International Journal of Special Education
2003, Vol 18, No.1.

THE EFFECTS OF FIVE MINUTE PRACTICE, UNLIMITED PRACTICE, WITH SAFMED CARDS ON CORRECT AND ERROR RATE IN MATH FACTS FOR TWO ELEMENTARY SCHOOL CHILDREN WITH LEARNING DISABILITIES

Julie Casey
T. F. McLaughlin
Kimberly P. Weber
Gonzaga University
and
Mary Everson
Spokane School District #81

This study evaluated the effectiveness of three Precision Teaching techniques daily timing, modeling at the top of the timed tests, and SAFMEDS (say all facts one minute each day shuffled) on the fluency of see to write math facts with two elementary school students identified as learning disabled. A modified ABCA single case design was employed. The various interventions packages did improve the students' correct rate and for see to write multiplication math facts for the participants. The applicability of various intervention procedures for elementary school special education students is discussed.

The teaching of multiplication facts is a basic part of the math curriculum in today's schools. Research has shown that students with mild disabilities often use counting strategies (e. g. finger counting) to solve basic mathematical problems (Lerner, 1999; Skinner, Beatty, Turce, & Rasavage, 1989). Unfortunately, strategies typically result in a general lack of speed in solving math problems. The use of these strategies can dramatically diminish the student's performance of mathematical functions commensurate with peers and the requirements of many math related tasks (Skinner et al., 1989; Skinner & Schock, 1995).

Calculation skills have been seen as one of the predictors in assessing a student's success in general academic performance (Lloyd, 1978; Haring, Lovitt, Eaton, & Hansen, 1978). Lloyd (1978) found that poor academic performance, found as early as the third grade, was a predictor of later school failure and increased risk for dropping out of school. Thus, 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.

Immediately recalling of math facts is superior to using counting strategies, and allows students to respond with less effort and more fluency across settings (Miller & Heward, 1992; Pieper, 1983). For example, many of the math skills need to be performed at a certain rate or speed in order to be functional (Heward, 1994, 2002; Johnson & Layng, 1994; McLaughlin & Skinner, 1996; Miller & Heward, 1992). The use of finer counting strategies by students may be acceptable for addition and subtraction problems, but are insufficient for multiplication and division and more complex problem types (Silbert, Carnine, & Stein, 1990; Stein, Silbert, & Carnine, 1997). Further, individuals with low math skills may also be excluded from certain vocational and career options (Resnick, 1989; Resnick, Wang, & Kaplan, 1973; Skinner & Smith, 1992). In addition, automatically recalling basic number facts allows the student to devote more attention to more complex mathematical procedures (Binder, 1994; Johnson & Layng, 1994; Resnick, 1989).

Precision teaching procedures (Kunzelmann et al., 1970; Lindsley, 1991; West, Young, & Spooner, 1990) have been shown to assist students in the acquisition of basic skills. Such procedures as daily drill and practice (Anthony, Rinaldi, Hern, & McLaughlin, 1997), flash cards, (Ashbaugh & McLaughlin, 1997), error drill (Abrams & McLaughlin, 1997), home instruction (Farley & McLaughlin, 1996), SAFMEDS (say all facts one-minute each day shuffled), (Eshleman, 1985; McDade, Austin, & Olander, 1985) and daily charting (Abba & McLaughlin, 1995; Lindsley, 1991; West et al., 1995).

The purpose of this study was to increase the fluency and accuracy of see to write math facts with three elementary school students identified with learning disabilities. In addition, various timing and practice strategies recommended in Precision Teaching were evaluated in the present case report.

Method

Participants and Setting

The participants of the study were two 10 year old fifth-grade male students enrolled in a resource room special education math class. The participants were enrolled in a small sized elementary school located in an upper income area of a large urban school district. Each participant matched the state and federal definition for learning disabilities in math. Teacher reports also indicated that the students' skills in math were below grade, and each participant expressed a poor view of their ability to improve their skills.

The setting for all sessions was the school resource special education classroom (Everson & McLaughlin, 1996). The classroom was staffed by a certified teacher, one teacher's aide, and a student teacher from a local university. The students came to the resource room during each participant's respective math class in general education.

Dependent Variables and Measurement Procedures

The dependent variables were digits per minute. The first author employed timed drill and practice math sheets to collect data for both digits correct and errors per minute

(fluency). These data sheets were arranged with problems presented in order with answers at the top

of the sheet to facts at random without a model. Data were collected daily for a total of six school weeks.

