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ADI

Summer Conference information inside!

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Direct Instruction Conferences 1989

Orlando, Florida • June 19—21
Florida DI Conference

Chicago (Lisle), Illinois • June 26—28
Third Midwest DI Institute

Lewes, Delaware • July 17—20
Fourth Atlantic Coast DI Conference

Houston, Texas • July 31—August 2
Texas DI Institute

Kalamazoo, Michigan • August 7—10
Kalamazoo Conference

Eugene, Oregon • August 7—11
15th Eugene DI Conference

Salt Lake City, Utah • August 14—18
Fourth Salt Lake City DI Institute

Lake Tahoe (Kings Beach), Nevada • August 21—23
Second Lake Tahoe Conference

Reading, Pennsylvania • August 21—23
The Second Eastern Pennsylvania Conference on DI

Los Angeles, California • June 29—30
Los Angeles DI Conference

Tacoma, Washington • August 28—30
Puget Sound DI Conference

Training on Direct Instruction programs, techniques, and Mangagement Systems. Trainers include program authors such as Zig Engelmann, Doug Carnine, Wes Becker, Randy Sprick, Bob Dixon, Gary Johnson and many others.

The **Direct Instruction News** is published Fall, Winter, Spring and Summer, and is distributed by mail to members of the Association for Direct Instruction. Membership and subscription information may be found on page 41 of this newsletter. Readers are invited to submit articles for publication relating to DI. Send contributions to: The Association for Direct Instruction, P.O. Box 10252, Eugene, Oregon, 97440.

From the Editor:

This issue is the second of three planned HISTORICAL ISSUES. The third Historical Issue will appear as the Summer, 1989 issue. The articles I have selected for this issue include two studies of the use of DI with normal kids and nine articles covering a broad range of special education applications. The intent of this issue is to use Engelmann's SAMENESS PRINCIPLE — use widely differing positive examples to teach the range of applicability of a concept. The concept of interest is THE TYPE OF LEARNER FOR WHICH DI IS USEFUL. The conclusion that emerges is that *effective teaching methods are effective teaching methods regardless of the nature of the learner*.

Since DI research first focused on disadvantaged and special education kids, we have been asked a hundred times a year (since 1970) "Is Direct Instruction only for the low-achiever?" The first two reports answer this question with "Obviously not." Studies with middle-class kids show that they make great progress when taught with DI technology.

The range of special education studies we have sampled cover Downs Syndrome kids from birth to six, severe behavior problems, deaf children, severely retarded teenagers, first graders with limited reading skills, adults who read poorly, autistic children, and students said to have learning disabilities. The conclusions are remarkably similar. Let me give you a couple of samples.

In reviewing their research with autistic kids, O'Neill and Dunlap (p. 30) conclude: "The three areas (of research) discussed above may be viewed as illustrations of the general applicability of effective instructional methods to training autistic children. In particular, they point out a substantial overlap across Direct Instruction techniques, and the procedures that work for severely handicapped, autistic children. *This similarity of teaching methods suggests that principles underlying effective instruction may be more influential in the process of learning than the special characteristics of any particular student population.*"

In summarizing her review of the findings of the five Institutes for Research on Learning Disabilities, Stepnoski concludes: "Systematic instruction, which incorporates features of direct teaching (corrective feedback, mastery learning, reinforcement, distributed practice, and review) was consistently effective with LD students."

This theme is consistent through the eleven studies reviewed in this special issue. Maybe, someday, educators will get the message and students will get the benefit.

Wes Becker

DI Outcomes with Middle-Class Second Graders

by Siegfried Engelmann
and Doug Carnine

From *ADI News* Volume 1, Number 2 (Winter, 1982).

Because the Distar programs are used extensively with lower performing children, many educators have assumed that the programs are designed only for low performers and that they are either not appropriate or are even stultifying for "average" children. The Distar authors, on the other hand, maintain that the programs are designed for any child who has not mastered the skills necessary to read, to solve arithmetic problems, or th handle basic language operations.

Data on the Engelmann-Becker Follow Through Model (Becker & Engelmann, 1978) tend to substantiate the authors' contention that Distar does not inhibit middle-class children's achievement. Within Follow-Through classrooms, 20 percent of the children were middle-class. At the end of second grade the average performance in reading decoding for 3,363 poor children who started in first grade was grade level 3.7 (based on the Wide Range Achievement Test norms); for 898 middle-class children, the average reading performance was grade 4.5.

To further document the effects of Direct Instruction on the attitudes and achievement of "average" children, data were collected on a classroom of 30 middle-class second graders in Springfield, Oregon. The top half of the total second-grade enrollment — as determined by teacher assessment — was placed in the experimental classroom (28 children). These children had been in Distar as first graders also. Two low-performing children were added to the experimental classroom. One was a repeater (the only student who had been retained). The other was placed in the classroom on the recommendation of the reading specialist.

During both the first-grade year and the second-grade year, the children were taught primarily by trainees (students at the University of Oregon enrolled in a practicum on Direct Instruction techniques). Two academic skills — reading and arithmetic — were taught by trainees each morning during a two-hour period. For reading the second-grade year, each child received one-half hour of small-group instruction in level III Distar (which focuses heavily on science content), one-half hour of independent reading seatwork, and one-quarter hour of entire class presentation and one-quarter hour of independent seatwork.

The second-grade classroom teacher was rated as a superior teacher; however, the trainees were responsible for the bulk of academic instruction in reading and arithmetic.

A supervisor was responsible for training the trainees and for monitoring their performance. A total of six trainees taught the children over the two-year period. The trainees usually switched subject areas or small groups at the beginning of each new quarter, which meant that the children were frequently taught by three different "teachers" during the year, some of whom initially had never taught children before. Based on training data and children's performance in Follow Through, one would expect that the inexperienced trainees would not be able to achieve performance gains as great as those of experienced teachers.

These tests were given from late April to early June of the second-grade year: Stanford Achievement Test (Primary Battery 2) for Reading, Arithmetic, and Science, Wide-Range Achievement Test for oral reading. The ten children who performed best in reading achievement also received the Gates-MacGinitie test of *Speed and Accuracy* (for fourth through sixth graders).

An attitude questionnaire (developed by the investigators) was designed to tap the children's feelings about their reading program, their teacher, and themselves. (See Table 1.) The attitude questionnaire was presented to the entire class. The tester told the students that he was going to ask questions about their reading program and that the children were not to write their names on the test form. The tester then read each item aloud and the children circled the words that indicated how they felt. (The questions did not appear on the children's answer sheets.)

Results

Figure 1 presents bar graphs of the reading test scores. The first bar shows the mean reading (comprehension) score for all 30 children on the Stanford Achievement Test and the publishers norm (cross-hatched). The mean performance for the 30 subjects was at the 4.6 grade level. The only two children who scored below grade (below 2.7) were the two low performers added to the classroom. Both scored 2.6.

The second bar shows the mean performance for all children on WRAT Reading (oral decoding). No child

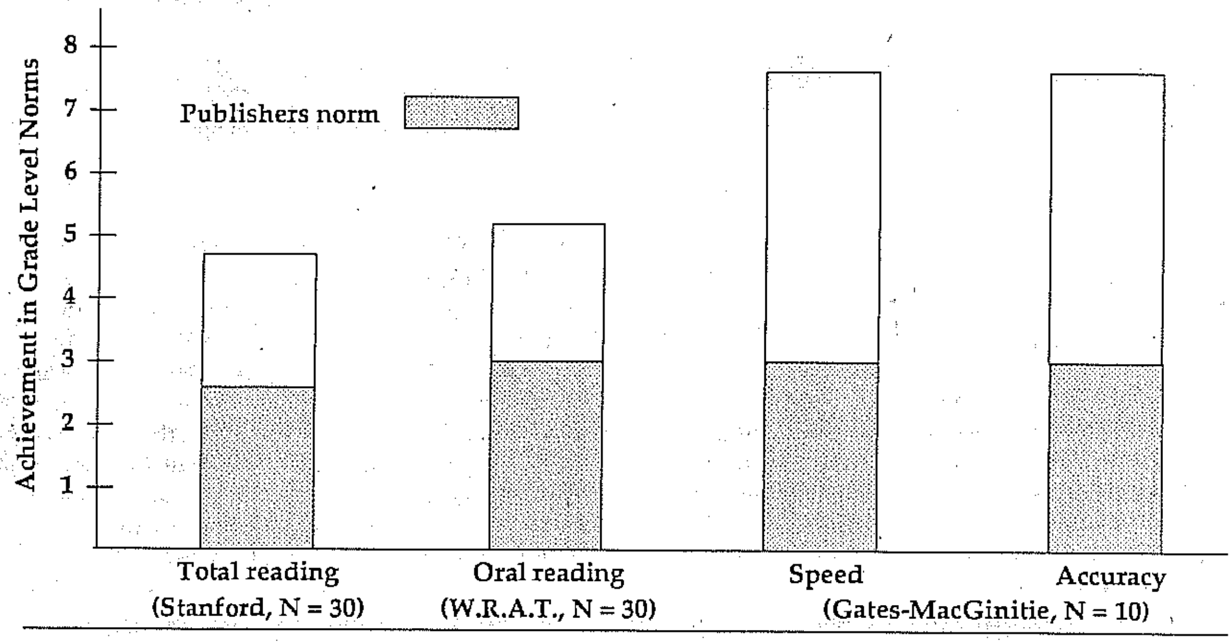

Figure 1. Reading Achievement

scored below grade norm.

Results of the Gates-MacGinite tests of *Reading Speed and Accuracy* appear on the third and fourth bars. Only the top ten children received this test. Although the children were in the second grade, they received the fourth through sixth grade battery because that was where they were performing. The ten children's mean performance was grade level 7.6 for speed and 7.5 for accuracy. The lowest score for speed was 4.6 (both scores achieved by the same child).

Figure 2 shows the performance of all 30 children in Science and Arithmetic as measured by the Stanford second-grade battery.

The children were not taught science as a subject. What they had learned about science derived from Distar Reading III. The 15-minute daily entire class activity could be labelled "science," since the children learned the various science rules presented in Distar III during this time. In science performance, the mean of 4.0 is significantly above the expected norm of 2.7. Only four children scored below grade level.

The mean Arithmetic performance (grade level 3.4) is not as high as that of reading and science. The standard deviation for arithmetic performance was only .83, indicating a narrow score distribution. Five children were below grade level.

The results of the attitude questionnaire are summarized in Table 1.

Items 1 through 5 deal with the student's enjoyment of the level III material. In response to item 1, 67 percent of the children indicated that they enjoyed the text material (the stories) a lot. The group enjoyed the workbook less, however, the highest category (a lot) was marked by 43 percent of the children. Most children (73 percent) indicated that the material "just right" in terms of difficulty (item 3). In items 4 and 5, the students indicated that they enjoyed either the middle (47 percent) or the end of the program (40 percent) far more than the beginning.

Items 6 and 7 may be considered as a crude indicator of the extent to which the children's interest was either stimulated or stifled by Distar Reading III. The summary of item 6 indicated that almost three-fourths of the students (73 percent) talked about the content some or a lot with other people. Also, 67 percent of the

Figure 2. Science and Math Achievement

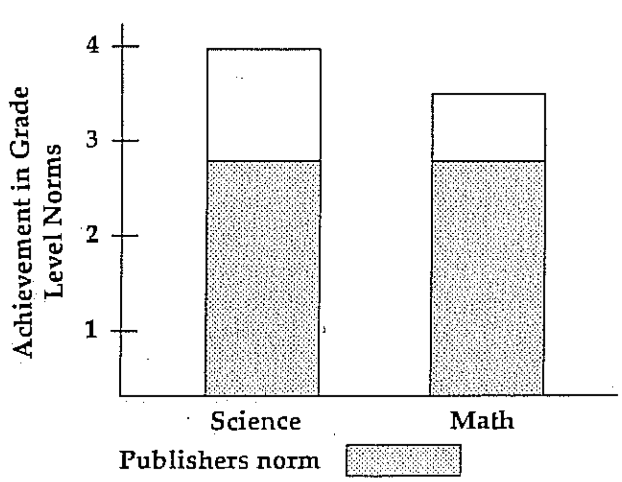

Table 1. Distar Reading Attitude Questionaire and Children's Responses

	1	2	3	Mean
A. Enjoyment				
1. How much did you enjoy the stories?	a little (4)*	some (6)	a lot (20)	2.5
2. How much did you enjoy the workbook?	a little (6)	some (11)	a lot (13)	2.2
3. Were the materials:	too easy (5)	just right (22)	too hard (3)	1.9
4. Which part of the program did you enjoy the most?	beginning (3)	middle (15)	end (12)	2.3
5. Which part of the program did you enjoy the least?	beginning (16)	middle (7)	end (7)	1.7
B. Interest and Curiosity				
6. How much did you talk about what you've learned with other people?	a little (8)	some (10)	a lot (12)	1.3
7. Have you read other books to find out more about something you read in a story?	Yes (20)	No (10)		1.3
C. Self-Image				
8. How smart are you compared to other kids you know?	smarter (9)	just as smart (16)	not as smart (5)	1.9
9. How well are you going to do next year in school?	very well (19)	O.K. (10)	not too good (1)	1.4
10. How smart are you going to be when you grow up?	very smart (24)	average (6)	below average (0)	1.2
11. How much did the teacher expect you to work?	a little (1)	some (2)	a lot (27)	2.9

* Numbers in parentheses indicate the number of children who circled that response.

children read other books to find out more about specific content presented in the reading program (item 7).

Items 8 through 10 deal with "self image" as it relates to being smart and performing well academically. Responses to item 8 indicate that the children do not consider themselves smarter than other kids they know; however, according to item 9, 80 percent of the students believe they will be very smart when they grow up. Almost two-thirds of the children (63 percent) indicate that they will do very well in school during the following year (item 10).

While there is no comparison group reported in this study, the performance of the children seems to be far above what would be expected in middle-class second-grade classrooms. There were no non-readers at the end of the second-grade year. In fact, the two lowest performers on the Stanford were only one-tenth grade level below norm. Both of these students scored above grade level on the WRAT. If we consider the publisher's norms as a basis for comparison, the children reported in the study were significantly accelerated, although the children had received no kindergarten instruction and although the classroom situation was less than optimal for achieving maximal performance or attitude gains. The constant switching of trainees meant temporary breaks in continuity. The inexperience of the trainees frequently meant that the children did not progress as rapidly as a more experienced Distar teacher would have moved them.

Some Conclusions

This study is not presented as a definitive statement about the effectiveness of highly structured, direct-instruction techniques with average and above-average performers; however, the data suggest that many statements like the following are false.

1. *Highly structured programs either retard or hold back average or above-average performers.* The teaching procedure is basically the same for both above- and below-average children; however, where they start and where they end is different. As soon as the children show that they can perform on a particular skill, the teacher moves to the next skill. The children in the study completed an average of 460 lessons during the two-year period.

2. *While highly structured programs may be successful in teaching very basic skills, such as decoding, they are not well designed to teach comprehension and reasoning skills.* The comprehension mastery as measured by the Stanford (4.4) was 1.7 years above grade level.

3. *Children who learn from highly structured programs find the instruction boring.* Neither the behavior of the children in this study nor their responses to the questionnaire provide any evidence that they found the highly structured presentations boring. While recognizing that their teacher required them to work hard, the children generally enjoyed what they did. An interesting point is that they enjoyed the program more as they progressed through it.

4. *Structured programs stifle curiosity and instill passive, stimulus-response behavior.* The children reported that they discussed the content of the program outside of class and two-thirds of them read books about specific concepts taught in the program. Discussions and independent projects are generally taken as signs of both independence and curiosity.

5. *Structured programs do not promote positive self-image.* Self-image is difficult to measure because there are many facets to a positive self-image. (Confidence on the basketball court does not imply a positive self-image in a reading group.) Although the measures used to judge "self-image" in the present study are, at best, crude, the children seem to be saying that they feel confident about themselves, that they are smart, that they will do well in school next year, and that they will be smart when they grow up. The only item that provides an apparent inconsistency with this interpretation is 8, to which the children responded that they generally consider themselves as smart as other children. A possible interpretation is that the children were using their classmates as a basis for this evaluation. The fact that they feel they will do very well next year and will be very smart when they grow up implies that they currently consider themselves quite smart. If these statements actually reflect their feelings, the children exhibit a quite positive self-image with reference to academic performance.

