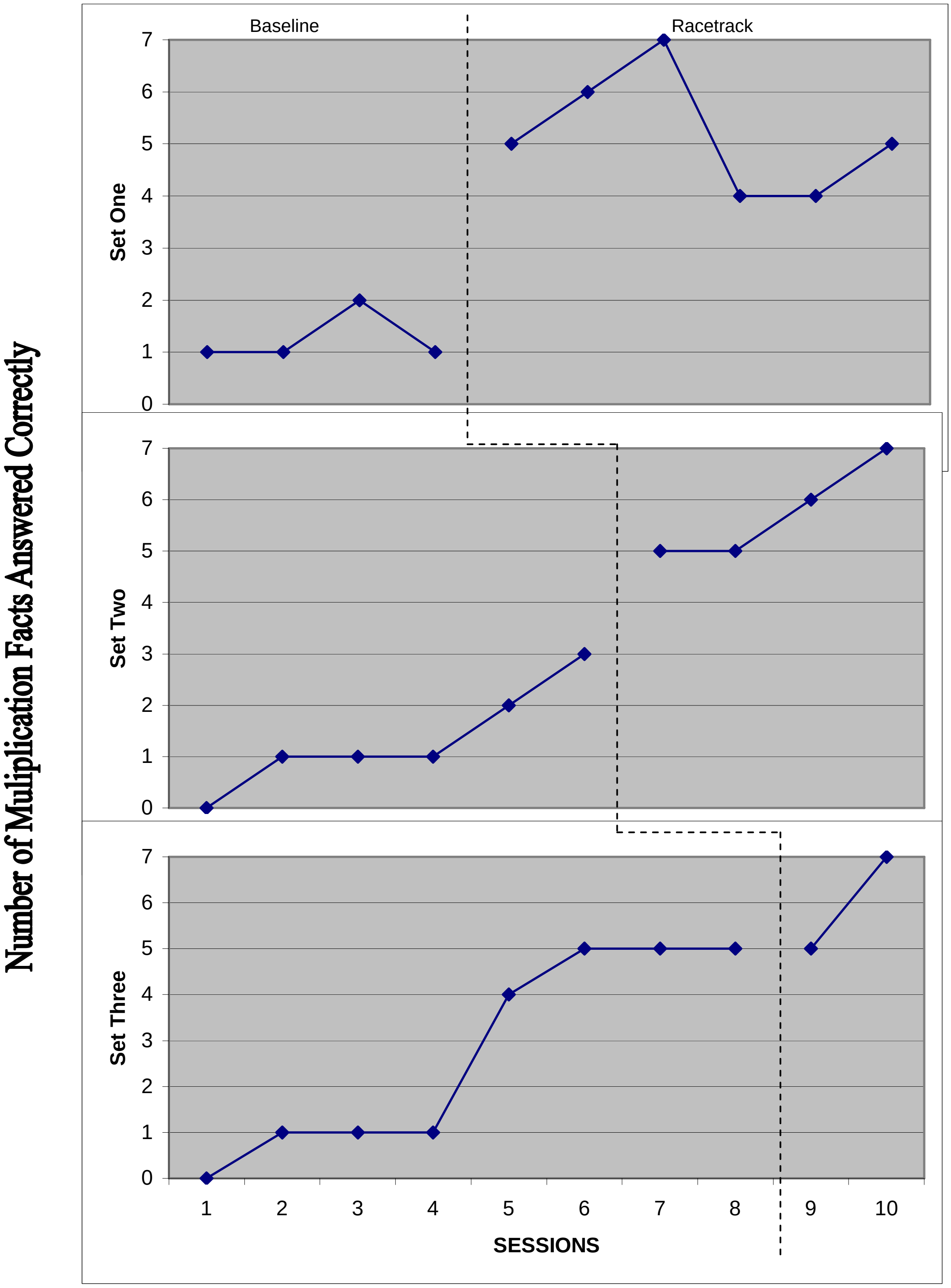
The design used was a multiple baseline across behaviors (Kazdin, 1982). Baseline was employed with the problems the participants did not answer correctly from a sheet with all the multiplication or division problems. Baseline was conducted for at least three days for the first set of math problems, at least five days for the second set of math problems, and at least seven days for the third set of math problems. The math racetrack was implemented for 3 to 7 days in a staggered fashion different sets of math facts (multiplication facts for Jason and division facts for Mike).