Reliability

Reliability of measurement was calculated by having the math probe sheets regraded by a second interobserver. Reliability was taken once during baseline and once during each of the three intervention phases. Reliability in terms of correct digits as well as problems correct was100%.

Experimental Design and Conditions

An ABCA design (Kazdin, 1982) was utilized in the study. Data were collected for approximately six school weeks.

Baseline. Baseline consisted of timed, 1-minute probes to establish each participants' correct and error rates. During baseline the students were allowed a five minute practice session. Data were taken for three data days.

*SAFMEDS prior to testin*g. SAFMEDS were employed prior to the assessment of student performance on the various math probe sheets. Each student was given facts printed on 3 by 5 note cards. The students were allowed to put back on the pile any fact they missed. When they could say the solution correctly for two consecutive times, they were allowed to put another pile. After five minutes of practice, the students were required to complete their math fact test.

No time limit practicing test and SAFMEDS. The students were allowed to have as much time to practice the test prior to completing the 1-minute probe sheet in math. This condition was in effect three school weeks and seven data days.

Baseline-2. The final phase of the study the students went back to baseline. When the student had reached the goal of 80 to 100 correct digits per minute for three consecutive data days with one or no errors, a baseline was put into effect for the skill mastered and the next set of math skills to be mastered were taught.

Results

The number of correct and error digits for each of the two participants across the duration of the case report can be seen in Table 1. As these data show, two of the participants increased their accuracy while the third participant increased during the unlimited practice condition.

For the first participant, the correct rate was low (M = 20.2) with no errors. When SAFMD cards were added and daily drill took place, a small increase was found for corrects (M = 29; range 24 to 35). When the child was allowed unlimited practice and SAFMEDS, correct rate improved (M = 68; range 27 to 90) with just 1.0 error. Since the child meet the standard for corrects, baseline performance for X5's was implemented. Correct rates were starting to accelerate, for the last two sessions (M = 40.8; range 20 to 69).

Table 1.
The Mean and Ranges for Corrects and Errors in Spelling by Condition and Participant.

Participants				
Participant 1				
Conditions	*Measures*			
	Corrects	Range	Errors	Range
Baseline	20.2	16-31	00.00	-----
SAFMEDS	29.0	24-35	00.00	-----
SAFMEDS and Unlimited Practice	68 *	45-90	.412	0-1
Baseline 2 X5's	40.8	20-69	00.00	----
Participant 2				
Conditions	*Measures*			
	Corrects	Range	Errors	Range
Baseline X5's with Answers	85.5	62-95	00.00	----
Baseline X5's no Model or Answers	40.5	39-42	00.00	----
SAFMEDS	55	52-57	00.00	----
SAFMEDS and Unlimited Practice	67	60-71	00.00	----
Baseline 2 X4's	24	18-30	00.00	-----

For the second student, correct rate was high for X5's with the correct answers provided (*M* = 85.5; 62 to 95). When baseline conditions were applied to new set of X5's without the answers modeled, correct rate was low (*M* = 40.5; range 39 to 42). When SAFMEDS were employed, correct rates increased (*M* = 55; range 52 to 57). When the time limits for testing were removed, correct rates further increased (*M* = 67; range 60 to 71). When baseline conditions were applied to a set of X4's, correct rates were low (*M* = 24; range 18 to 30). Error rates were low across the duration of the various interventions.

Discussion

The results of the study indicate that correct rate could be increased with each of the two elementary students with learning disabilities. Several methods suggested for use when implementing Precision Teaching methods were found to be effective. Allowing the students to practice their skills for longer than five minutes coupled with SAFMEDS was the most effective. Both students improved their skills in multiplication with only one error.

The research also had some limitations. For example, data were not able to be gathered consistently for a variety of reasons (e.g. illnesses and school holidays, etc.). Some

interventions appeared to be more powerful than others. The way in which the interventions were implemented cannot rule out order effects. The unlimited time to practice with SAFMEDS was always preceded by the SAFMEDS only condition. A counterbalancing of these procedures would do much to rule out order effects (Kazdin, 1982).

The first author gained a great deal of knowledge from the study to apply toward working with other children. The use of precision teaching allowed the students to be on a variety of individualized programs in math and for one to evaluate various teaching procedures at the same time. This has been suggested elsewhere (McLaughlin, Williams, Williams, Peck, Derby, Bjordahl, & Weber, 1999; Williams, McLaughlin, Williams, Howard, & Marchand-Martella, 1993).as a way to assists in the teaching of preservice teachers in data-based and effective teaching strategies. In the present case reports, additional procedures could have been introduced for one of the participants to increase her performance in math.