In summary, this study provides good support for the use of Direct Instruction programs with all children, not just the difficult-to-teach children. ◆

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Is DI only for Low Achievers?

by Edward Schaefer
Cape Henlopen School District
Nassau, Delaware

From *ADI News* Volume 6, Number 1 (Fall, 1986).

Direct Instruction, as a set of generic teaching strategies, has amassed a solid support base in the research literature over the past ten years (Cotton & Savard, 1982; Rosenshine & Stevens, 1981; Rosenshine, 1983). In the same manner, a variety of Direct Instruction curricula (such as the *Distar Reading, Language*, and *Arithmetic*) have proven remarkably effective in promoting student achievement in basic skills (Cotton & Savard, 1982; Fabre, 1983). Such curricula are based upon two premises: (1) that students' learning in the classroom is a function of environmental events, and (2) we, as educators, can increase the amount of students' learning by carefully engineering the details of students' interaction with the classroom environment. The curricula integrate those generic Direct Instruction teaching strategies with a set of curriculum design features drawn from empirical behavior theory (applied behavior analysis), the logical analysis of concepts and tasks, and the empirical analyses of classroom resources, especially the use of time and personnel (Becker, et al., 1981).

At times, however, one hears that Direct Instruction strategies and, especially, direct instruction programs are appropriate *only* for low achievers; and that such programs would have a debilitating effect on average and above-average students (Ogletree & Depasaligne, 1975). That such programs are appropriate for most low achievers would seem to be a matter of fact (Becker & Carnine, 1980). That they are appropriate only for low achievers would appear to represent a position based more upon assumptions, philosophies, and perceptions than upon empirical evidence.

It is our purpose here to present empirical evidence that would address the appropriateness of one such Direct Instruction program, *Reading Mastery* (Engelmann, et al., 1983), for average and above-average students in regular classroom settings.

Reading Mastery is a direct instruction basal reading program for grades K-6. The programs for grades K-2 are revisions of the *Distar Reading* series (1974 & 1975 editions). As such they emphasize decoding accuracy and fluency for the beginning reader, and the development of literal and inferential comprehension skills.

Reading Mastery program for grade 3 is also a revision of a previous edition of *Distar Reading*. *Reading Mastery* Level III emphasizes reasoning and reference skills; comprehension of new vocabulary and complex sentence forms; the interpretation of maps, graphs, and timelines; and the application of facts, rules, and schema to a wide variety of contexts. Levels IV-VI are entirely new. Level IV emphasizes problem-solving skills and reading in the content areas. Students are taught to comprehend new vocabulary and sentence forms, acquire information about the world, evaluate problems and solutions, and complete research projects.

Levels V & VI emphasize literary and writing skills. Students are taught to comprehend figurative language and predict vocabulary from contest; to analyze characters, settings, plots, themes, and arguments; to infer the main idea; to create outlines and complete writing assignments; and to apply these skills to the classic novels (e.g., *Tom Sawyer*), short stories (e.g., *The Necklace*), biographies (e.g., *Harriet Tubman*), poems (e.g., *Casey at the Bat*), and expository articles (e.g., *Schools in the 1840's*) provided in the program, *and* to any such material encountered outside their formal reading program.

Engelmann & Carnine (1982) report a study in which the previous edition of the *Distar Reading* program was used by a class of 30 average and above-average second graders. End-of-year assessment on the primary battery of the Stanford Achievement Test showed a mean reading grade level of 4.6 for the 30 students. The difference between the distribution of scores and the expected distribution was significant at the .001 level. No students in the group achieved a Stanford Reading Score less than 2.6 grade level.

Pre-publication validation studies (SRA, 1983) by the program authors of the revised (Levels I-III) and new levels (IV-VI) of the *Reading Mastery* program were conducted with a full-range of below-average, average, and above-average students. Daily student success rates on all decoding and comprehension tasks presented in the program were the primary data source. Allocated and engaged time data were also collected, as was information from teacher and student interviews. Data were collected using "permanent products" of student work and weekly observations in the classroom by outside observers, who also assessed each teacher's fidelity to the program as stipulated in the teacher's manual for each level. During and immediately after the first phase of study, those parts of the program that failed to produce consistent student success rates of at 85% were re-designed or re-written. Following these revisions and during the second phase of classroom tryout the authors indicate that daily success rates were consistently at or above criterion across the validation classes, and that only relatively minor revisions were necessary. The use of actual time and daily student success rate measures, in combination with a two-phase revision process, represents an approach to effective teaching that is quite consistent with the often demonstrated, process-product relationship between student achievement and "academic learning time" (the amount of time students are *successfully* engaged in task-related activities). Each level (I-VI) of the *Reading Mastery* program was put through this two-phase process separately, with 2-3 years of classroom data collected during the two try-out and revision cycles for each level of the program.

During the 1984-85 school year the writer coordinated a "pilot study" of *Reading Mastery* in one regular fourth grade and three regular fifth grade classrooms in an intermediate school of about 300 students. The school is located on Delaware's Atlantic seaboard and serves a predominantly middle-class population. Minority students represent about 25 percent of the student body. The school contained 4 classes each of grades 4, 5, & 6: average class size was 25 students of mixed ability and achievement levels. Students were placed in classes by the building principal so as to create a heterogeneous balance using achievement, gender, and race as primary criteria; and individual student maturation and learning style as secondary criteria. Prior to the 1984-85 school year *Reading Mastery* had been used only for special education and basic skills students, with very good results. Students in regular classrooms used *Keys to Reading* (The Economy Company, 1980). The school had been using *Keys to Reading* for five years.

In the fourth grade each of the four teachers taught reading to their own class. One teacher used *Reading Mastery* and the remaining three teachers continued to use *Keys to Reading*. In the fifth grade reading was taught by only 2 of the 4 teachers; each "reading" teacher was responsible for her own class and one other. One of the fifth grade teachers used *Reading Mastery* for both of her reading classes, while the second fifth grade teacher used *Reading Mastery* for one class and *Keys to Reading* for the other.

All six teachers involved in this study had at least 10 years of teaching experience and were highly rated by administrative staff. All six teachers had taught at the school for at least five consecutive years and had used *Keys to Reading* throughout that time. Consequently the teachers using *Keys to Reading*, and their students, were very experienced with the program and had demonstrated their competence in using it. The three teachers who had volunteered to use *Reading Mastery* were using the program for the first time, as were their students. These three teachers did receive 6 hours of training in *Reading Mastery* prior to the school year, and were visited once in the classroom during the school year by a trainer/consultant.

As a matter of State mandate in Delaware, all students in grades 1-8, and 11 are tested annually using a standardized, norm-referenced achievement test. Students are tested according to their assigned grade level regardless of their current levels of academic achievement. In March of 1984 and again in March of 1985, the Comprehensive Test of Basic Skills (CTBS) was administered to all students using the level of test assigned to their respective grade levels (i.e., Level "E" in third grade, "F" in fourth grade, and "G" in fifth grade).

Table 1 shows the mean NCE (normal curve equivalent) scores for the 4 fourth grade classes. An NCE score of 50 represents the national average; the standard deviation is 21. In addition to the 2 reading subtests (Vocabulary and Comprehension) and the composite Total Reading score, Table 1 also shows the results for the CTBS spelling subtest. The same fourth grade teacher who was using *Reading Mastery* also was piloting a Direct Instruction spelling program — *Spelling Mastery* (SRA, 1980). The other fourth grade teachers continued to use *Keys to Spelling* (The Economy

Table 1. CTBS Results—Reading Mastery Pilot

Grade 4	Vocabulary			Comprehension			Total Reading			Spelling		
	'84	'85	Gain	'84	'85	Gain	'84	'85	Gain	'84	'85	Gain
Economy 1	66.7	72.4	5.7	63.5	68.1	4.6	65.6	70.8	5.2	64.3	67.6	3.3
Economy 2	65.5	69.5	4.0	56.4	66.0	9.6	61.3	68.0	6.7	67.6	71.0	3.4
Economy 3	58.6	65.0	6.4	58.0	68.0	10.0	58.6	66.2	7.6	66.9	71.2	4.3
Economy Average	63.6	68.9	5.3	59.3	67.3	8.0	61.8	68.3	6.5	66.3	69.9	3.6
Reading Mastery 1	58.0	65.5	7.5	56.7	66.8	10.1	57.6	66.3	8.7	58.0	62.6	4.6

Table 2. CTBS Results—Reading Mastery Pilot*

Grade 5	Vocabulary			Comprehension			Total Reading		
	'84	'85	Gain	'84	'85	Gain	'84	'85	Gain
Economy 1	71	69	-2.0	69.7	65.7	-4.0	70.4	67.6	-2.8
Reading Mastery 1	61.0	63.5	2.5	64.6	67.7	3.1	63.0	65.3	2.3
Reading Mastery 2	68.1	69.3	1.2	66.8	69.9	3.1	67.2	69.5	2.3
Reading Mastery 3	77.4	77.0	-.4	71.2	74.0	2.8	74.5	75.7	1.2
Reading Mastery Average	68.8	69.9	1.1	67.5	70.5	3.0	68.2	70.2	2.0

Company, 1981).

All of the fourth grade classes were above or well above the national average according to their 1984 scores. Of the 12 possible comparisons between *Reading Mastery* and *Keys to Reading*, based on the "gains" from 1984 to 1985, all 12 favored the *Reading Mastery* program. All 4 spelling comparisons favored *Spelling Mastery*

Table 2 shows the CTBS scores for the fifth grade. The Economy 1 class and the Reading Mastery 1 class were both taught by the same fifth grade reading teacher. Based upon the 1984 scores, all 4 classes were above average, with the Economy 1 and Reading Mastery 3 classes scoring 1 standard deviation and 1 1/3 standard deviations above the national average respectively. As with the fourth grade, all 12 comparisons, based on '84-85 gain scores, favored *Reading Mastery*. Especially noteworthy is the comparison between the Economy 1 and Reading Mastery 1 classes, since these 2 classes were taught by the same teacher. The difference in gain scores on the comprehension sub-test totals 7.1 points or 1/3 of a standard deviation. This is an educationally significant difference favoring the *Reading Mastery* class.

Additionally, each *Reading Mastery* teacher was interviewed and submitted written feedback concerning the effectiveness of *Reading Mastery* in a regular classroom. Each of these teachers indicated a decided preference for *Reading Mastery*, and wished to use it again during the '85-86 school year. The fifth grade teacher who used *Keys to Reading* for one of her classes stated that she wished to use *Reading Mastery* exclusively during the next school year.

All 28 comparisons of gain scores from the CTBS favored the Direct Instruction programs (i.e., *Reading Mastery* and *Spelling Mastery*). All the teachers who used these programs thought them most effective and requested to use them again the following year. Likewise student reactions to the Direct Instruction programs were enthusiastic. Such results with average and above-average students are quite consistent with those of many previous studies demonstrating the effectiveness of Direct Instruction with low-achieving students.

Now what of our original question: "Is Direct Instruction only for the low-achiever?" Apparently not. Considering all of the information presented here, the pattern seems quite clear: Good teaching profits everyone! ◆

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**Editor's note: In interpreting Table 2 gain scores, be careful not to think in terms of Grade Equivalent Scores. These are standard scores where "no gain" means the students progressed a year in reading for a year in school. The negative scores in Table 2 indicate that some groups did not quite progress a year. If you divide the gain by 21 (e.g., 7.5/21 = .357) you will have the gain against the norm group in standard deviation units. The gains shown are consistently in favor of Reading Mastery, but the differences between Reading Mastery and Economy are not great, ranging from .10 to .33 standard deviation units. One would have to conclude that, as used by these teachers with these students, Economy is also an effective program.*

Section 2. DI Strategies for Special Learners

Mainstreaming Down's Syndrome Kids

Reported by Wes Becker

From *ADI News* Volume 2, Number 1 (Fall, 1982).

Graham Clunies-Ross, Rosemary Clunies-Ross, and Alan Hudson of Melbourne, Australia, have been working to accelerate the development of Down's Syndrome children using Direct Instruction strategies and programs. Their evidence shows not only remarkable learning accomplishments by these children, but also demonstrates that the earlier you start, the more the children progress.

Recently, Hudson and Clunies-Ross examined the capabilities of schools to deal with the integration ("mainstreaming") of 15 children with intellectual handicaps. They found that most schools were not prepared to deal with the children's academic problems and that "satisfactory academic progress occurred only when the children were in highly structured learning situations." Three of the schools having problems agreed to introduce more structured programs. Each school also had one child from Clunies-Ross' early education project with Down's Syndrome children.

In each of three schools, the teacher in the class with the Down's Syndrome child was asked to identify (by rating all) other children functioning at a similar level as the Down's Syndrome child in reading and/or math achievement. In class A (5-year-olds), 24 children were identified; in class B (5-year-olds), 10 children were identified; in class C (first graders), 8 children were identified. DISTAR Fast Cycle Reading was used as the sole method of reading for the third school term (12 weeks) in all three classes. The children had previously been in a language experience reading program. DISTAR Arithmetic I was used in classes A and B as the sole method for math instruction.

Pretests and posttests were made using the ACER Primary Reading Survey Test, Level AA, and the Keymath Diagnostic Arithmetic Test for classes A and B. The results were as follows:

Results for Primary Reading Survey			
Class		Pretest	Posttest
		(percentiles)	
A & B (5-year-olds)	(N = 31)	23rd	50th
C (Grade 1)	(N = 8)	50th	77th

Results on Keymath			
		(Grade Equiv.)	
A & B (5-year-olds)	(N = 31)	1.15	1.65

These are obviously substantial gains for the 12-week period. But what about the Down's Syndrome children?

"Although the children's achievement in each instance fell below their respective group means, the children made good progress. In reading, their average normative performance rose from below the 11th percentile to the 40th percentile. In arithmetic two of the children gained, respectively, the equivalent of .3 and .5 grades during 12 weeks of direct teaching. The teachers reported that they were able to work effectively with Down's Syndrome children in the DI groups."

Clunies-Ross notes that the children, selected because of their slower progress, were progressing at a rate comparable to average achievers. "The DISTAR programs seem to produce remarkably predictable outcomes across a diversity of student groups. They appear to have impressive potential as a basis for attaining the goals of instructional integration (mainstreaming)." ◆

Bringing Serious Behavior Disorders Under Control

by Geoffrey Colvin, Larry Sessions,
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From *ADI News* Volume 3, Number 4 (Summer, 1984).

The delivery of services to handicapped children has seen remarkable growth since the inception of PL 94-142. However, one small group of students still causes serious problems for school administrators, teachers, specialists and parents. These handicapped students have *severe behavior problems* (violent aggression, tantrums, self-injury, running away,m self-induced vomiting, eating nonedibles, smearing feces, and refusal to eat). They are a threat to others and a threat to themselves. Remediation has generally been ineffective. Many school districts have been compelled to provide alternative placements for these students, such as home-based instruction, out-of-district placement or institutional placement. These placements, while often expensive, are generally not effective in changing the behavior so that the student can return home or move to a less restrictive environment. There is a great need nationwide for a behavior technology that can be implemented within a school district that not only brings about behavior change, but ensures that the behavior change is generalized and maintained at school, at home and in the community. This article describes a basic framework for developing and implementing such a program.

Model Program

A project to develop a model program for bringing these students under control at school, in the home and in the community was undertaken in the Natrona County School District in Casper Wyoming. The project has three basic components:

1. Implementation of a behavior technology described in *Generalized Compliance Training: A direct-instruction program for managing severe behavior problems* (Engelmann & Colvin, 1983).
2. Development of procedures to ensure effective communication and collaboration between personnel at school and the parents.
3. Demonstration of the model with a handicapped student who has a long history of serious behavior problems (biting self and others, head banging and attacking others).

The procedural steps in the model are as follows: (1) documentation that the student's behavior is resistant to normal interventions, (2) accurate assessment of the student's behavioral patterns, (3) implementation of procedural safeguards, (4) implementation of compliance training to extinguish inappropriate behavior, (5) generalization of behavior control across people (parents, teachers, support staff) across settings (different classrooms, cafeteria, gymnasium, bus, etc. and home settings), and across tasks (self-help skills, academic skills and vocational skills), and (6) development of appropriate instructional programs.

Step 1: Documentation of the Severity of the Student's Behavior

It is important to establish that the students' behavior *cannot be remediated* through normal interventions either by: (a) attention to the details of good instruction (content, schedule, pacing, motivation, etc.) and/or (b) implementation of basic classroom management techniques (differential reinforcement, time-out, token economies, behavioral contracts, etc.).