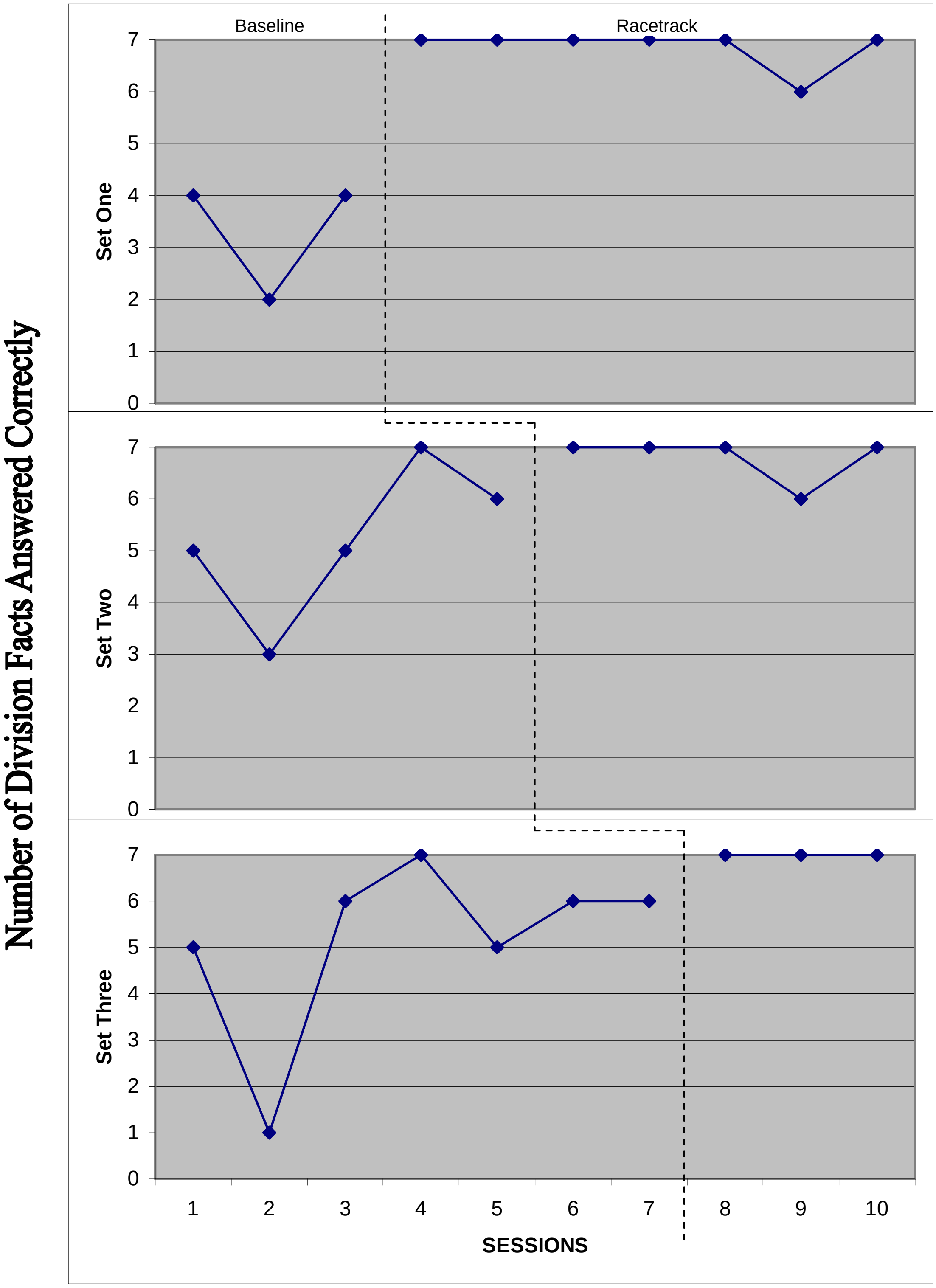
*Procedures and Experimental Conditions*
*Baseline.* During the baseline, each participant was given a sheet with every multiplication or division problem ranging from 0x0=n to 12x12=n and 1/1=n to 12/120=n, this was tested once and had a total of either 143 multiplication problems or 140 division problems. The multiplication facts were single or double digit factors multiplied by a single or double-digit fact, resulting in a single or double-digit product. The division facts were single, double or triple digit factors divided by single, double or triple digit factors. Resulting in a single, double or triple digit factor. No corrective feedback provided during baseline. Each participant was asked to try their best to answer each problem; they were also told if they did not feel they could answer a problem that it was all right. The experimenter explained to the participants that the point was just to try to see what they could do and how smart they were. The participants were tested with seven multiplication or division facts for at least 3, 5, or 7 data points for baseline. The math facts were given to the participants in a test with seven multiplication or division facts 0x0=N to 12x12=N or 1/1=N to 120/12=N, the last step in baseline was to time each participant on the racetrack with all problems they had shown to know and get correct on the sheet with every multiplication or division fact ranging from 0x0=N to 12x12=N or 1/1=N to 120/12=N. The points for the token reward system were earned when the participant would improve their time on the math racetrack or after they had truly shown they worked to the best of their ability.

*Math racetrack.* During the math racetrack the participants were given the racetrack with a mix of seven problems they did not know and the rest were problems they knew totaling 28 problems. Each participant had three different racetracks with the same 21 problems they knew and seven different problems they did not know. The problems were arranged in an order that presented two to four problems they knew and one they did not know. This is very similar to what we have done with sight word vocabulary reading racetracks (Falk et al., 2003; Rinaldi, Sells, & McLaughlin, 1997).