The present findings also replicate a large body of literature that has shown Precision Teaching procedures to be effective for children with and without disabilities (Johnson & Layng, 1995; Lindsley, 1991; West et al., 1990). In addition, SAFMEDS were found to improve student performance and this has been reported elsewhere (e.g. Eshleman, 1985; McDade et al., 1985). Finally, providing additional opportunities for practice coupled with SAFMEDS was shown to be the most effective procedure across two students and different skill sets. Also, providing additional opportunities to respond has been suggested as an effective and time efficient way to improve student performance (Delquadri, Greenwood, Stretton, & Hall, 1983; Delquadri, Greenwood, Whorton, Carta, Hall, 1986; and Greenwood, Delquadri, & Hall, 1984) and reduce the probability of school failure (Greenwood, 1991). Finally, the immediacy of feedback was increased using various drill and practice procedures such as those suggested in Precision Teaching and copy, cover, and compare (Skinner, Shapiro, Turco, Cole, & Brown, 1992; Stading, Williams, & McLaughlin, 1996) than can improve student performance in multiplication.

References

Abba, S., & McLaughlin, T. F. (1995). Use of daily measurement, standard celeration charting, and a Nicotrol patch to reduce cigarette smoking with a female college student: A case study. *Journal of Precision Teaching and Celeration, 13*(1), 55-59.

Abrams, T., & McLaughlin, T. F. (1997). Effectiveness of error correction, error drill, praise, role reversal, and hand signals on correct rate, error rate, and comprehension. *Journal of Precision Teaching and Celeration, 14*(2), 24-30.

Anthony, C., Rinaldi, L., Hern, C., & McLaughlin, T. F. (1997). Reading racetracks: A direct replication and analysis with three elementary students. *Journal of Precision Teaching and Celeration, 14*(2), 31-36.

Ashbaugh, R., & McLaughlin, T. F. (1997). Precisely naming street names and locations. *Journal of Precision Teaching and Celeration, 14*(2), 19-23.

Binder, C. (1994). Measurably superior instructional methods: Do we need sales and marketing? In R. Gardner III, D. M. Sainato, J. O. Cooper, T. E. Heron, W. L. Heward, J. W. Eshleman, & T. A. Grossi (Eds.), *Behavior analysis in education: Focus on measurably superior instruction* (pp. 21-41). Pacific Grove, CA: Brooks/Cole.

Delquadri, J., Greenwood, C., Stretton, K., & Hall, R. (1983). The peer tutoring spelling game: A classroom procedure for increasing opportunity to respond and spelling performance. *Education and Treatment of Children, 6*, 225-239.

Delquadri, J., Greenwood, C. R., Whorton, D., Carta, J., & Hall, R. V. (1986). Classwide peer tutoring. *Exceptional Children, 52*, 535-542.

Eshleman, J. W. (1985). Improvement pictures with low celerations: An early foray into the use of SAFMEDS. *Journal of Precision Teaching, 6*, 54-63.

Everson, M., & McLaughlin, T. F. (1997). Effects of self-monitoring for students with learning disabilities. *International Journal of Special Education, 12*(1), 1-15.

Farley, J., & McLaughlin, T. F. (1996). Evaluating the effectiveness of home drill with a middle school student with ADHD. *Journal of Precision Teaching and Celeration, 13*(2), 33-367.

Greenwood, C.R. (1991). Longitudinal analysis of time, engagement, and achievement in at-risk versus non at-risk students. *Exceptional Children, 57,* 521-535.

Greenwood, C.R., Delquadri, J., & Hall, R.V. (1984). Opportunity to respond and student academic performance. In W. Heward, T. Heron, D. Hill, & J. Trapp-Porter (Eds.) *Behavior analysis in education* (pp. 58-88). Columbus, OH: Merrill.

Haring, N. G., Lovitt, T. C., Eaton, M.D., & Hansen, C. L. (Eds.). (1978). *The fourth R: Research in the classroom*. Columbus, OH: Merrill Publishing Co.