The target student for demonstrating this model program met this requirement. He has a long history of serious behavior: smashing bus windows with his fist, biting himself and drawing blood, biting his teachers, hitting himself and banging his head on a wall. He has had several school placements, none of which were successful in controlling his behavior. His father took early retirement and kept the student at home with him on a home-based placement. The student had been at home for nine months prior to entering A.J. Woods School (Casper, Wyoming) for evaluation and subsequent training.

Step 2: Assessment of the Student"s Behavioral Patterns

The assessment phase is designed to determine the range in inappropriate behaviors exhibited by the student, the contexts that prompt the inappropriate behaviors, and the student's compliance level and skill level in various instructional areas. In addition an analysis was made between the baseline performance of the student in a home-based instructional program and the performance level required for full integration in a school-based program. The results of this assessment are presented in Table 1.

Step 3: Procedural Safeguards

Because of the severity of the student's behavior and the potential risk of serious injury to the student and/or staff, a number of procedural safeguards were instituted:

1. The parents were fully informed of the details of the procedures to consequate biting and aggression and to induce appropriate behavior.

Table 1. Assessment of Behavior Patterns in Baseline and Corresponding Annual Goals

Baseline Level (August 1982)	Annual Goal (June 1983)
1. Home based instruction.	1. Full-day school program.
2. Under control/supervision of one person (father).	2. Under control/supervision of any legitimate authority.
3. Control by restraint.	3. Control by voice.
4. Rewards are mostly food.	4. Rewards are mostly social (approval, praise).
5. Bites self in the context of: a. Resisting tasks b. Securing attention c. Expressing needs	5. Biting is extinguished.
6. Transportation is restricted to parents car with father driving.	6. Uses appropriate school transport.
7. Functions only in one-on-one situations.	7. Functions in a group.
8. Is prompt-bound on many basic self-help skills.	8. Is independent on basic self-help skills
9. Displays limited independent work skills.	9. Works independently on vocational tasks
10. Communicates basic needs inappropriately. (biting/agitation/noises).	10. Uses simple communication to express needs.
11. Has a very restricted diet of high calorie and high sugar content foods.	11. Has a balanced diet.
12. Is quite overweight.	12. Is a reasonable weight.
13. Does not interact with peers.	13. Interacts with peers.

2. Complete disclosure and consent from the school district for implementation and maintenance of the program were obtained.
3. The building principal and staff were fully informed and trained in the procedures.
4. Continued monitoring of the program and regular evaluation meetings were scheduled.
5. Commitment from all staff and parents to collaborate and make joint decisions that will be adhered to both at home and at school.
6. Contingencies were set up within the school so that any outbursts of serious behavior could be dealt with immediately.

Step 4: Implementation of the Generalized Compliance Training Program

The Generalized Compliance Training program was then introduced. The details of the full program are presented in the training manual (Engelmann & Colvin, 1983). Once the target student had met criterion on the compliance set, biting and hitting were targeted as major noncompliances. The procedures for dealing with biting and hitting are presented in Table 2. By June, 1983, these behaviors had virtually been extinguished.

Step 5: Generalization of Learned Behaviors

Since this student initially functioned in a highly restrictive environment, careful programming has been necessary to generalize his skills. The basic approach has been to identify the components of a task or context where the student has been performing (baseline) and then to identify the corresponding components of the targeted task or context. The strategy then was to show *sameness* across the two contexts. Two approaches were used to demonstrate this sameness: (a) introduce components of the targeted context into the training context and/or (b) introduce components of the training context into the targeted context. The details of these procedures are presented in the text (Engelmann & Colvin, 1983).

Step 6: Developing Instructional Programs

The major components in developing instructional programs were:
1. Provision for transition between the compliance training and instruction.
2. Identification of range of skills (language, motor skills, discrimination ability).
3. Selection of appropriate content (emphasis in vocational, self-help, and communication).

Table 2. Consequation Procedures for Student's Hitting/Biting

Student hits or bites

Major	Minor
• "No hitting." Loud & Sharp	• "No hitting." Sharp warning tone.
• 20-30 stand up/sit downs in firm/sharp voice.	• 4 stand up/sit downs (2 each).
• Give command "No hitting" every 8-10.	• Exit command to original context
• Exit command to original context.	
• Reinforce.	

Notes:
1. Use voice only (prompt sharply only if he doesn't stand up or sit down).
2. If 2 minor behaviors occur close together, treat the 2nd as a major offense.
3. If hitting/biting occurs during consequation, raise voice for 2-3 stand up/sit downs and increase the total to 10.
4. Give reminder in a positive tone of "No hitting" periodically after consequation.
5. If there is doubt between a minor or a major offense, treat it as a minor infraction.

4. Design of programs to facilitate independent work.
5. Introduction of group instruction.
6. Facilitation of social interaction with peers.

Summary

The present project was designed to field test a model program for changing a student's serious behavior problems at home, at school, and in the community. Specifically, a handicapped student with severe behavior problems had been on home-based instruction with his parents. The model program was instituted to bring the student's severe behavior under control and to integrate the student into a full day program at A.J. Woods School in Casper, Wyoming. The major components of the model are a behavior technology, Generalized Compliance Training, and effective communication and collaboration procedures between the A.J. Woods Staff and the parents. By June, 1983, the student's serious behavior was virtually under control and he was in a full day instructional program. ◆

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Generalized Skills Training with Severely Retarded Students

by Robert H. Horner
Heidi Rose

From *ADI News* Volume 1, Number 4 (Summer, 1982).

Direct Instruction typically brings to mind elementary school classrooms, small groups of students sitting around a teacher, rapid pacing, and carefully programmed academic materials. The technology of Direct Instruction, however, appears to have as much promise for teaching vocational, self-help and community living skills to severely handicapped students. Consider Lisa.

Lisa is 18 years old, severely retarded, minimally verbal, and a student in a secondary special education classroom. During her IEP meeting Lisa's parents indicated that they want her to learn skills that would allow her to function more independently in community settings. They would like her to cross streets independently, purchase items from stores, go to movies, and learn a vocation. Two characteristics of these requests are worthy of note. The first is that they reflect a growing trend toward identifying age appropriate, functional, community-referenced objectives for severely handicapped students. The second characteristic is that unlike many of the skills taught to severely retarded students, the above activities require acquisition of a general case skill — one which the student can use in a wide variety of contexts. The purpose of this article is to describe recent efforts to use direct instruction procedures to teach general case skills to severely handicapped students.

"The general case has been taught when, after instruction on some tasks in a particular class, any task in that class can be performed correctly (Becker & Engelmann, 1978)." For example, a student in a classroom has learned the general case for double digit addition when s/he can add any pair of double digit numbers. A student in the community has learned the general case for street crossing when s/he can cross any street in town. Community skills are usually different from classroom skills in that they: (a) take longer to perform, (b) require more complex motor responses, (c) include more distractors, and (d) are more likely to change across performances.

People with severe disabilities often do not perform daily living skills related to moving about in the community, purchasing items, visiting friends, or taking advantage of leisure activities (movies, parks). With recent efforts to include severely handicapped individuals in community options has come an interest in how to teach these basic community skills. As with early efforts to teach math and reading, early efforts to teach community skills to severely handicapped students have focused on teaching a single example of the skill, and hoping that after the student learns that example s/he will be able to do other examples. As with our experience in teaching math and reading we have learned that severely handicapped students do not "generalize" very well.

While Direct Instruction with severely retarded students in the community may look different than Direct Instruction of math skills with a small group of non-handicapped children, the principles in use are the same. To teach community skills with severely handicapped students requires the same care in selecting and sequencing teaching examples as is found in a DISTAR program. A Direct Instruction teacher avoids student confusion about "b" and "d" by selecting and sequencing teaching examples. Similarly, the confusion associated with one-way and two-way streets is avoided by selecting and sequencing teaching examples.

Any community skill which requires that students perform correctly in non-trained situations (i.e., new streets, new vending machines, new electronic games, new items in the store) is a general case skill. The ability of severely handicapped students to learn these skills rests largely with the ability of teachers to adapt Direct Instruction technology to the community.

"A rose is a rose is a rose" (Gertrude Stein, Sacred Emily, 1913). In most cases you can also assume that the process for adding two numbers, or the rule for defining a language concept will be the same from place to place and time to time. Because math, language, and reading skills are nearly the same in all parts of the country, it is reasonable to build programmed texts for teaching these skills. Unfortunately, the same strategy does not work for community skills. The skills required for street crossing in Eugene, Oregon are different from those needed in Denver, Chicago, or New York. The vending machines in Miami are different in their shape, sounds, and methods of operation from those found in Wyoming, even though they have many similarities. As a result, there are few programmed materials which teachers can use that are programmed for their local community. Of more importance, it is unlikely that a curriculum soon will be published which meets all the requirements of all local communities. The need to teach community-referenced skills, and the diversity among communities require that teachers of severely handicapped students assume a major role as *developers* of community skill sequences.

For the teachers of severely handicapped students, the teaching skills of pacing, prompting, reinforcing, and correcting must be supplemented with competence in selecting and sequencing teaching examples. Because of this, recent research at the University of Oregon has begun to address rules that teachers can use when programming vocational and community skills with severely handicapped students. Two examples of this work are described next.

As older severely handicapped students prepare to leave school, access to employment becomes a major concern. A recent study conducted by Rebecca McDonald examined the use of DI to teach a general case vocational skill. The skill involved using a plierlike tool to crimp and cut the wire leads of circuit board assemblies performed by handicapped and nonhandicapped workers in the electronics industry. The job requires a general case skill because the type of components that are crimp/cut will vary from day to day. All components require the same manipulation (i.e., place each wire lead in the pliers and squeeze), but different components require slightly different ways of performing the task. Small components, for example, are more difficult to place in the pliers and the big components can get twisted. Errors occur if the pliers are not held next to the head of the component or if the component is held at an angle. The twenty (20) components were selected to cover the range of all components in terms of: (a) shape of the component head, (b) size, and (c) the distance between the wire leads. Four students from a TMR classroom were given the twenty components and asked to "crimp" them. This baseline measure was followed by each student being trained how to crimp-cut *one* component. Following training with a "single instance" componentthey were again tested with the 20 non-trained components. The four students were finally trained (one at a time) with a set of three "general case" components. The general case components were selected to sample the range of component variability across the dimensions head size, head shape, and distance between leads. After a student could perform correctly with all three general case components s/he was again tested with the 20 non-trained components. An experimental design was used to ensure that any effects seen could be attributed to this training strategy.

Results from this study show the power of DI with severely handicapped students. None of the students knew how to crimp-cut components before instruction. After learning the Single Instance component the students performed many mistakes on the 20 test components. Not only did Single Instance training *not* teach the general case skill, it actually taught students to perform errors. Only those few components in the set of 20 that were just like the Single Instance component were performed correctly. After training on the three general case components, however, errors dropped out, and nearly all the 20 non-trained components were performed correctly by each student. Training with the general case components resulted in students learning a general case skill.

This study indicates the importance of some basic DI rules. It takes more than one teaching example to teach a general case. In vocational skill training, as well as in teaching academics, it is necessary to select general teaching examples, and to make sure these examples sample the range of differences that may be encountered.

While we believe the superior performance of students following general case training was the result of the rules used to select training examples, it is possible that students performed better after general case training simply because general case training involved *more* teaching examples. To examine this possibility, and to emphasize the need to select training examples that "sample the range" Jeff Sprague conducted a study on teaching general-case-vending-machine use.

Jeff's study was much like Rebecca's in that a group of 10 vending machines were selected which represented all the different kinds of vending machines in town. Students from TMR classrooms who did not know how to use vending machines were taught with a single Instance machine and tested with the 10 non-trained machines. Some students then were taught with three similar machines. These students got experiences with more machines but not with machines that sampled the range. Other students were trained with three machines that did sample the range of variation in such things as how the machine was activated and how the product was removed from the machine. Only those students trained with the three "general case" machines learned to perform successfully across the 10 non-trained test machines. This study demonstrates the importance of selecting both multiple training examples *and* selecting examples that sample the range of variation to be encountered.

These two studies are a beginning toward the application of DI technology to vcational and community skill instruction with severely handicapped students. More work is needed to identify the rules that teachers should use for designing and conducting community-referenced programs, but the foundation provided by existing DI research should prove extremely helpful.

Direct Instruction is out of the classroom. It is happening today with severely handicapped people in their local communities. Recent research indicates that while the behaviors and settings in the community are different, many of the programming rules of DI will apply. Teachers of severely handicapped students need these rules to build community-referenced programs. Severely handicapped students need these rules to become more independent participants in thier communities. ◆

A Review —

Tactile Reception of Speech by the Deaf

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From *ADI News* Volume 4, Number 3 (Spring, 1985).

Children with profound hearing impairment invariably suffer severe deficiencies in expressive and receptive speech and language development (Ling, 1976). Although lip-reading and hearing aids enable partial reception of speech, the acoustic information necessary for the accurate perception and intelligible production of speech is largely unavailable to the profoundly deaf. Despite special educational programs, materials, and personnel, the academic progress of these children lags significantly behind that of their hearing peers, and their social and economic potentials are considerably reduced.

For the past fifty years, researchers in a variety of disciplines have wondered whether speech could be adequately perceived and learned through the sense of touch (Kirman, 1974; Reed et al., 1982). This was a question with which Wes Becker introduced me to Zig Engelmann in mid 1971. I was then a Research Associate at the Oregon Research Institute (ORI) in Eugene, involved with the development of a biomedical engineering program there. Zig was convinced that it was possible to perceive speech tactually because of some experiments in tactile pattern recognition he had performed with Don Bitzer at the University of Illinois some years before. He argued that he could develop the instructional methods to train children and adults to fluently perceive speech through the skin, if I could build a device which would faithfully transmit all the acoustic components of speech to the skin.

At the same time, I was unaware of previous research in this field, and so set about to reinvent the wheel. From experience in speech research at Haskins Laboratories (now in New Haven, Connecticut), I knew that speech could be broken down ("analyzed") into fifteen or so bands of channels for telephone transmission and then re-assembled ("synthesized") at the receiver with little degradation in quality and intelligibility. Such devices were called "vocoders" (from "voice coder"), and had been investigated at Bell Laboratories since the later thirties (Dudley, 1939). We would present the acoustic energy present in each of the analyzer channels of the vocoder to different points on the skin. Since the skin is insensitive to frequencies much above 400 cycles per second (Hz), we had to convert the audio frequency energy in each channel to vibrational energy at some relatively low frequency; we chose 60 Hz and utilized a vibrator which would operate at this frequency for each channel. Since the output of the analyzer portion of the vocoder contained virtually all the speech information at the input, it seemed reasonable that presentation of this information to the skin in a suitable form could result in speech perception if the brain was assisted by the right kind of training and could interpret the tactile patterns in much the same way it interprets speech and language.

ORI agreed to fund the construction of the device, and Zig agreed to fund the training personnel costs. Early in 1972, a young technician, John Hunt, was hired to assist in the design and fabrication of the device which we now called a "tactual vocoder". The device was assembled by late 1972, and spanned the frequency range from 85-10,000 Hz in 24 channels so that high and low speech frequencies, which are not present in telephonic transmission, were included. The vibrators, were organized in five modules of five each (minus one) which were worn on either one or both arms. Both subjects and trainers had their own microphones so that the subject could perceive both her own speech as well as that of the trainer.

A vocabulary list of some sixty words was developed. Some of the words differed only in vowel sound (boot, bait, bat), some in consonant sound (silly, filly; sly, fly), some were similar (days of the week), and others were quite dissimilar (the subjects' names). The initial participants in the study were Millie Schrader, Laurie Skillman, and Linda Youngmayr—training coordinators from the Follow Through Project (Engelmann-Becker Model) who each spent about ten hours per week alternately as subjects and trainers. The subject's hearing was masked by ear plugs and by loud continuous noise in a headset. Subjects were trained without visual contact so that the only information received was through the tactual vocoder. A structured stimulus/response protocol with correction procedures was faithfully followed. Despite interruptions caused by travel schedules, all the words in the vocabulary could be reliably identified after roughly 50 hours of training. There was no evidence of an asymptote in word acquisition rate, and learning rates were similar whether vibrator module placement was on one or both arms. Carol Morimitsu joined the study somewhat later, and it was with her that no difference in tactual perception was seen whether the vibrator modules were placed on the forearms or thighs. Even more surprising was the discovery by Linda and Laurie that speech intonation and stress could be accurately mimicked by the subject without training specifically directed to these skills. The first experience was judged successful, and a second experiment was undertaken with several profoundly deaf children from the Eugene school district.