During the racetrack the participants were timed while completing the racetrack, a maximum of five seconds was given to the participants to complete each problem. If a problem was answered incorrectly, or the participant was unable to answer in the five-second allotment, then the correct answer was provided to the participant. After the racetrack was completed, the participant reviewed the answers to all problems. The racetrack was used until the participant showed an increase in the number of problems they answered correctly. During the math racetrack a token system was also employed. Participants were timed with the racetrack containing problems that were unknown. The following times the participants were timed to see if they increased their original time or their goal time. On subsequent timings if the participant increased their time or were able to show a good effort, they received a small bag of candy of their choice (i.e. M & M’s, Mini-Oreos, Mini-Snickers or Starbursts). Each participant was shown the record sheet used to keep track of their points, and adding their points at the end of each session.

## Results
The outcomes below show the graph results of baseline and math racetrack for each of the participants. Although the participants preformed better on some days than others, there was a definite upward trend concerning the amount of problems answered correctly during math racetrack. During the course of the project the experimenter would give a brief break of approximately one minute between each set of data, but frequently Mike and Jason would request to keep working, asking *What’s next.*


Number of Muliplication Facts Answered Correctly
Baseline
Racetrack
Set One
Set Two
Set Three
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
8
9
10
SESSIONS




During baseline for Mike, he performed well on a few of the problems, but overall his performance and number of problems answered correctly was lower than the numbers of problems answered correctly during the intervention phase using the racetrack. For set one, Mike averaged 3.3 with a range of 2 to 4 problems correct for baseline. For set two, Mike averaged 5.2 with a range of 3 to 7 problems correct for baseline. For set three, Mike averaged 5.1 with a range of 1 to 7 problems correct for baseline. For set one, Mike averaged 6.8 with a range of 6 to 7 problems correct for the math racetrack. For set two, Mike averaged 6.8 with a range of 6 to 7 problems correct for the math racetrack. For set three, Mike averaged 7 with a range of 7 to 7 problems correct for the math racetrack. During baseline for Jason, he started to perform better as time went one, but overall his performance and number of problems answered correctly was lower than the numbers of problems answered correctly during the intervention phase using the racetrack. For set one, Jason averaged 1.25 with a range of 1 to 2 problems correct for baseline. For set two, Jason averaged 1.3 with a range of 0 to 3 problems correct for baseline. For set three, Jason averaged 2.75 with a range of 0 to 5 problems correct for baseline. For set one, Jason averaged 5.2 with a range of 4 to 7 problems correct for the math racetrack. For set two, Jason averaged 5.75 with a range of 5 to 7 problems correct for the math racetrack. For set three, Jason averaged 6 with a range of 5 to 7 problems correct for the math racetrack.

**Discussion**

A racetrack procedure was proven effective in improving the fluency of see-to-say words in isolation by a student with learning disabilities in a study by Rinaldi and McLaughlin (Rinaldi, McLaughlin, 1996). In addition this replicates our additional work in reading with children with and without disabilities (Rinaldi et al., 1995) and our more recent work with elementary school students with learning disabilities (Falk et al., 2003). In this study, we attempted to use a racetrack procedure similar to that used in a study by Rinaldi and McLaughlin to improve two students with learning disabilities fluency in and ability to complete multiplication or division facts. The math racetrack procedure resulted in an increase in the correct responses across all multiplication or division sets targeted.

While the Math Racetrack was shown to be effective (an increase in the problems answered correctly after intervention), there were weaknesses found during the study. First, no long-term data available for this study due to the completion of student teaching by the first author. It was difficult to implement because the regular special education teacher was also working with the participants during the rest of the week on other tasks and skills. Unfortunately, towards the end of the study the first author had to carry out as much as three sessions in one class period due to time constraints and the ending of student teaching. It may be possible in the future to increase the length of data collection and analysis by having students spend a minimum of one day per week in their respective special education classroom settings during their methods courses during the first eight weeks of the semester. Due to high stakes testing (WASL and WAAS) in the State of Washington, we are implementing such a change this upcoming spring semester.

The present study does provide some additional evidence that a racetracks procedure can be adapted to math. The outcomes also lend support for the use of various easily implemented classroom procedures such as copy, cover, and compare (Conley et al., 2004), add-a-word spelling (Schermerhorn & McLaughlin, 1997), and tutoring techniques (Malone & McLaughlin, 1997). These procedures can improve the academic performance of a wide variety of children and youth in their basic skills and allow for active student responding (ASR) on the part of the students in the classroom (Heward, 2004). At this time we are exploring the use of copy, cover, and compare with handwriting and spelling and further uses of a racetracks procedure in these and other academic skill areas (Derby, Mortenson, Conley, & McLaughlin, 2000).

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