Heward, W. L. (1994). Three "low" tech strategies for increasing the frequency of active student response during group instruction. In R Gardner III, Sainato, D., Cooper, J. O., Heron, T., Heward, W. L., Eshleman, J., & Grossi, T. A. (Eds.) *Behavior analysis in education: Focus on measurable superior instruction* (pp. 283-320). Pacific Grove, CA: Brooks/Cole.

Heward, W. L. Exceptional children: An introduction to exceptional children. Upper Saddle River, NJ: Merrill/Prentice-Hall.

Kunzelmann, H., Cohen, M., Hutten, W.J., Martin, G., & Mingo, A. (Eds.). (1970). *Precision teaching: An initial training sequence*. Seattle, WA: Special Child Publications.

Johnson, K. R., & Layng, T. V. (1994). The morning side model of generative instruction. In R. Gardner III, D. M. Sainato, J. O. Cooper, T. E. Heron, W. L. Heward, J. W. Eshelman, & T. A. Grassi (Eds.). *Behavior analysis in education: Focus on measurably superior instruction* (pp. 173-197). Pacific Grove, CA: Brooks/Cole.

Lerner, J. (2000) *Learning disabilities theories, diagnosis, and teaching strategies* (7th ed.). Boston: Houghton Mifflin Co.

Lindsley, O. R. (1991). Precision teaching's unique legacy from B. F. Skinner. *Journal of Behavioral Education, 1*, 253-266.

Lloyd, D. N. (1978). Prediction of school failure from third-grade data. *Educational and Psychological Measurement, 38*, 1193-1200.

McDade, C. E., Austin, D. M., & Olander, C. P. (1985). Technological advances in precision teaching: A comparison between computer testing and SAFMEDS. *Journal of Precision Teaching, 4*, 49-53.

McLaughlin, T. F., & Skinner, C. H. (1996). Improving academic performance through self-management: Cover, copy, and compare. *Intervention in School and Clinic, 32*, 113-118.

McLaughlin, T. F., Williams, B. F., Williams, R. L., Peck, S. M., Derby, K. M., Bjordajhl, J. M., & Weber, K. M. (1999). Behavioral training for teachers in special education: The Gonzaga University program. *Behavioral Interventions, 14*, 83-134.

Miller, A. D., & Heward, W. L. (1992). Do your students really know their math facts? Using daily time trials to build fluency. *Intervention in School and Clinic, 28*(2), 98-104.

Pieper, E. (1981). A technique for discovering LD adolescents' strategies for solving multiplication facts. *The Pointer, 27*(2), 40-41.

Resnick, L. B. (1989). Developing mathematical knowledge. *American Psychologist, 44*, 162-169.

Resnick, L. B., Wang, M., & Kaplan, J. (1973). Task analysis in curriculum design: A hierarchically sequenced introductory mathematics curriculum. *Journal of Applied Behavior Analysis, 6*, 679-710.

Silbert, J., Carnine, D., & Stein, M. (1990). *Direct instruction mathematics* (2nd ed). Englewood Cliffs, NJ: Prentice-Hall.

Skinner, C. H., & Schock, H. H. (1995). Assessing mathematics skills. In A. Thomas, & J. Grimes, (Eds.) *Best practices in school psychology* (pp. 731-740). Washington DC: The National Association of School Psychologists.

Skinner, C. H., Shapiro, E. S., Turco, T. L., Cole, C. L., & Brown, D. K. (1992). A comparison of self and peer-delivered immediate corrective feedback on multiplication performance. *Journal of School Psychology, 30*, 101-116.

Skinner, C. H., Turco, T. L., Beatty, K. L., & Rasavage, C. (1989). Cover, copy, and compare: A method for increasing multiplication performance. *School Psychology Review, 18*, 412-420.

Stading, M., Williams, R. L., & McLaughlin, T. F. (1996). Effects of a copy, cover, and compare procedure on multiplication facts mastery with a third grade girl with learning disabilities in a home setting. *Education and Treatment of Children, 19*, 425-434.

Stein, M., Silbert, J., Carnine, D. (1997). *Designing effective mathematics instruction: A direct instruction approach*. Upper Saddle River, NJ: Merrill/Prentice Hall.

West, R. P., Young, K. R., & Spooner, F. (1990). Precision teaching: An introduction. *Teaching Exceptional Children, 22*(3), 4-8.

Williams, B. F., McLaughlin, T. F., Williams, R. L., Howard, V. F., & Marchand-Martella, N. (1993). The NCATE process and behaviorally-based special education. *Journal of Behavioral Education, 3*, 39-59.