Carol, Laurie, and Linda were the teachers for the deaf children. Both teacher and subject wore microphones connected to the tactual vocoder so that the children could receive tactile feedback from their own verbal productions. The vibrator modules were worn on the children's thighs so that their hands and arms were unencumbered. There was no visual contact between the children and their teachers during perception training, but face-to-face contact was used during production training. Initially, the children learned to identify readily discriminable nouns (e.g., alligator vs. hat) by pointing to pictures of these objects placed in front of them. As training and verbal proficiency progressed, language concepts and phrases were introduced. A token reinforcement system was used for correct responses. Accumulated tokens could be used to purchase toys from a "store" in the lab. Gary, the child with the most extensive training, had acquired over 150 words at the time the results of both studies were published (Engelmann and Rosov, 1975). Gary ultimately went on to acquire over 600 words in his vocabulary before the study was terminated. Because of these results, research interest in the field increased considerably. Engelmann was awarded a contract by the (then) Bureau of Education for the Handicapped to develop and evaluate an instructional program in speech and language for deaf children utilizing the tactual vocoder as a training aid. While deaf children who were taught with the program performed at a significantly higher level of speech and language proficiency than those receiving conventional instruction, there was no significant difference between the vocoder and non-vocoder groups. At the Smith-Kettlewell Institute in San Fransisco, Frank Saunders (1973, 1976) was developing a tactual vocoder using electrical rather than vibratory stimuli. This provided the potential for a significant reduction in device size, mechanical complexity, and power consumption. At the University of Washington, Dave Sparks (1978) adopted Saunders' electrocutaneous stimulation technique, and developed another version of the tactual vocoder on which he did considerable evaluative research. Similarly, two postdoctoral fellows at the University of Washington, Kim Oller and Rebecca Eilers, developed a keen interest in the concept, and, using a more compact version of the device built by Hunt at ORI, published a very encouraging study of tactual speech perception in older deaf children after moving to the University of Miami (Oller et al., 1980). At about the same time, Trish Brooks and Barry Frost (1983) of the Queen's University in Kingston ,Ontario, built their own sixteen channel vibrotactile vocoder, and independently confirmed the results of the Engelmann and Rosov study in a very tightly controlled experiment in which a hearing subject acquired a tactual vocabulary of 150 words. This was subsequently enlarged to 245 words with evidence of phonetic generalization (Brooks et al., 1982; Frost et al., 1983). These investigators also extended their studies of tactual vocoder performance to deaf children (Brooks et al., 1983).

Utilizing the functionally compact vocoders that Hunt has built for Engelmann's BEH contract, Bill Gavin set up a vocoder-based oral training program for deaf preschool children in the Fall of 1982 at the Institute of Logopedics in Wichita, Kansas. This program is being conducted as a pilot study of vocoder usage with deaf preschoolers (Harr et al., 1984; Born et al., 1984), and is intended to become a full scale clinical research study of vocoder usage in the near future. At the present time, five preschoolers are enrolled in the program. They wear the vocoder arrays for approximately three of the six available classroom hours per day. The time spent wearing the vocoder arrays is necessarily limited because the children are tethered to the vocoders by the cables which connect the vibrator arrays to the box containing the electronics.

It was precisely these limitations of non-portability and limited vocoder exposure which prompted Gavin and me to submit a proposal to the Department of Education in the late summer of 1983 for the design and construction of a fully wearable/portable vibrotactile vocoder, functionally identical to the non-portable units that has been build by Hunt at ORI. A contract to perform this task was awarded to the Research Division of the Institute of Logopedics in October 1983, and the first fully wearable vibrotactile vocoder was worn by Julie, a profoundly deaf four-year old, in December of 1984.

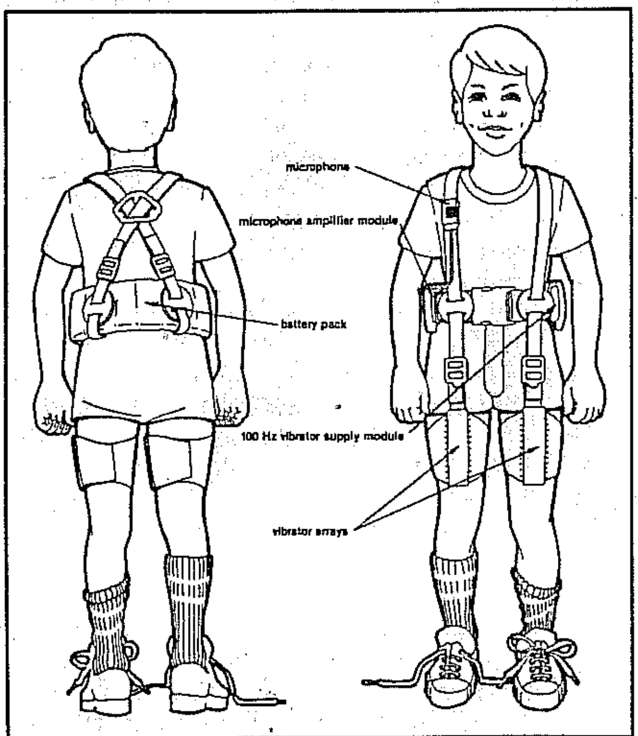

Figure 1. The Wearable Vibrotactile Vocoder

The wearable vibrotactile vocoder is shown in Figure 1. The unit weighs 5.5 pounds, 3.5 pounds of which are contained in the rechargeable battery pack which is worn at the back of the waist. The vibrator arrays are strapped to the anterior surface of the thighs in the same configuration as the non-portable unit, except that the arrays now contain most of the electronic circuitry. A small microphone, worn on a suspender strap, is connected to a microphone amplifier module on one side of the belt, and vibrator power supply — low voltage battery module — is placed on the other side. The device is powered by plugging in the battery pack, and disconnected by unplugging. When unplugged, the battery pack is readily plugged into a battery charger. Battery life is about six hours, which is sufficient for a school day. Julie frequently wears the unit home after school and on weekends; a spare battery pack is easily inserted into the harness on these occasions. The unit has proved to be unexpectedly durable in the first few months of field testing. No significant equipment problems have occurred, and only minor engineering changes have been incorporated to further increase reliability.

The wearable vibrotactile vocoder has performed so well that the Institute of Logopedics will proceed with the construction of thirty additional units destined for its deaf preschool program, and for evaluative programs at the Wichita Public Schools, the University of Miami's Mailman Center for the Childhood Diseases, the Central Institute for the Deaf in St. Louis, and the Massachusetts Institute of Technology. With a relatively large number of units being subjected to evaluative research, we expect that the acceptance and use of the vibrotactile vocoder either as a speech training aid or as an external auditory prosthesis for severely and profoundly deaf children will become widespread. ◆

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Using Corrective Reading with Adults

by Cynthia M. Herr
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From *ADI News* Volume 3, Number 3 (Spring, 1984).

While the *Corrective Reading Program* was originally written for use in grades four through twelve, it is equally effective when used with adults who are non-readers or who read at a very low level. I began using *Corrective Reading* with adults when I started teaching in the Study Skills Learning Center at Lane Community College in 1979.

The Study Skills Learning Center offers developmental courses in language arts for students who are enrolled at Lane Community College. Some of the students are enrolled in vocational courses; some are pursuing academic degrees. Students range in age from young adulthood to middle-age. Among the courses offered in the Study Skills Learning Center are several classes designed to provide intensive remedial work in reading, writing, and spelling. These Read, Write, Spell classes, as they are called, require the students to attend class 10 hours per week. This is approximately three times the class time required for most courses at the college. There are three levels of Read, Write, Spell classes. The lowest level is for students who read at less than a fifth grade level, as measured on the Wide Range Achievement Test (WRAT). The second level is for students whose reading levels fall between the fifth and seventh grade levels, and the third level is for students whose reading levels are above the seventh grade level. Enrollment in any of these classes is by instructor permission only, and all students are pretested on the WRAT before being allowed to register for one of the classes. As a matter of department policy, standardized test data are recorded by instructors for all classes offered in the Study Skills Learning Center. The maximum enrollment for the lowest level class is 12 students. A classroom aide is assigned to assist the instructor of the lowest level class during the ten hours of weekly class time.

I taught the lowest level Read, Write, Spell class for nine terms between Fall, 1979 and Spring, 1982. During this time, I used *Corrective Reading* as the primary reading program for the class. Besides the WRAT, the Nelson Reading Test (a timed test of vocabulary and comprehension) is typically administered. Many students take a Read, Write, Spell class for only one or two terms. But during the three years I taught the class, three students enrolled in my class for several consecutive terms. This enabled me to gather long term data on their reading progress. I have also had contact with each of the three students over the last two years. Thus, although I do not have test scores on their current reading levels, I do know that all three students have continued their education programs to some degree. The purpose of this article is to describe the use of *Corrective Reading* with these three adults and to present the data on their progress during the time they were enrolled in the Read, Write, Spell class.

For the most part, I used the *Corrective Reading Program* in the same manner with adults as I had with elementary and high school age students previously. Each student was given the placement test and assigned to either *Decoding B* or *Decoding C*. In the cases of these three students, who shall be referred to as W., D., and M., each student began *Corrective Reading* in *Decoding B, Lesson 1*. Since the Read, Write, Spell class met for two hours each day, I was able to divide the class of 10-12 students into two skill groups which met with me for a *Corrective Reading* lesson for 45-60 minutes a day. During the other hour of class time, the students worked with the aide. During this time, the aide did timed readings with the students, taught a spelling lesson, and assisted the students in their independent seat work.

Initially, I covered only one *Corrective Reading* lesson a day with each group. The lessons were taught according to the program manuals. One of the most critical aspects of teaching reading to adults who are reading at a very low level is having the students read aloud. Unfortunately, this is the aspect of teaching reading which is most often excluded in teaching adults, primarily because instructors are afraid that adults will be too embarrassed to read aloud. During the first week of class, my students were shy about reading in front of other students. I made a point of explaining to them why it was critical for them to read aloud, and I assured them that no one would laugh at their mistakes. We closed the door to our classroom to facilitate privacy, and the rule about laughing at mistakes was strictly enforced. I never once had a student refuse to read aloud under those circumstances. The students received considerable positive reinforcement, and they were soon quite comfortable about reading aloud in class. One of the nicest benefits of having the students read aloud in each other's presence was that each student quickly realized that his/her reading problem was not unique. The students developed into a very close-knit, supportive group and encouraged each other to continue whenever one of the group members became discouraged.

For most of *Decoding B*, I covered one lesson a day. I found that adult readers with few decoding skills take as long to master beginning reading skills as do children who are just learning to read. However, once these students had successfully mastered most of *Decoding B*, I found that their learning rates accelerated more quickly. I was able to do one lesson in class plus the chalk-board work for the next lesson and assign the second story for homework. The class aide then did both timed readings with the students the next day. The students' error rates did not increase with this accelerated pace. I also found that most of the adults I taught had little trouble comprehending the *Corrective Reading* stories as long as they were decoding them accurately. Because of their receptive language, which for most students was quite good, they had little trouble with the vocabulary in the stories. This also made it possible to cover *Decoding C* at an accelerated pace. Except for their greater expressive and receptive language abilities, these adults learners were very similar to other beginning readers in the types of errors they made in their reading. I found that teaching adults beginning reading skills was very similar to teaching children beginning reading skills.

Often I have been asked whether these adults objected to the content of the *Corrective Reading* stories. They did *not* object. Sometimes they joked about how silly some of the fictional stories were, but all of them were much more concerned about their reading progress than they were about the content of what they read. With *Corrective Reading*, their progress became evident to them within the first couple of weeks. As long as they felt they were learning to read, they likely would have read anything I had asked them to read.

The case histories of the three students demonstrate the kind of reading progress adults can make when they are taught with a well-structured, carefully sequenced reading program like *Corrective Reading*. The test scores for these three students, W., D., and M., are presented in Tables 1 and 2. In addition to the standardized tests, I also administered the *Corrective Reading* mastery tests at the appropriate times in the program. Although Tables 1 and 2 show pretest and posttest scores for each term, the pretest score for most terms is the posttest score from the previous term. In most cases, there was only a few weeks' time between the end of one term and the beginning of a new term. It would have been inappropriate to have tested continuing students on the same standardized test within just a few weeks' time.

Table 1. WRAT Reading Scores (Pretest/Posttest)
(Grade Equivalent Scores)

Student	Fall '79	Winter '80	Spring '80	Fall '80	Winter '81	Spring '81	Fall '81	Winter '82	Spring '82
W.	1.9/2.7	2.7/3.7	3.7/5.0	3.4/4.1	4.1/6.0	—	—	—	—
D.	2.4/3.5	3.5/4.1	4.1/*	2.6/3.6	3.6/4.1	4.1/4.3	4.3/4.7	4.7/5.9	5.9/*
M.	—	—	—	3.3/3.9	—	—	3.4/4.1	4.1/5.2	5.2/6.0

*Student was absent when testing was done

Table 2. Nelson — Total Reading Scores (Pretest/Posttest)
(Grade Equivalent Scores)

Student	Fall '79	Winter '80	Spring '80	Fall '80	Winter '81	Spring '81	Fall '81	Winter '82	Spring '82
W.	2.2/2.1	2.1/3.2	3.2/3.0	3.0/3.1	3.1/3.8	—	—	—	—
D.	2.3/3.0	3.0/3.5	3.5/*	2.5/2.8	2.8/2.5	2.5/2.9	3.4/3.0	3.0/3.6	3.6/*
M.	—	—	—	2.7/2.9	—	—	2.9/3.1	3.1/4.0	4.0/4.1

*Student was absent when testing was done

Student W. entered the Read, Write, Spell class Fall term, 1979. At that time, W. was in his mid-twenties. He had attended school only until he was thirteen, at which time he left home and traveled around the United States. At various times in his life he had been enrolled in government funded training programs, but because of his poor reading skills, he had always eventually dropped out of such programs. When he entered the Study Skills Learning Center, his reading score on the WRAT was a 1.9 grade equivalent. He knew some sight words, but had almost no phonic skills for decoding regular words. W. was determined that he was going to learn to read, and he spent many additional hours in the Study Skills Learning Center lab practicing the sounds of letters with the aid of a language master machine—a technique which he had heard about and which he insisted on being taught how to use. Since that time, I have often used a language master machine to provide additional drill on both phonics and sight-word skills for my students. W. made very steady progress during the five terms that he was in my Read, Write, Spell class. He learned new skills rapidly and in two terms went from being my lowest student to being the most capable student in my *Decoding B* reading group. W. is a fine example of what a very motivated student of normal ability can accomplish when taught in a structured, phonically based program. In a year and a half of study, W.'s scores on the WRAT went from a 1.9 grade level to a 6.0 grade level. W. made less spectacular progress on the Nelson Test of Reading, primarily because it is a timed test. On a similar reading comprehension test, in an untimed setting, W. scored several grade levels above his 3.8 score on the Nelson. In the Spring, 1981, term, W. moved on to the next level Read, Write, Spell class. Following that term, he stopped coming to the Study Skills Center for classes, primarily because of tuition costs and job conflicts. Periodically though, he would stop in to see me, and he always said that he was still getting help on his reading from Lane Community College's adult non-credit program. This last Fall term, 1983, W. again enrolled in credit classes at Lane Community College. He entered a Textbook Reading class with a 5.5 grade level score on the California Reading Test. He is currently enrolled in an auto mechanics program and is managing the course textbook with some one-to-one tutoring assistance several times a week. W.'s goal is to pass the GED (general equivalency degree) test sometime in the next few years. I believe that he will achieve that goal.

