were recorded by the teacher and each student and plotted on Standard Celeration Charts.

Experimental Design
A single subject two-tier multiple baseline across participants design was used to evaluate the effects of the Direct Instruction flash card procedure. A description of the various conditions follows.

Procedures
Prior to beginning the research, the researcher compiled 54 flash cards containing single digit math facts. Problem types ranged from $2 \times 2 = n$ to $9 \times 9 = n$.

Baseline
During baseline, fifteen flash cards were presented each day. No specific instruction or corrective feedback was provided. Then, the 100-problem fact sheet was presented to the participants, and their performance was recorded. The baseline data on the multiplication problems were gathered for 3 to 4 school days.

Direct Instruction flash card procedures
During this condition, the flash cards were sorted and contained 12 cards that the student could rapidly respond with a correct solution and 3 cards on which the participants had erred during baseline. The researcher presented the complete set of flash cards. Using a Direct Instruction format (model, lead, test, and retest), the researcher presented the 15 facts three times and spent approximately 5 minutes tutoring each student. When the child was able to name the fact for three consecutive sessions, it was removed and replaced by a new fact that had been missed during baseline. At the end of each flash card session, data were measured using a 100-problem fact sheet.

Reliability of Measurement
A second independent observer was trained by the researcher to evaluate reliability. The trained independent observer assessed the student’s accuracy of written answers twice during baseline and four times during the Direct Instruction flash card intervention for a total of 6, 20 sessions or 30% of all sessions. The number of correct written responses and errors was determined using a timer and calculator by both the researcher and independent observer. Interobserver agreement was calculated by dividing the number of agreements per test by the number of agreements plus disagreements and multiplying by 100. An agreement was defined as both observers independently marking an answer as correct or both marking an answer as an error. A disagreement occurred if one observer marked an answer as correct, but the other observer marked the answer as incorrect. The mean agreement was 100%.

RESULTS

Correct and Error Rate
Charts 1 and 2 show corrects and errors for each participant. Compared to baseline performance, each student showed improvement during the Direct Instruction flash card procedure. These data are summarized in Table 1.

Baseline data for Participant-1 had an average of 4.75 for corrects (range 3 to 6) and 12.25 errors (range 10 to 14). During the Direct Instruction Flash Card intervention accuracy increased for
Table 1. The Mean and Standard Deviation for Each Measure by Participant for each Experimental Condition.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Corrects</th>
<th>SD</th>
<th>Errors</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Participants</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4.75</td>
<td>31.26</td>
<td>12.25</td>
<td>2.34</td>
</tr>
<tr>
<td>2</td>
<td>4.00</td>
<td>1.0</td>
<td>7.667</td>
<td>3.06</td>
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<tr>
<td>Direct Instruction Flash Card Procedure</td>
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<td></td>
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<tr>
<td>Participant</td>
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</tr>
<tr>
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<td>30.875</td>
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<td>2.062</td>
<td>2.886</td>
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<tr>
<td>2</td>
<td>25.765</td>
<td>11.877</td>
<td>2.059</td>
<td>1.519</td>
</tr>
</tbody>
</table>

corrects ($M = 30.8$; range 12 to 47), and there was a decline in errors ($M = 2.06$; range 0 to 10).

Baseline data for Participant-2 had an average of 4 for corrects (range 3 to 5) and 7.6 errors (range 5 to 11). During the Direct Instruction Flash Card intervention accuracy increased for corrects ($M = 25.765$; range 10 to 43), and there was a decline in errors ($M = 2.059$; range 0 to 6.)

**DISCUSSION**

These data indicate that the Direct Instruction card procedures were effective to teach and increase mastery of basic math facts. This replicates the work of several researchers who have employed various drill and practice procedures (e.g. Skinner et al. 1989; Stading, Williams, & McLaughlin, 1996). In addition, these techniques were shown to be successfully implemented at school and at home.

Direct Instruction card procedures have been suggested as effective (Silbert, et al., 1990; Stein et al., 1997), and in the present report, data were presented to confirm such a conclusion with more confidence that if an AB design would have been employed.

The findings from this study also suggest that the Direct Instruction card procedure should be considered for students with disabilities as a valuable technique that can be implemented as a supplemental activity to school-based instruction. McLaughlin & Stone (2000) employed this same procedure in the home. Cards allow students increased opportunities to respond. Increasing opportunities to respond has also been linked to increased achievement by several researchers (Delquadri, Greenwood, Whorton, Carta, & Hall, 1986; Sacca, 1988; Maheady, Sacca, & Harper, 1987; Miller & Heward, 1992; and Thurston & Dasta, 1990) across a wide range of students, as well as subject-matter areas.
There were limitations in the present outcomes. First, only two participants were employed, and they were quite similar in age and disability. Additional replications could employ a wider variety of students and disability designations.

Another research project might employ baseline and card procedures using an alternating treatments design, or counter balancing the conditions might do much to answer the question of the efficacy of card drill with Direct Instruction.

The cost of the procedures was low and well within a school’s budget. The children enjoyed the procedures used and looked forward to math.

Further areas of study might include: (a) comparisons of these strategies to other tutorial and practice procedures (e.g., peer tutoring, computerized drill, in-home tutoring, and practice programs), (b) use of the procedure for students with disabilities and their parents, as well as with additional instructional content areas, and (c) monitoring of effects over time and (d) with practical tasks determine retention and potential generalization of skills, at home and school.

REFERENCES


Jenkins, & C. G. Pious (Eds.). Mentally handicapped children: Education and training (pp. 107-140). Baltimore, MD: University Park Press.


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