Student D. entered the Read, Write, Spell class at the same time as W. Although his initial WRAT score was higher than W.'s (2.4), his progress over a period of three years was much less consistent and slower. D. is probably the most severely learning disabled student I have taught in 12 years of teaching. D. had almost no decoding skills when he entered my class as a young man in his middle twenties. He had earned a high school diploma, but had few of the skills normally associated with that degree. I started D. in *Decoding B*, and he made slow but steady progress over the next three terms. Tables 1 and 2 show that his test scores on both the WRAT and the Nelson increased gradually that year. As is characteristic of many learning disabled students, D. often appeared to have mastered a skill one day only to have forgotten it the next day. This was painfully obvious when I tested D. in September, 1980, after a summer in which he had no reading instruction. His reading level and skill had regressed to almost the level at which he had begun the year before. D. repeated *Decoding B* that Fall and Winter terms. His progress the second time through the program was faster, and he retained skills more easily. He began *Decoding C* Spring term, 1981. As a measure of his increased ability to retain new skills, D.'s test scores the following Fall term show no decrease, in spite of the three months he was without instruction. D. continued to make steady progress in *Decoding C* during the 1981-82 school year. He completed *Decoding C*, but unfortunately, due to a serious illness, he did not complete the last week of school and was not present for the posttesting. D left Oregon and I did not hear from him for two years. However, he appeared in my office just a few weeks ago. He had come back to get his educational records because he is applying to the University of Washington to complete an art degree. He intends to enroll in their special reading program while he is there. According to D., he is reading regularly and he believes that his reading skills have continued to improve. I believe that if D. had not had three continuous years of direct instruction in reading, he would still be reading at a second-grade level. His learning disability is so severe that without the continual repetition of newly acquired skills, he would quickly forget them. Had D. been in a program that was not flexible enough to allow him to repeat the same class, although not the same material each term, nine times, he would never have received the number of repetitions of each skill that he needed in order to retain those skills. D. is a testament to the fact that truly learning disabled children do not outgrow their disability when they become adults. Learning will probably never be easy for D., but with good teaching he can learn and retain what he learns.

Student M., a woman in her early forties, entered my class Fall term, 1980. Because of her sight word reading skills, she scored at the third grade level on the WRAT. However, I started her in *Decoding B* because she had few decoding skills. M. made good progress that term. Her motivation level was much higher than before, and she was able to complete *Decoding B* and *Decoding C* in the next three terms. In just nine months, M.'s reading score on the WRAT improved 2 years and 6 months. M. continued on in the next level Read, Write, Spell class for one more term, and then she quit school to support her family. Probably the most impressive fact about M.'s experience in the Read, Write, Spell class, besides her reading progress, is that she was able to intervene on her son's behalf when she realized that he was not learning to read in first grade. She knew enough about her own reading problems to recognize that her son was being taught with a sight-word method which was teaching him no decoding skills. Because she was able to judge that the reading program was not appropriate for him, she was able to work with his school to get him into a *Distar* program in which he did very well. I don't know if M. has continued to read very much since she left the Read, Write, Spell class, but I do know that she is successfully supporting her family, and she is keeping a very close watch on her son's progress in school.

I believe that the experience of these students show that *Corrective Reading* is just as effective a program for adults as it is for children and teenagers. Adult non-readers need to be taught just as carefully with a program that stresses decoding skills as do children who are first learning to read. The material content of the program is far less important than many teachers believe. The stories do not have to be relevant to an adult's life. The critical factors to consider in choosing a program for non-readers, whether children or adult, are how carefully the skills are sequenced and taught and how much repetition of those skills is provided. The *Corrective Reading Program* meets those criteria as few other programs do. ◆

Teaching Complex Content to Secondary LD Students using Mastery Learning, Technology, & DI Theory

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A major obstacle to mainstreaming is the performance difference between learning disabled students and their peers. Various interventions have been offered to help overcome these differences: Curriculum-based assessment (Fuchs, 1986), Direct Instruction curriculum design (Engelmann & Carnine, 1982), technology (Leiber & Semmel, 1985), mastery learning (Bloom, 1984), tutoring (Scruggs & Aidder, 1986), learning strategies (Deshler, Schumaker, & Lenz, 1984), and so forth. Since presenting these interventions singly has been found to improve student learning, combining several of these interventions would probably produce even stronger effects. Such comprehensive interventions might well be essential for cognitively complex topics such as fractions, chemistry, reasoning skills, etc. This review covers research on interventions that have combined Direct Instruction curriculum design, technology, and mastery learning to provide instruction in complex topics.

The interventions focused on secondary students who were experiencing increasing demands to learn complex material, exemplified by new high school graduation requirements, particularly in science. Secondary science textbooks are not designed to meet the needs of learning disabled students. These textbooks look more like reference books than instructional programs. Many biology texts have increased in size by over 300 pages during the past several years. According to Mary Budd Rowe of the University of Florida, an average high school science text requires students to master 3000 terms and symbols or an average of 2 per minute of class.

A required course, such as earth science, deals with the solid earth, the oceans, and the atmosphere, and generally includes geology and geophysics, meteorol-

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ogy, oceanography, and solar-terrestrial astronomy. This extremely large collection of material provides a great challenge even to the earth science teacher, let alone the resource room teacher. Typically, each of these earth science topics is covered independently, with its collection of rules and nomenclature, as if there was no connection among the topics. Explanations of the ways in which the earth, the atmosphere, and oceans work are usually presented in a disjointed way that leaves students with a jumbled collection of unrelated words and facts.

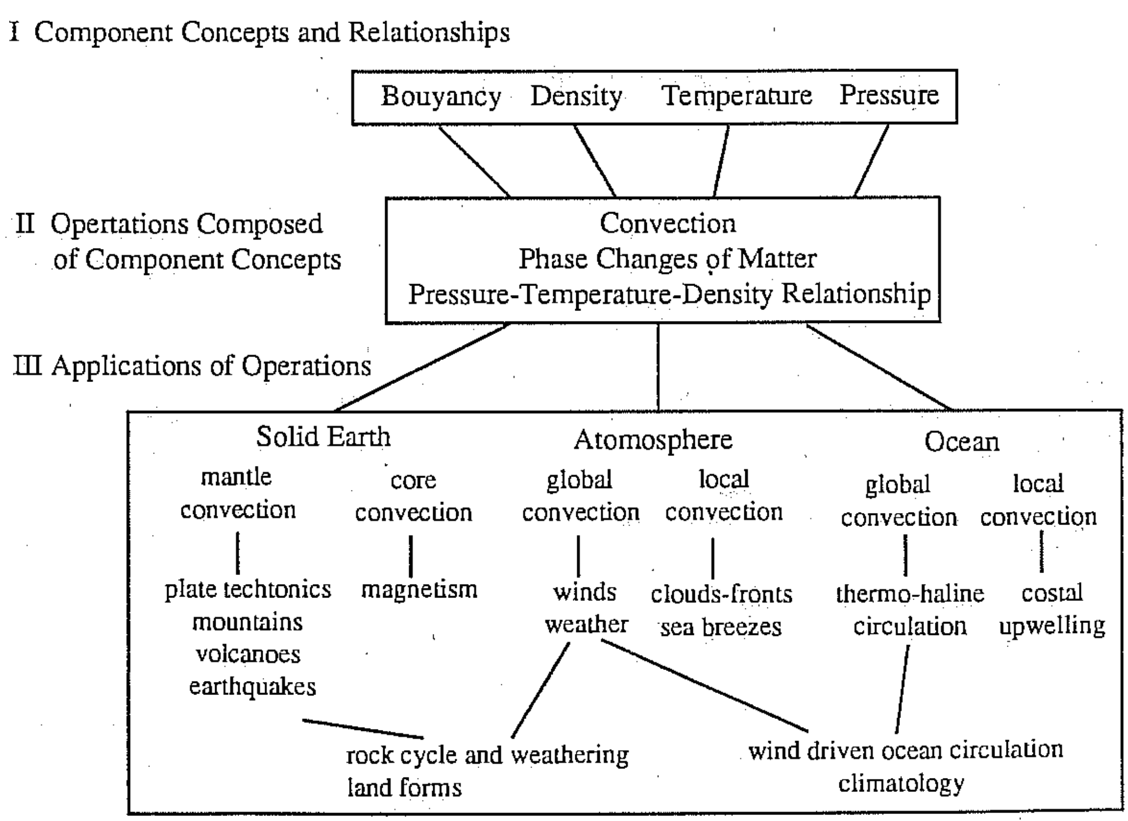
We have attempted to remedy these and other problems for secondary learning disabled students by integrating instructional design, technology and mastery learning procedures into a comprehensive intervention.

Instructional Design

One of the primary principles of instructional design set forth by Engelmann & Carnine (1982) is to show how seemingly unrelated phenomena can be unified through a common set of rules. Learning a small set of related rules that then makes sense out of dozens of facts is easier than learning those same facts as unrelated bits of information. This approach is illustrated in Figure 1, taken from the Earth Science course of the Core Concepts in Math and Science series (Systems Impact, Inc., in press). After a brief introduction to the properties of solids, liquids, and gases, several component concepts and relationships are taught. These constitute Level I in Figure 1: buoyancy, density, temperature, and pressure. At Level II, component concepts are combined to form operations. These are the processes of convection, the relationships between pressure, temperature, and density, and the phase changes of matter. These simple operations provide the unifying basis for the study of earth science and are the foundation upon which the rest of the course is based. Convection in particular is central for formulating models for the structure and dynamics of the earth, the atmosphere, and the oceans.

The remainder of the course is devoted to generalizing the operations to a wide range of applications

Figure 1

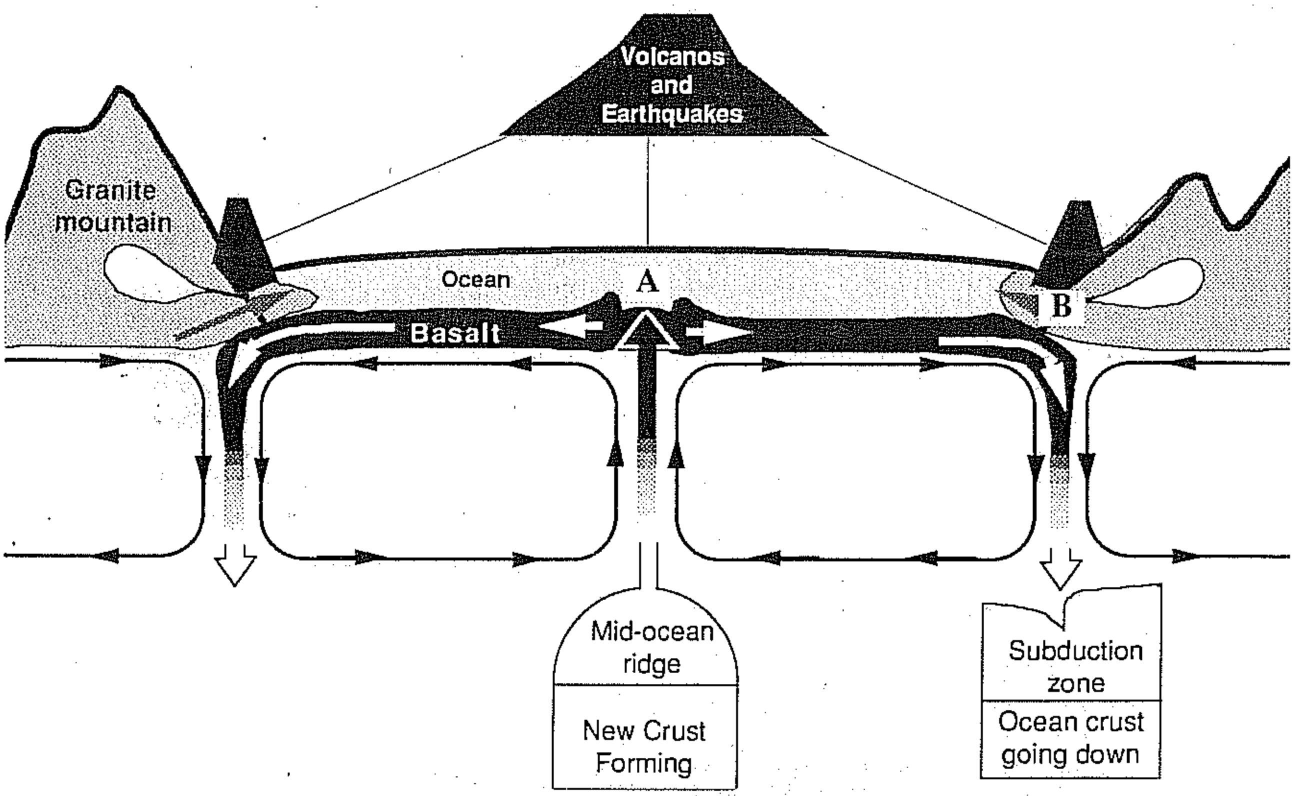


(Level III in Figure 1). An examination of Figure 1 shows the importance of convection for applications to earth science. For example, the medium of mantle convection is rock. While this appears implausible, it is known that, over long periods of time and under the influence of tremendous temperatures and pressures, rock in the mantle flows like a liquid. The heat source for mantle convection is the residual heat from the earth's formation, trapped near the center of the earth. The convection process moves heated material from the core toward the surface.

Figure 2 illustrates the relationship of mantle convection to most of the important large scale geologic features on the earth's surface. The convection currents are very slow moving but they are massive, dragging the crust of the earth and moving continents and ocean beds around. For example, at point A in Figure 2, the convection currents are rising and moving outward, pulling the ocean crust apart. Molten rock upwells in this area, forming the vast mid-ocean ridge system, with undersea vulcanoes and earthquakes due to the movement and cracking of the crust and the upward push of molten rock.

At locations where the convection currents are coming together (B in Figure 2), the ocean (floor) crust collides with the continental crust. The ocean crust is more dense than the continental crust, so the heavier ocean crust sinks below the continental crust, in a region called a subduction zone. The continental crust is pushed upward and giant granite mountain chains are formed, while the downward moving ocean crust forms deep trenches in the ocean along the edge of the continents. Earthquakes and volcanoes form along subduction zones, as the ocean crust slides against the continental crust, moves down, and melts. If zones where earthquakes, volcanoes, and mountain chains occur are mapped on the earth's surface, we get an idea of where the major convection currents in the

Figure 2



mantle are moving up or down.

Thus, convection, specifically the process of mantle convection, helps explain many, seemingly diverse phenomena such as the occurrence of mountains, volcanoes, earthquakes, mid-ocean ridges, ocean trenches, and fault systems. Once the process of convection is understood, these major topics of earth science are easily and logically presented. Convection can also account for many of the phenomena found in the ocean and atmosphere—the global heat pattern and the wind patterns of the earth, as well as the dynamics of fronts and clouds, and ocean currents and the temperature structure of the world's oceans.

Technology

The technology component of the *Earth Science* Course is the laser videodisc. One side of a videodisc contains up to 54,000 individual high-resolution video frames. The frames can be shown in rapid succession to create motion sequences or displayed singly for any period of time. Moreover, by pressing a few keys on a remote control pad (very similar to the remote control for a TV), the teacher can move anywhere on the disc in just a second or two. Automatic stops built into the disc allow still frame exercises to appear and stay on the screen following an explanation or demonstration.

The way these features are orchestrated can be illustrated with an example: The teacher is presenting a videodisc lesson from *Earth Science* on a large monitor to an entire class of students. She diagnoses students as having difficulty with the concept of bouyancy, so she enters the address for the segment of the disc that explains bouyancy. Within seconds, the students are reviewing bouyancy with a dynamic video presentation. At the end of the demonstration the disc stops automatically, displaying an application exercise. With the remote control device, the teacher is able to move around the room to see when students have had enough time to complete the exercise. The teacher then uses the remote control to advance the player to the next frame, which shows the answer to the exercise.

Thus, videodisc technology allows an *interactive format* usually not possible with conventional audio visual materials. The videodisc technology also dynamically presents experiments and demonstrations that are difficult or expensive to conduct in classroom situations. Vivid visual demonstrations are associated with nearly every concept that is presented, rendering them easily understood. Computer graphics, sound effects, brisk pacing, highlights and other techniques also help maintain students' attention.

Mastery Learning

Earth Science has a specific system for helping teachers diagnose and remedy student difficulties. This system is embedded in six steps that are utilized with all concepts introduced in the program:

1. During the initial explanation of a concept, the narrator on the videodisc asks questions which students answer orally.
2. Immediately following the initial explanation students write answers to a series of problems. The last problem serves as an informal test. If more than 20% of the students miss it, the teacher plays an explanation from the disc. This pattern of demonstration followed by practice is repeated for each concept presented in a lesson.
3. Students do homework without supervision.
4. The next lesson begins with a quiz covering the one or two major concepts introduced in the previous lesson. The screen gives the disc address for a remediation if one is needed.
5. Every fifth lesson is a test. Again, teachers diagnose student errors and select remedies from the disc based on student performance.
6. After being tested, a concept is reviewed every few lessons.

The instructional design, videodisc technology, and six-step mastery learning procedure make it easier for the teacher to present essential content in a visually-compelling manner. Courses like Earth Science are particularly helpful to less confident teachers, since the academic content is presented in a clear fashion from which students will learn. Moreover, the course provides an in-class, daily model of effective teaching practices.

The remainder of this paper describes a series of research studies that incorporate a variety of instructional design principles, technologies, and mastery learning procedures. (See Table 1 for a summary.) Most of these studies asked specific research questions, using random assignment to treatment groups of learning disabled students and, in some studies, remedial students as well.

Research Studies

Chemistry

The components of the *Introduction to Chemistry* course from the Core Concepts series (Systems Impact, Inc., in press) were very similar to those of the *Earth Science* course—unifying principles were taught to an entire class via a tape version of the videodisc course with the same six-step mastery learning procedure. In the study (Carnine, Kelly, Noell, & Hayden, 1986), the subjects were students who had not yet passed a science class, which was a high school graduation requirement. Of the 16 students who participated, five were learning disabled and 11 were remedial. Ten students were in the 10th grade, five were in the 11th grade, and one student was in 12th grade. Students were taught with the chemistry program for four weeks, approximately 40 minutes per day. At the end of the four weeks, the students were given a post test. The test was also given to advanced placement, second year chemistry students at the same high school. (The mean percentile score on the math section of the Stanford Achievement Test was 17 for the experimental students and 95 for the advanced placement students.)

To insure that the test was not biased toward the content of the Core Concepts course, two high school chemistry teachers from another high school in a different district examined the test. After carefully considering each item, four questions were rejected. Each teacher felt the remaining questions were a fair measure of beginning chemistry, the kind of items that they would expect beginning chemistry students to know.

The experimental students had an average pretest score of 17.3 percent and an average posttest score of 76.9 percent. Advanced placement students averaged 82.1 percent on the posttest. The advanced placement students did not score significantly better than the experimental students who had received instruction with the Core Concepts Chemistry course.

Fractions

Mastering Fractions (Systems Impact, 1985) is another videodisc course from the *Core Concepts in Math and Science* videodisc series, with the same six-step mastery learning procedure. Earlier research (Kelly, Carnine, Gersten & Grossen, in press) compared *Mastering Fractions* with a widely-used math basal. Instructional design principles in *Mastering Fractions* reduced the number of errors learning disabled and remedial students made in several areas, including reversals of the terms numerator and denominator, misconceptions in analyzing fractions, and confu-

Table 1. Summary of Studies and Instructional Design Principles

Study	Technology	Instructional Design	Mastery Learning Principles
Chemistry	Videodisc	Teach unifying rules	a. Oral responese b. Work Check with remedy c. Homework d. Daily quiz with remedies e. Weekly test with remedies f. Continued review
Fractions	Videodisc	Present a full range of examples for a concept. Provide a mix of problem types.	
Health Promotion	Computer Simualtion	Teach knowledge skills, then explicit problem solving strategies.	Easier simulations must be mastered before more difficult ones are introduced.
Reasoning Skills	Computer Assisted Instruction	Teach step by step procedures for rule governed content. Relate student errors to earlier-taught rules.	Missed questions are automatically reviewed at a later time, until answered correctly.
Vocabulary	Computer Assisted Instruction	Teach only what students don't know in small sets of items. Review what has recently been taught.	After the words have been learned, they are again tested and, if necessary, retaught
Comprehension	Inexpensive Computer Networking	Give students continuous immediate feedback.	Use technology to score and summarize responses and provide them with usable information, which frees time for more teaching

sions in multiplying and adding fractions. For example, in *Mastering Fractions*, demonstrations and guided practice on a mix of multiplication and addition problems reduced confusions between these operations. The basal program always separated multiplication problems from addition problems, precluding the opportunity for students to practice discriminating the two operations.

A later study (Carnine, Kelly, Noell & Hayden, 1986) compared the performance of eight learning disabled middle school students placed in a self-contained classroom (mean percentile on total math for the CTBS was 16) with 21 seventh graders in a high-track math class (mean percentile on total math for the CTBS was 90). The learning disabled students were proficient in math facts, but scored only 5% on a fractions screening test. The learning disabled students took between three and four months (at 25-30 minutes per day) to complete 31 of the 35 lessons in *Mastering Fractions*. On a fractions test the mean score was 77% for the high-track seventh graders and 72% for the learning disabled students. Although the learning disabled students took a long time to complete most of the program, they could then perform fraction skills at a level comparable to their non-handicapped peers.

Health Promotion

In this study (Woodward, Carnine & Gersten, in press) 30 learning disabled high school students learned health-related facts concerning heredity, disease, nutrition, exercise, stress management, drinking, smoking, life styles, etc. through text material and lectures. They then learned problem-solving strategies for health promotion via a computer simulation. The mastery learning procedure required students to successfully apply the strategy to simpler character profiles before more complex ones were introduced. The problem-solving strategy required students to prioritize and change undesirable health habits, check stress level, and maintain health habit changes over time. The careful preteaching of relevant content, combined with instruction on explicit problem-solving strategies, resulted in over two-thirds of the 15 learning disabled students becoming proficient in health promotion analysis. Only two out of 15 nonhandicapped seniors in a health class exhibited this same level of problem-solving sophistication.

Reasoning Skills

Collins, Carnine and Gersten (in press) conducted research on a computer assisted instruction program that taught individual remedial and learning disabled students to draw syllogistic conclusions and critique arguments. The mastery learning procedure entailed each missed item being presented again later in the lesson, until the student answered it correctly. Students learned step-by-step procedures for constructing arguments and for critiquing arguments. The specific instructional design principle targeted for investigation was the use of process feedback, which related student errors to previously taught rules. Process feedback lead to higher scores on the posttest and a transfer test, without resulting in students taking significantly more time to complete the program.

In a later study (Collins & Carnine, 1986), the performance of four groups of students was compared: Learning disabled high school students, general education high school students, college students in an introductory logic class, and college preservice education students. The results appear in Table 2. On the constructing-arguments subtest (Part I), the learning disabled students were quite proficient, comparable to their general education peers and to the logic students. The college preservice education students scored significantly lower than the other three groups. On the critiquing-arguments subtest (Part II), the logic students scored significantly higher than the other

Table 2. Means for Parts I and II and Total Score (with Standard Deviations) for Learning Disabled Students, General Education Peers, College Logic Students, and College Preservice Education Students.

Group	Number	Construct Argument	Critique Argument	Total Test	
		Mean	Mean	Mean	Standard Deviation
Learning Disabled	23	11.09	7.96	19.00	4.11
General Education	53	10.94	6.42	17.36	3.74
College Logic	30	11.33	8.73	20.07	3.10
Teacher Preservice	41	8.15	7.29	15.44	5.11

three groups. Overall, the learning disabled students scored comparably to two of the three other groups, indicating a lack of any performance deficits.

Vocabulary

Johnson, Gersten and Carnine (in press) compared two computer assisted instruction (CAI) programs that taught the meaning of 50 words that were identified as high utility words by three high school special education teachers. Twenty-four learning disabled high school students were randomly assigned to learn the 50 words from one of the two programs.

The experimental CAI program incorporated these instructional design principles: (1) test students to identify the words requiring instruction so that instruction can be focused; (2) teach the words each student did not know and review previously introduced words; (3) maintain a teaching set of seven unknown words—a large enough set to require students to retain the word meanings but not so large as to overwhelm the students; (4) when a student responds correctly twice to a word on two consecutive lessons, move the word to a review pool and add another unfamiliar word to the teaching set.

The mastery learning procedure used in the program was to cumulatively review learned words. After a student learned ten unfamiliar words, these words were presented again as test words. If a student missed any of these words, they were moved back into that student's teaching set.

Eighty-three percent of the students in the experimental group mastered the 50 words versus 67% in the comparison group, who learned from a CAI program nationally recognized for teaching vocabulary. Students in the comparison treatment took significantly longer to master the 50 words—an average of 9.1 sessions compared with 7.6 sessions for the experimental group.

The performance of the learning disabled students was compared to that of 30 general education tenth graders in an English class; the mean score on a test of the 50 words was 86% for the learning disabled students and 81% for their general education peers.

Efficiency

The previous studies illustrate a variety of technologies, instructional design principles, and mastery learning procedures that contribute to the effectiveness of instructional programs. Efficiency is another important program attribute. Consider vocabulary instruction. Beck, Perfetti, and McKeown (1982) taught 104 words in 75 thirty-minute lessons. At the end of the study, students knew an average of 85 words that they did not know prior to the program, but this took 2,250 minutes of instruction or approximately 26 minutes per word. This amount of time is considerably more than that typically devoted to vocabulary instruction in secondary schools.

If technology can free the teacher from delivering drill and practice instruction, a significant efficiency could be realized. The computer-assisted program in the Johnson et al. study (in press) taught about 30 words, but a teacher was not required to instruct. Similarly, the reasoning skills program did not require a teacher. Although the computer simulation and videodisc courses required a teacher, the technology still made the instruction much more efficient. For example, in one study a teacher presented the content of the *Mastering Fractions* program on overheads rather than on the videodisc (Hasselbring, Sherwood & Bransford, 1986). The students learned as much from the overhead presentation as did other students (randomly assigned) who learned from the videodisc course. However, the teacher who used the overheads required a half-time assistant to create and manage the overheads!

Other research we have conducted has focused more exclusively on technology as a means of increasing efficiency. The technology was a low-cost networking system, Teacher Net, that instantly gives both teachers and students feedback on performance by networking eight or more keyboards to a single IBM computer (Carnine, 1984).

In a study by Golden (1986), each learning disabled secondary student responded on his own keypad to questions interspersed throughout a series of instructional sessions on reading comprehension. Responses were immediately scored and summarized by Teacher Net for the teacher. With Teacher Net, the assignments of 16 learning disabled students were scored almost instantaneously. Consequently, the teacher was able to immediately adjust her class presentation to address the difficulties experienced by individual students. The teacher scored the comparison students' answers after class and gave feedback at the beginning of the next day's class. The teacher took 35 minutes each day to score and analyze the responses of these students. Other studies using Teacher Net have found time savings of a comparable size in test administration and scoring of independent work.

Simple networking offers more than just efficiency. The Teacher Net students had significantly higher posttest scores on new comprehension material than comparison students taught the same comprehension curriculum without Teacher Net The Teacher Net students also had significantly higher engagement rates (89% versus 52%) and more positive attitudes toward instruction (78% versus 25%).

Conclusion

While the findings about the capability of learning disabled students to learn complex material are encouraging, the studies have several serious limitations—lack of follow-up data, use of experimenter-designed instruments, quasi- experimental design, etc. These are legitimate concerns. For example, learning disabled students' performance would probably deteriorate on follow-up measures if they were not given opportunities to periodically review what they had learned. Beside the limitations of the studies are the constraints imposed by the interventions themselves. Videodisc and low-cost networking require active teaching with frequent student teacher interactions, which is at odds with individualized, worksheet- oriented programs found in many special educations classrooms. In addition these educational technologies are very new and not widely found in schools; acceptance of new technology can come very slowly. On the other hand, computer assisted instruction is becoming common place. Yet CAI programs require extensive time on the computer, which is too expensive to provide in many schools. Some of our recent research (Noell & Carnine, 1987) suggests that low-cost networking might be an answer to the expense problem. In the short run, however, the availability of computers limits the practical significance of the present findings on effective CAI.

Looking further ahead, combining the capability of technology, Direct Instruction curriculum design and mastery learning may have to be tapped if learning disabled students are to make substantial gains in complex cognitive areas. Ultimately the expense of human teachers and the limits of what they can do within the school day necessitate new forms of instructional support. Without some such support, swings from mainstreamed to self-contained classes and back will continue. ◆

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DI Principles work with Autistic Children

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The past twenty years has brought a proliferation of intensive research and a delineation of educational principles and procedures applicable to autistic individuals (Koegel, Rincover, & Egel, 1982). Paralleling the progress in educating children with autism have been major developments in instructional approaches geared to broader-based populations. In particular, Direct Instruction has evolved into a powerful, systematic model with applications to children with autism, as well as to those with other kinds and degrees of educational problems and needs (Becker, 1977, Becker & Carnine, 1980, 1981; Engelmann, 1977; Engelmann & Colvin 1983).

The purpose of this paper is to illustrate the generality of techniques by relating some of them to recent developments in instructional research with autistic children. In recent years, we and our colleagues at UCSB and other centers have worked to improve educational interventions for children with autism. Increasingly, we are finding that, despite the unusual characteristics of autism, the underlying variables of effective instruction are surprisingly similar to those that influence the learning of other children. In order to demonstrate this affinity, we will briefly discuss three areas of recent research which can be directly related to previous writings in the DI literature. These areas are stimulus control, task variation, and instructional pacing.

Stimulus Control

A prominent feature of DI theory and procedures is the emphasis on bringing responding under the control of specific, relevant stimuli (Becker, Engelmann, & Thomas, 1971; Becker & Carnine, 1980; Horner, Bellamy, & Colvin, 1983). Research has shown that this is a particularly important aspect of teaching autistic children. For example, studies have shown that autistic children often learn to respond under inappropriate stimulus conditions. As a result, they often fail to perform the response when they are expected to do so in slightly different contexts. Rincover & Koegel (1975) investigated such stimulus control problems in a study with ten autistic children. The children were taught (in a treatment room) to respond to simple verbal commands such as, "Touch your nose." The children's performance of these responses was then assessed in a novel setting. The children who failed to respond in the extra-therapy settings underwent a stimulus control assessment. The results demonstrated that these children were responding to idiosyncratic and irrelevant stimuli from the training environment, such as the furniture, or inappropriate and inadvertent cues from the teacher. When these irrelevant stimuli were introduced into the extra-therapy setting, the children performed the responses. Such selective responding by autistic children has been labelled stimulus overselectivity (see Dunlap, Koegel, & Burke, 1981, and Lovaas, Koegel, & Schreibman, 1978 for reviews).

Difficulty in establishing appropriate stimulus control can have obvious negative implications for the education and learning of autistic children. However, research conducted over the last decade has provided techniques for helping to remediate or circumvent the overselectivity problem. These techniques include within-stimulus prompting procedures based on distinctive features (Schreibman, 1975; Rincover, 1978), and specific orienting cues (Koegel, Dunlap, Richman, & Dyer, 1981). The work in this area illustrates the attention that must be given to stimulus control aspects of instruction with autistic children, and it suggests that the theory and methodology of Direct Instruction can contribute to the solution of this problem.

Task Variation

The composition of instructional sessions in terms of the variety and type of tasks presented has been addressed by researchers in the areas of both Direct Instruction and autism. For example, Engelmann & Colvin (1983) recommended presenting familiar, well-learned tasks along with new, difficult tasks when the latter are initially presented in order to facilitate compliance and appropriate responding.

The use of previously-learned or maintenance tasks has been investigated with autistic and other severely handicapped students. For example Gaylord-Ross (1982) demonstrated that the presentation of easy or errorless learning tasks resulted in very low levels of aberrant behavior (self-injury, etc.) for severely retarded children, while difficult tasks were associated with much higher levels of such behavior.

Two additional studies have investigated the effects of these procedures with autistic children. Dun-

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lap & Koegel (1980) compared a *constant task* condition, in which a single task was presented throughout a session, to a *varied task* condition, in which the same task was interspersed with a variety of other tasks. The varied-task sessions produced improved and stable levels of correct responding as compared to constant-task sessions. Also, naive observers judged the children to be more interested, happier, and better behaved during varied task sessions.

Dunlap (1984) examined the influence of task variation on response acquisition. In this experiment, constant-task sessions involving new or acquisition tasks were compared with two types of varied-task sessions. In one type, acquisition tasks were interspersed among previously-learned maintenance tasks. The "varied-with-maintenance tasks" condition produced significantly more efficient learning, with no differences between the other two conditions. In addition, children's affect was rated more positive during the varied maintenance conditions. These results empirically demonstrate the recommendation made by Engelmann (1977) and Engelmann & Colvin (1983) — that maintenance tasks should be presented during instructional sessions in which new acquisition tasks are being taught.

Instructional Pacing

Rate of instructional presentation has also been studied. Direct instruction emphasizes rapid pacing during task presentation to facilitate attention and appropriate responding (Becker, 1977); Becker & Carnine, 1981; Engelmann & Colvin, 1983). Carnine (1976) compared fast and slow rates (1 second intertrial interval versus 5 second intertrial interval) of task presentation with two low-achieving children. Fast-paced instruction resulted in decreased off-task behavior and increased response accuracy and participation.

Similar studies have been conducted with autistic children. Koegel, Dunlap, & Dyer (1980) compared rapid pacing (very brief intertrial intervals — ITI's) with slow pacing (relatively long ITI's) during instructional sessions with low-functioning autistic children. Short ITI's produced higher levels of correct responding and improving trends in acquisition than long intervals.

A further study (Dunlap, Dyer, & Koegel, 1983) investigated the influence of ITI duration on self-stimulatory behavior. Effects on correct responding and self-stimulatory behavior were assessed. Short ITI's produced higher levels of correct responding and lower levels of autistic self-stimulatory behavior. Other types of self-stimulatory behavior were not systematically related to either ITI duration or correct responding. These studies support the use of a fast-paced instructional format to promote the responsivity and appropriate behavior of severely handicapped autistic children.

The three areas discussed above may be viewed as illustrations of the general applicability of effective instructional methods to training autistic children. In particular, they point out a substantial overlap across Direct Instruction techniques and procedures developed for severely handicapped, autistic children. *This similarity of teaching methods suggests that principles underlying effective instruction may be more influential in the process of learning than the special characteristics of any particular student population.*

As we acquire more and more knowledge about the education of children with autism, we find that their qualitative learning characteristics are not as dissimilar from other children as was once supposed. While their patterns of responding may seem unusual and relatively difficult to influence, the educational practices which have been proven effective are based on principles which are common to all instruction. Increasingly, we are learning that the tenets of empirically-documented instructional approaches, such as Direct Instruction, apply to students of all levels, regardless of handicap. ◆

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A Review of the Findings from the Research Institutes on Learning Disibilities

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Learning failure of mildly handicapped students in regular classroom instruction may be due, in part, to the nature of the instruction offered in the regular class. While non-handicapped students may be able to achieve even when instruction is complex or incomplete, mildly handicapped students can become confused or distracted by teaching methods that are less than optimal.

Identifying instructional variables that lead to improved student performance has been an important aim of educational research. The last five years have witnessed a growing awareness that many of the instructional variables identified in the teacher effectiveness research in regular classrooms have immediate relevance for special education (Rosenshine & Stevens, 1981; Brophy & Good, in press).

For example: "providing academically focused demonstrations and corrective feedback, teaching to mastery and monitoring student performance have been consistently linked to student achievement in the regular classroom." (Rosenshine, 1983).

In this article, I will focus on recent research coming from the Learning Disabilities Institutes and studies that have focused on specific teaching behaviors observed in actual LD classrooms.

Background of the Studies

In the late 1970's, five universities received research funding grants from the U.S. Dept. of Education's Bureau for the Handicapped. The grants were to be used to establish research institutes that would "identify" LD students, then develop and evaluate empirically effective interventions for that group of students. The five universities funded were the University of Illinois at Chicago, the University of Kansas, the University of Minnesota, Teachers College of Columbia University, and the University of Virginia.

Each institute established its research in a manner that differed from that of the other four, and attacked the problems from its own perspective.

The Chicago institute studied "oral communicative competence or adaptive social functioning, the causal attributes of LD successes and failure," and then developed interventions to improve reading skills and comprehension (Bryan, Pearl, Donahue, Bryan, & Pflaum, 1983). Their work was conducted with LD students from inner-city and suburban public schools, private schools, and a special school for LD students. The students studied were in grades one through eight.

The Kansas Institute developed their "learning strategies" intervention model in two developmental stages: (1) during their first two years, they studied the learning characteristics of LD adolescents and their school settings to establish a data base; and (2) based on these data, the researchers developed an intervention instructional methodology, modification of materials, and motivational and evaluation components. They worked with LD students and low-achieving students in three large school districts, each representing a different socio-economic level, in eastern Kansas. The University of Minnesota researchers took a very different approach from the other institutes and focused their efforts largely on assessment and decision-making processes involved in identification and placement of LD students.

The Columbia researchers organized into five task forces and studied two major areas: (1) teaching strategies in reading, spelling, arithmetic and study skills; and (2) studies of reading comprehension (Connor, 1983). Resource rooms and special education classes in New York's elementary schools and special schools were used.

The fifth institute, the University of Virginia, studied and developed educational interventions for LD students with attentional problems, and academic strategies training for reading, math, and study skills (Hallahan, Hall, Danna, Kneedler, LLoyd, Loper & Reeve, 1983). Their research was conducted in elementary resource rooms and special classes for LD students.

While there is wide diversity in research approaches and interests, the Institutes conducted research that included experimental and quasi-experimental studies, and summative evaluations of an entire intervention model.

Another line of research included in this report attempted to make finer-grade evaluations of the teaching components or combinations of components linked to academic gains (Leinhardt, Zigmond & Cooley, 1981; Englert, 1983).

Instructional Interventions from the Institutes

Researchers at the Columbia, Kansas, and Virginia Institutes incorporated into their intervention models many features from direct instruction. Stevens and Rosenshine (1981) have described these features as central:

1. Focus on academics.
2. Specifying and ordering objectives.
3. Direct teaching (model and demonstrations).
4. Supervised practice.
5. Corrective feedback.
6. Teaching to mastery.
7. Continuous monitoring of student progress.

In many of the studies reviewed by this author, the researchers examined more than one of these features or examined the impact of the entire instructional program. First reported are the major research findings on three specific instructional components:

1. Corrective feedback.
2. Teaching to mastery.
3. Continuous monitoring of student performance.

Feedback and Correction Procedures

While the importance of monitoring errors is clearly documented in the teacher effectiveness literature, much less emphasis has been given to this topic in the LD literature. Deshler (1974), in a review of the most frequently used texts in special education classrooms, found only one text that discussed the important role of monitoring performance and use of feedback in learning and performance of LD students. Most instructional techniques treat it as an incidental by-product of learning rather than a primary instructional goal. Neglect of the topic is ironic, given the problems LD students encounter in discriminating correct and incorrect responses (Schumaker, Deshler, Alley, Warner, Clark & Nolan, 1982).

Given that correcting errors is a critical variable controlling learning and performance, how should teachers respond to students' answers?

Gille and Fayne (1980) compared the effect of practice only and practice with informative feedback on sight word recognition for "normal" and LD readers. Eleven LD students and 9 "normal" students, ages 9-13, reading 2-6 years below grade level, were exposed to randomized blocks of 10 high frequency words (Dolch) and 20 infrequent words. Ten words per week were given for three consecutive weeks. In the Practice Only Group, students received information only about the accuracy of responses. In the Practice Plus Feedback Group, all students received information about their accuracy and "vocalization time." For example: the teacher responded: "that was faster than last time," or "that was slower."

The results showed that, as expected, LD students had significantly slower vocalization times than their normal peers for both high and low frequency words; but the LD students showed a greater difference in magnitude with low frequency words. Normal readers showed a relatively stable performance across both conditions. Most importantly, LD readers exhibited decreasing vocalization time under the Practice Plus Feedback than Practice Only treatment condition.

This study documented that "reaction time can be reduced by supplying informative feedback to students, relative to a pre-established criterion, and can serve as a powerful reinforcer to enhance performance" (Gille & Fayne, 1980).

In a series of studies on students' language skills and reading comprehension, Bryan et al. (1983) developed an intervention strategy that focused students' attention on the meanings of words in sentences. The results showed that only students who could read at 2.0 grade level or above could use the strategy.

In a follow-up study with: (1) LD students, (2) low-achieving, non-handicapped students, and (3) normal third, fourth, and fifth grade students, Bryan et al. (1983) found that students, who could read at or higher than 2.0 grade level, benefitted most from instruction that included correction procedures that focused on relations within sentences and specific word meanings.

Teaching to Mastery

Mastery learning (Bloom, 1968) proposes that the majority of students can master the same material if two conditions are met: (1) each student must be given sufficient time to master each learning step in the instructional sequence, and (2) each student must be given appropriate help and feedback in order to correct and rework the learning steps until each is mastered. The goal is to fix achievement at some constant mastery level (e.g., 80 or 90%) and manipulate instruction (i.e., amount of repetition, feedback or correction) until mastery is achieved (Bryant, 1980a). According to Block (1971), the steps in mastery learning include:

1. Specification of instructional objectives.
2. Well-defined tasks.
3. Mastery of specific steps in the skills heirarchy.
4. Criterion-referenced evaluation.
5. Provision for repeated instruction.

Since the goal is to reach a specific level of mastery, item 5 above, giving repeated practice, is a crucial factor, particularly for slow learners (Bryant, 1980b).

Bryant, Fayne & Gettinger (1980) applied the mastery learning model to sight word instruction for 36 elementary learning disabled students from special education classes. Thirty sight words were presented in a 9-day instructional sequence that controlled unit size, focus (setting expectations, providing demonstrations, and prompts) and teaching to mastery. The results on an individually-administered criterion-referenced test showed that 84% of the LD students reached 80% accuracy.

Fleischmer, Garnett & Preddy (1982) presented 126 LD students, ages 8-13, basic math fact instruction using instructional principles from direct instruction and mastery learning in their intervention. Their results showed that: (1) systematic direct instruction that included cumulative and distributed practice was effective; and (2) teaching to mastery facilitated retention of facts.

Continuous Monitoring of Student Performance

Rosenshine (1983) has pointed out that "frequent assessments of whether all the students understand the content or skill being taught or the steps in a process" constitutes one important element in monitoring student performance and checking for understanding. Ysseldyke, Thurlow, Graden, Wesson, Algozzine & Deno (1983) found in their observational studies of teachers' decision-making processes that *data* collected at least three times per week facilitates making decisions about student progress. Decisions based on data rather than judgment alone is associated with increased student performance.

Intervention Models

Three research institutes designed intervention models in basic academics incorporating features of systematic instruction: (1) "LD efficient instruction" (Columbia); (2) "Learning Strategies Curriculum" (Kansas); and (3) "Academic Strategies" (Virginia).

LD Efficient Instruction: Characteristics of the Instructional Materials and Research

In developing a strategy to teach basic reading and spelling skills to LD students, the Columbia researchers developed LD efficient lessons. Lessons incorporated five major principles:

1. Providing focus, (setting expectations, using prompts and providing models).
2. Giving sufficient practice so that a level of mastery is reached (e.g., minimum set at 80%).
3. Allowing time for distributed practice and review.
4. Providing discrimination training.
5. Training for appropriate transfer.

A study by Bryant et al. (1980) investigated the effects of LD efficient lessons on acquisition of regular and irregular words with 36 elementary LD students from special education classes in N w York public schools. A data-based model of remedial phonics instruction was used by special education teachers who taught nine 30-minute lessons. Using a criterion-referenced pre-and posttest, the results showed that the students learned 75% of the words taught.

In a series of follow-up studies on phonics, sight words, and spelling instruction, Bryant et al. (1983) incorporated revisions of the LD efficient materials which were characterized by six instructional features:

1. Limiting unit size.
2. Providing academic focus and expectations (teacher directed lessons).

3. Reducing "response competition" by dropping out mastered items.
4. Teaching to mastery (defined as eliciting the correct response on 2-3 consecutive trials).
5. Providing distributed practice and review.
6. Discrimination training for generalization and transfer.

The results of these studies, which had a duration of three weeks, suggested efficacy for short-term gains; however, no long-term studies have been conducted.

Learning Strategies: Methodology and Research

Based on data describing LD adolescents' academic performance and the setting demands of secondary schools, researchers at Kansas developed an intervention model "to teach students how to learn rather than to teach students specific context." (Schumaker, Deshler, Alley & Warner, 1983).

The nine step teaching model consisted of:

1. Make the student aware of his/her current learning habits.
2. Describe the new learning strategy.
3. Model the strategy.
4. Have the student practice the strategy in controlled materials.
6. Give feedback.
7. Have the student practice the strategy in grade-level materials,
8. Give feedback.
9. Test.

A series of single-subject, experimental studies using this model to teach a variety of academic and social skills, with a variety of LD students and in a variety of settings was conducted. The results on criterion measures of student's performance on classroom assignments, students' grades, regular class teachers' and students' satisfaction measures, and students' performance on school district composition competency evaluations supported the hypothesis that LD students can be taught specific strategies that they can apply to various materials, even in their regular classrooms. (Deshler, Schumaker, Alley, Warner & Clark, 1982).

Academic Strategies Training: Methodology and Research

The Virginia Institute developed educational interventions for reading and math based on Direct Instruction design and teaching practices. Table I shows an attack strategy for the task class of basic multiplication facts (from Callinan, Lloyd & Epstein, 1981).

Teaching practices (Hallahan, et al., 1983) include the following steps:

1. "The teacher should demonstrate the use of the strategy using multiple examples of its appropriate and inappropriate application.
2. Students should practice its use under closely monitored conditions in which practice is monitored.
3. Teachers should provide reinforcement for accuracy and corrective feedback.
4. Teachers should fade monitoring as students reach skill mastery."

These procedures were used to teach LD students academic skills in three areas: (1) sounding-out words, (2) long division problem solving, and (3) simple multiplication problems.

The results on academic strategies training showed that LD students can be taught strategies for a variety of academic tasks; strategies can be taught in short-term periods; and LD students who had mastered the strategies on specific tasks demonstrated greater facility in acquiring tasks of the same class (Cullinan et al., 1981). Further research is needed to systematically explore what variables (i.e., student grade level, ver-

Table 1. Attack Strategies for Multiplication

Attack Strategy: Count by one number the number of times indicated by the other number.

Steps in Attack Strategy:	Example:
1. Read the problem.	2 x 5 = ____
2. Point to a number that you know how to count by.	student points to 2
3. Make the number of marks indicated by the other number.	2 x 5 = ____ /////
4. Begin by counting by the number you know how to count by and count up once for each mark, touching each mark.	"2, 4 . . ."
5. Stop counting when you've touched the last mark.	". . . 6,8,10"
6. Write the last number you said in the answer space.	2 x 5 = 10 /////

balization of steps in the instructional sequence, etc.) are more closely related to improving student performance.

Teaching Behaviors

To determine the specific teacher behaviors that lead to academic gains, Leinhardt et al. (1981) studied reading instruction and its effects for 105 LD students in self-contained classrooms at the primary level. Their descriptive results showed that three teacher behaviors were significantly related to reading gains: (1) focus on academics, (2) teacher instruction (model, explanation and feedback), and (3) provision of reinforcement.

Englert (1983) evaluated and contrasted groups of teacher trainees found to be differentially effective in improving student performance, on specific direct instruction variables. Seventeen teacher trainees were evaluated on four general measures of teacher behaviors: (1) content coverage, (2) student accuracy and success levels, (3) teacher feedback, and (4) maintenance of high task involvement. The results showed that more effective trainees differed significantly from less effective trainees on 4 out 5 measures of content coverage and in feedback strategies, with the more effective trainees being less likely to tell answers following incorrect pupil responses.

Trainees were evaluated also on specific direct instruction practices. The results identified 3 significant variables: (1) greater occurrence of lesson objectives, (2) concept examples, and (3) error drill. In other words, teachers who stated the objectives of the lesson, provided many examples and nonexamples of a concept, and provided ample practice were found more effective. This study is one of few observational studies to study teacher effectiveness variables with special education students and documents several teaching behaviors consistent with the teacher effectiveness literature in regular education classrooms.

Although these two studies suggest correlational rather than causal relationships, they do provide several implications for practice.

Conclusions and Implications

By comparing the results of the Institutes' studies to those of the two instructional dimensions studies, areas of agreement are beginning to emerge about effective instructional and teaching practices for mildly handicapped students. Caution is needed in applying these findings since they have dealt primarily: (1) with cognitive learning of basic skills, (2) with learning disabled students, and (3) in controlled special education settings. However, they are consistent with a wide range of findings on effective teaching (Stevens & Rosenshine, 1981). These studies show that:

1. Rather than assessing and developing interventions based on underlying "process dysfunctions," the study of learning deficits and developing interventions to teach explicit strategies for learning specific tasks is productive.
2. Systematic instruction, which incorporated features of direct teaching (corrective feedback, mastery learning, reinforcement, distributed practice, and review) was consistently effective with LD students.
3. Specific teaching behaviors which focused students' attention on academics; used demonstrations, feedback and reinforcement; and provided examples of concepts and ample practice were associated with academic gains for mildly handicapped students.

While teachers can be effective in improving student performance, they can't do it alone. Stallings (1981) suggests that schools should provide on-going opportunities for teachers to receive feedback on their progress. Further, every instructional program should be evaluated for effectiveness by directly observing teachers' behaviors before, during and after interventions, and by measuring students' academic gains. Administrators, supervisors, and teachers must band together to improve education for the mildly handicapped.

In short, each of us, in regular education and special education, must continue to promote the understanding that the aim of special education is not to put a burden on the educational system, but rather to make the tasks of educating all students easier and learning more achievable.

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A Success Story —

Transition First Grade

by Ed Schaefer
and Patrice Riggin
Lewes, Delaware

From *ADI News* Volume 6, Number 3 (Spring, 1987)

Once there were sixteen children who had just completed kindergarten and would soon enter first grade. For these children kindergarten had been a very trying experience. They were not being "promoted" to first grade, but rather "administratively assigned" to grade 1. However, the expectations for these children in first grade were not very exciting. Given their performance in kindergarten, it was expected that these children would find first grade as difficult and frustrating as kindergarten, and that they would almost certainly repeat first grade.

It was not that these children were handicapped. They did not qualify for classification and placement in special education. Nor were these children part of an atypical low functioning class, for every year there were 15 to 30 such children in the same predicament. Nor was this school a "bad" school; rather, standardized test scores indicated that the "average" student in this school was 10 or more points above the national average.

Why, then, were these children having such difficulty in school? A number of rather typical explanations were offered:

1. they were "slow learners" (IQ scores for the 16 children ranged from 77 to 100, with a mean and median of 90);
2. their home environments were "inadequate";
3. the children were simply not yet "ready" for formal academic instruction.

The authors favored the alternative explanation that these children simply had not been provided with the quantity and quality of instruction that was necessary. For these children, and for this reason, the Transition First Grade program was created in June of 1985. The transition class was designed to serve the children with a lower student-teacher ratio (16-1), a full-time instructional aide, and a radically different approach to curriculum and instruction. In the transition class the authors decided that both the teacher and the aide would use the DISTAR reading, language, and mathematics programs exclusively until the students mastered level 1 of each program. Thereafter, the "regular" reading, math, and language programs would be introduced as the students continued through level 2 of the DISTAR programs. Each of the "regular" first grade classes had a student-teacher ratio of 22/23-1, a half-time instructional aide, and followed one of the popular, traditional basal programs for reading, language, and math instruction.

Students were chosen for the transition class by the principal and kindergarten teachers who based their decisions on the students' records of performance in the regular kindergarten program and on the results of the Comprehensive Test of Basic Skills (CTBS - Level A) administered at the end of the kindergarten year. Essentially, the 16 lowest performing or most at-risk students from the entire class of about 125 kindergartners were chosen for the transition class; the authors had no voice in the selection of students for the transition class.

Procedures

Initially students were given the placement tests for DISTAR *Language I* and *Reading Mastery I* and were grouped accordingly. The top group (6 students) was placed in *Reading Mastery-Fast Cycle I* and *DISTAR Language I* - Lesson 31. The middle group (5 students) was placed in *Reading Mastery I* - Lesson 11 and DISTAR *Language I* - Lesson 21. The third group (5 students) began *Reading Mastery I* at Lesson 1 and *DISTAR Language I* at Lesson 11. Some regrouping occurred during October and November, and by the end of the year there were 7 students in the top group, 6 in the middle group, and 3 in the third group. Arithmetic instruction began at Lesson 21 of DISTAR *Arithmetic I* as a whole class activity, but three weeks into the school year the class was split into two groups, the higher group with 9 students, and the second group with 7 students.

In the mornings the students spent 40 minutes in a reading group with the teacher, 40 minutes in a language group with the aide, and 40 minutes doing independent seatwork. Independent seatwork consisted of the worksheets ("take-homes") from the DISTAR reading and language programs, supplemental *Reading Mastery Seatwork*, and materials from the DISTAR *Reading I Activity Kit*. Later in the year, additional supplemental materials were used to increase practice in comprehension activities. The schedule was arranged so that the top group did independent work, then language group followed by reading group. The middle group met first with the teacher for reading, then did their independent work, and then worked with the aide in language group. The third group did language first, then reading, and then independent work.

After lunch, the students had a 15-minute recess followed by spelling instruction in small groups. Initially, the students utilized the spelling program from *Reading Mastery I* and eventually, the *Spelling Mastery Program* Level A. Arithmetic followed spelling, then reading reinforcement activities, handwriting, and if time permitted some science or social skills instruction. Reading reinforcement activities consisted of sound reviews, additional practice in sounding out words and group reading of the stories in the DISTAR *Library Kit*. Beginning in late November with the top group and in January with the others, this also consisted of reading the stories in the basal reading program used in the regular first grade classrooms (*Keys to Reading*, 1986 edition-The Economy Co.). Reading vocabulary was pretaught on charts, with words introduced two days before they appeared in the story. On the chart each word was printed in the DISTAR orthography and also in regular orthography as it appeared in the Economy reader. The students were directed to sound out the first word (utilizing the DISTAR orthography), and then told that the second word said the same thing as the first word. When the words were reviewed, students were directed to read each word the "fast way"; the sounding out procedure was used only as a correction at that point. The format for irregular words used in *Reading Mastery I* ("that's how we sound out the word, this is how we say the word") was used for any word for which the students did not have the necessary phonetic skills or which could not be decoded phonetically. After orally reading the story in the group, the comprehension/vocabulary worksheets were done.

A similar procedure was used in teaching the vocabulary in those materials later used for additional supplemental comprehension practice.

Initial handwriting activities referred to letters only as sounds and followed the presentation sequence of *Reading Mastery I*, in order to reinforce reading skills and minimize confusions. Words practiced were those which had been introduced in reading vocabulary activities; sentences were taken from the stories. Capitals were introduced after lower case letters, and prior to their introduction in *Reading Mastery II*, but in the same sequence of "easy capitals" and then "hard capitals."

Results

The results clearly exceeded our highest expectations. All 16 children mastered at least 90% of the objectives in Level I of all three DISTAR programs.

Seven of the 16 children also mastered at least 90% of the objectives in Level II of the DISTAR *Reading Mastery* program. Ten of the children mastered at least 85% of the objectives in the *Riverside Mathematics* and the *Economy Reading* programs used in the regular first grade classrooms. This last statistic is very critical because it meant that *10 of the transition students had met all the criteria for promotion to the second grade,* and in fact, were promoted to regular second grade classes in June of 1986. Of the remaining 6 students, 5 were assigned to regular first grade classes, and one was eventually diagnosed as "learning disabled/emotionally disturbed" and placed in a special education setting. Follow-up of these students during the first half of the 86-87 school year indicates that *all the transition students are performing at satisfactory or outstanding levels of achievement in all subject areas.* (Report cards for grades 1 & 2 indicate three levels of performance: unsatisfactory, satisfactory, outstanding, rather than letter grades.)

Another interesting pattern of information about these 16 students becomes apparent when one compares their IQ scores with the results of the Woodcock Reading Mastery Test administered late in the second half of the 85-86 school year (see Table I). As mentioned above, the average IQ of the transition student was 90. Using the same standard metric where the mean is 100 and standard deviation is 15, and converting the standard scores from the IQ test into expected grade equivalents on the WRMT, yielded a class average grade equivalent of 1.6 GE. Actual, average grade equivalent scores from the WRMT yielded a class average of 2.3 GE, or an average standard score of 112. Taken as a group, these 16 children had exceeded their measured ability level by almost a full year in grade equivalent terms, and by a whopping 1 1/2 standard deviation units.

How is such overachievement possible? John Carroll answered this question convincingly in 1963 when he stated that overachievement is a function of "high perseverance, instruction of high quality, and ample opportunity for learning." These are exactly the conditions that prevailed in the transition first grade classroom when a first rate teacher skillfully used high quality Direct Instruction programs. She was able to maximize time allocated to instruction, motivate exceptionally high rates of student engagement with instructional tasks, and produce average student success rates almost 1 1/2 standard deviation units higher than expectations.

Table 1. Performance on the Woodcock Reading Mastery Test (WRMT).

Student	IQ	Actual WRMT SS	Difference SD Units	Projected WRMT GE	Actual WRMT GE
AZ	85	128	2.86	1.4	2.6
ZA	84	119	2.33	1.4	2.3
LA	88	112	1.60	1.4	2.1
PP	84	127	2.86	1.4	2.6
AA	90	112	1.46	1.6	2.3
GF	89	118	1.93	1.5	2.4
BT	92	116	1.60	1.6	2.3
MT	87	115	1.86	1.5	2.3
TN	97	119	1.46	1.7	2.5
JN	98	119	1.40	1.8	2.6
DK	90	131	2.73	1.6	3.0
RH	77	103	1.73	1.3	2.0
CA	90	104	0.93	1.6	2.0
WM	86	88	0.13	1.6	1.6
JA	96	112	1.06	1.8	2.3
FK**	100	68	-2.13	1.9	1.2
Class Average	90	112	1.46	1.6	2.3

IQ- (Mean=100; SD=15)
SS- Standard Score (Mean=100; SD=15)
SD- Standard Deviation
GE- Grade Equivalent (Instructional Level)
**- Student diagnosed as LD/ED and placed in special education program for 86-87 school year.

Obviously these children were not slow learners. Two-thirds of the transition students met the standard school criteria for promotion to second grade. Obviously socio-economic and family circumstances were not preventing these children from learning. The 4 children who made the most significant gains were all low-income minority students. (See students AZ, ZA, PP, and DK in Table I.) Obviously these children were more than "ready" to learn. Fourteen of the 16 children in the transition class made progress that far surpassed expectations.

The conclusion seems inescapable: Effective education is a matter of *good teaching of good programs.* We already know enough to do both, right now, should we choose to do so.

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Institute Schedule

Monday, June 26, 1989

9:00—9:30 Institute Opening
9:30—9:45 Coffee Break
9:45—12:00 "A" Sessions Meet
12:00—1:00 Get-Acquainted Lunch
1:00—3:30 "B" Sessions Meet

Tuesday, June 27, 1989

8:30—12:00 "A" Sessions Meet
12:00—1:00 Lunch (on own)
1:00—3:30 "B" Sessions Meet
4:00—6:00 S.R.A. Reception

Wednesday, June 28, 1989

8:30—12:00 "A" Sessions Conclude
12:00—1:00 Lunch (on own)
1:00—2:30 "B" Sessions Conclude

Registration Information

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DISTAR Language I & II • *Adrienne Allen*
Managing Chronic Behavior Disorders • *Geoff Colvin*

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DISTAR Arithmetic I & II • *Adrienne Allen*
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Please register me for the following:

___ I wish to attend a Pre-Institute Workshop only. I have enclosed $75.00 ($60.00 for ADI members). I will attend the workshop titled: ____________________

___ I wish to attend the Institute only. I have enclosed $145.00 ($116.00 for ADI members). My "A" and "B" session choices are listed below.

"A" ____________________

"B" ____________________

___ I wish to attend the Pre-Institute and the Institute. I have enclosed $195.00 ($176.00 for ADI members). I will attend the workshop titled: ____________________

My "A" and "B" Session choices for the Institute are listed below.

"A" ____________________

"B" ____________________

For office use Date Fee Check PO# By Salt Lake City 1

The Association for Direct Instruction Announces

The 15th Annual Eugene Direct Instruction Training and Information Conference

August 7-11, 1988
Eugene Hilton Hotel & Conference Center
Eugene, Oregon

Sessions

A Teaching the Beginning Reader
A Reading II and Fast Cycle
A Reading III-VI
A Corrective Reading, Decoding
A Advanced and Corrective Math
A Supervision of DI Programs
A Solutions to Classroom Discipline Problems
A Diagnosis, Corrections & Firming
A Overview of DI Research and Theory
A Instructional Techniques for Severely Handicapped Learners

B Teaching the Beginning Reader
B Reading III – VI
B Corrective Reading, Comprehension
B Arithmetic I & II
B Effective Spelling Instruction
B Introduction to DI Techniques
B Beginning Langugae
B Overview of All DI Programs
B Reading Mastery & Literature
B Managing Serious Emotional Disturbances

C Teaching Facts and Fact Systems
C Effective Spelling Instruction
C Advanced Supervision Techniques
C Expressive Writing Instruction
C Adapting Content Areas for Low Performers
C Options for At-risk and Special Needs Students

D Video Disc Instruction in Math & Science
D Teaching Study Skills
D DI Supplemental & Transitional Activities
D Compters in Education – DIAL
D Recent Research in Reading
D Overview of DI Research

E Teach Your Child to Read in 100 Easy Lessons
E Compters in Education – The Classroom Assistant
E Recent Research in Reading
E Overview of DI Theory
E Model for a DI Preschool

Featured Speakers:
Zig Engelmann • Paul Weisberg

Other Presenters:
Wes Becker, Randy Sprick, Bob Dixon, Ann Arbogast, Jane Carter, Maria Collins, Gary Davis, Ann Glang, Annemieke Golly, Phyllis Haddox, Tracy Hall, Gary Johnson, Georgia Layton, Kathy Madigan, John Noell, Jerry Silbert, Marilyn Sprick, Marcy Stein, Linda Youngmayr

Conference Registration Information

Where-When: *To be held August 7-11, 1989, at the Eugene Hilton Hotel and Conference Center, in downtown Eugene, Oregon.*

How to Pre-Register: *Please fill out the registration form. Enclose with check or Institutional purchase order for the proper fee. Send application to the Association for Direct Instruction. Pre-registration before July 7 guarantees space in preferred sessions. Any session with less than 20 participants may be cancelled. A confirmation receipt will be sent to all pre-registered participants.* *THIS FORM COVERS CONFERENCE PRE-REGISTRATION ONLY. THIS DOES NOT CONSTITUTE PRE-REGISTRATION FOR COLLEGE CREDIT OR ROOM RESERVATION.*

Fees and Discounts: *The conference registration fee is $160.00. Association members receive a 20% discount ($32.00 off). Groups of 5 to 9 participants receive a 10% discount. Groups of 10-19 receive a 20% discount. For groups of 20 or more, call for a quotation. Ask for Bryan Wickman at (503) 485-1293. The member and group discounts cannot be used together. Choose the discount that will benefit you the most. The fee does not include lodging or meals with the exception of the picnic, and coffee each morning. All training materials are included in the fee. New members are eligible for the 20% discount when membership application and appropriate fees accompany registration form.*

Lodging: *The special conference rate at the Eugene Hilton is $44.00 per day for a single. Doubles are $52.00 ($26.00 per person) plus tax. We will send you a reservation envelope for the Eugene Hilton.* *DO NOT SEND ANY ROOM RESERVATION MONEY TO THE ASSOCIATION*

College Credit: *An optional 1, 2 or 3 hours of college credit through the University of Oregon Summer Session are available at an additional cost of $32.00 per quarter unit. Persons interested in college credit should so indicate on the pre-registration form. We will send additional information on college credit along with your conference pre-registration confirmation.* *DO NOT SEND ANY ROOM RESERVATION MONEY TO THE ASSOCIATION*

Refunds and Cancellations: *A 100% refund will be issued if a written request is postmarked by July 21. After that an 80% refund will be given. A written request must be received in our office before any refunds will be made.*

Optional Events: *Monday there will be a picnic at Skinners Butte Park to get acquainted. A meal for you and 1 guest is included in the registration fee. Wednesday from 4:00 to 5:00 there will be a special conference presentation. Paul McKinney will address the conference and we will present the 1988 ADI Awards for Excellence in Education. Afterward, there will be an opportunity for conversation with trainers and other conference participants.*

Conference Registration Form

Please fill out the registration form completely and mail to ADI.
Make checks payable (U.S. funds only) to **Association for Direct Instruction**
Because space is limited, early registration is recommended. Use an address where you will receive your mail up until the conference.

Name (as you would like it to appear on your name tag)________________________

Street ________________________

City ____________ State ____________ Zip ____________

Phone ________________________

Agency Affiliation ____________________ Position ____________

I would like to register for the following (list one "A", one "B", and either one "C" *or* one "D" **and** one "E" session):

"A" ________________________

"B" ________________________

either C **"C"** ________________________

or D & E **"D"** ________________________

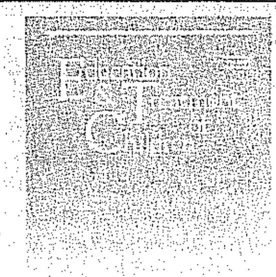
"E" ________________________

I am an Association for Direct Instruction member: Yes No
I will attend the picnic: Yes No
Have you attended the Eugene Conference previously?______ What year(s)? _______
Please return this form with your check or District Purchase Order to:

Association for Direct Instruction, P.O. Box 10252, Eugene, Oregon 97440

For office use only: Date______ Fee_____ Check_____ PO#_______ By:____

EDUCATION & TREATMENT OF CHILDREN



Education & Treatment of Children is a quarterly journal devoted to the dissemination of information about the development and improvement of services for children and youth, with particular emphasis on teaching/training effectiveness.

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