# DIRECT INSTRUCTION IN EDUCATION

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This paper examines Direct Instruction--one branch of the ***"instructivist"*** approach in education (Finn & Ravitich, 1996). The paper is divided into the following sections: 1) a definition of the instructivist approach; 2) the mission of instructivist educators; 3) varieties of instructivist education; 4) principles of instruction and classroom organization derived from research on learning; 5) a description of a class where Direct Instruction is used; and 6) correction of certain myths about education guided by instructivist principles--myths that decrease students' access to effective education.

## I. A Definition of the Instructivist Approach in Education

The words "behaviorist" and "behavior modification" conjure up the rightfully-unpleasant image of teachers using candy and tokens to train students to cooperate, stay on task, and perform rote tasks--similar to rats and pigeons in an experimental psychology laboratory. This image has little to do with reality. In fact, the instructivist approach is about **education** and **human development**, not discipline and training.

**To educate means to lead forth**--to bring new members into a culture of **ideas** (e.g., bodies of knowledge), **moral principles**, and **skills** (e.g., reading) so they may contribute to the culture and realize their potentials. Systematic education (e.g., schooling) requires a **curriculum** (a sequence of ideas, skills and moral principles to teach) and **instruction** (communication between teachers and students). This raises two questions. "What guides curriculum and instruction?" "And how is the effectiveness of curriculum and instruction determined?" Different approaches are defined by their answers. The instructivist answer involves two principles and two concepts.

### Instructivist Principles: Reality and Knowledge

In contrast to proponents of "constructivism" (Cobb, Wood, and Yackel, 1990; Noddings, 1990; von Glasersfeld, 1984, 1995), instructivists believe that:

1. **External reality exists independently of what we think of it.** It is hard to prove this proposition true. However, the opposing proposition advanced by radical constructivists and postmodernists in education--that external reality is merely an idea, interpretation or text--is absurd, and if acted on can have painful consequences (Nola, 1997; Peirce, 1877; Suchting, 1992).

2. Our species has labored to better understand reality and has **organized knowledge into systems**--mathematics, biology, literature, and history, among others. The role of teachers is to help students acquire this knowledge (and to generate **their own** knowledge), in the form of **concepts** (knowledge that), **propositions** (knowledge why), **strategies** (knowledge how), and **operations** (knowledge how to). This is best done by: a) teaching with clear and explicit knowledge objectives; b) teaching concepts, principles, strategies and operations in a carefully

crafted sequence enabling students to build elemental knowledge (decoding new words and identifying main ideas) into complex wholes (reading fluently and comprehending stories); and c) attending closely to students' achievements and difficulties (Brophy and Good, 1986; Ellis, Worthington, & Larkin, 1994; Rosenshine, 1986; Rosenshine and Stevens, 1986; Walberg, 1990;). This leads to concepts that guide the instructivist approach.

**Instructivist Concepts: Behavior and Learning**
Instructivist educators are guided by the concepts ***"behavior"*** and ***"learning."*** Behavior is anything students **do**. Generally, behavior that is grist for development in education is **observable**. However, inner behaviors, such as thoughts and feelings, though not directly observable except by the individual, are affected by the same environmental events and arrangements as observable behavior. Therefore, the instructivist approach certainly addresses how students: 1) **feel** (e.g., pleasure at achievement); 2) **think** (e.g., wonder, plan, figure, decide, solve, mentally rehearse); and 3) **act** (talk, read, write, discuss).

The second main concept is learning. *Learning is **change** in behavior (feeling, thinking, acting) that results from interaction with the environment--i.e., from teaching--systematic or incidental.* Of course, learning is affected by health, sleep, prior learning, and maturation. It is also affected by the nature of the environment; e.g., opportunities to interact with objects and persons.

In light of the concepts "behavior" and "learning," the instructivist approach means that an educator (college professor, school principal, classroom teacher, student intern):

1. Draws on the enormous literature on how human beings learn, to design curricula and forms of communication (instruction) that are congruent with students' competencies, preferences, needs, and capacities. And

2. Focuses on changes in students' behavior (learning) as a way of keeping track of students' progress and the adequacy of their education.

## II. The Mission of Instructivist Educators

The mission of instructivist educators is to create environments with students that will foster students' (and teachers'): 1) **investment** in the educational process; 2) **prosocial participation** in the class as a culture or community; 3) **cognitive-conceptual knowledge** (e.g., concepts and principles in reading, science, social studies, math, higher-order thinking, or reasoning); 4) **practical knowledge** (e.g., strategies and operations for skillful problem solving); and 5) an increasing ability to **direct their own learning**. Instructivist educators believe that virtually all students can experience success, and when they do not experience success, something is wrong with instruction.

> ...we begin with the obvious fact that the children we work with are perfectly capable of learning anything that we can teach... We know that the intellectual crippling of children is caused by faulty instruction--not by faulty children. (Engelmann & Carnine, 1991, p. 376)

From as long ago as the 1950's, instructivist educators have been guided by an **ethic of social justice**--i.e., equal access of all individuals and groups to effective education and to the opportunities for self-development, jobs, and social contributions that depend on effective education. Instructivist educators were among the first to create programs to improve education for disadvantaged children and their families; to prevent or replace antisocial behavior in children; to humanize large, custodial training schools that warehoused persons with disabilities; and to develop effective treatments for persons with a variety of illnesses or conditions, including depression, anxiety disorders, autism, and learning disabilities. This early and more recent work is described in Gardner et al. (1994), Ullmann and Krasner (1966), and Ulrich, Stachnick, and Mabry (1970).

Instructivist education succeeds where other curricula fail with disabled and otherwise challenged individuals. This leads some educators to believe that instructivist education is suitable only for the educationally challenged. This unfortunate inference is as illogical as providing supernutitional food only to the most malnourished. In fact, instructivist education is field tested with all sorts of populations, including challenged, average and gifted learners, and is highly effective with all (Gardner, Sainato, Cooper, Heron, Heward, Eshleman, & Grossi, 1994).

Finally, instructivist educators feel a **moral imperative** to design and participate with students in effective educational environments.

> We function as advocates for the children, with the understanding that if we fail the children will be seriously pre-empted from doing things with their lives, such as having career options and achieving some potential values for society. We should respond to inadequate teaching as we would to problems of physical abuse... We should be intolerant because we know what can be accomplished if children are taught appropriately. (Engelmann & Carnine, 1991, p. 376)

## III. Varieties of Instructivist Education

The instructivist approach (teaching guided by experimental research on instruction and learning) has three prominent, related, but distinct approaches--applied behavior analysis, Precision Teaching, and Direct Instruction. When combined, we have an educational environment that is simultaneously nurturing, gives all students the maximum chance of learning all of the curriculum at their own pace, and fosters creativity, community and independence (Bessellieu & Kozloff, 1999; Binder & Watkins, 1990).

### Applied Behavior Analysis

The first branch is applied behavior analysis (Schloss & Smith, 1998). Applied behavior analysis is not one distinct educational program. Rather, the term refers to a loosely coupled set of practices derived from: 1) decades of experimental research on how environmental events and arrangements affect learning; and 2) principles of "operant" learning (i.e., learning in more or less voluntary behavior) found in the work of B.F. Skinner (Skinner, 1938, 1953). The major contributions of applied behavior analysis to education are as follows.

1. Methods for examining the interaction between students and their environments so that one can discover **functional relationships**; i.e., one can find out how each student's learning is fostered or impeded by such things as the difficulty of tasks, the pacing of instruction, the amount and kind of assistance from a teacher, or the nature of interaction with peers.

2. Guidelines for using knowledge of functional relationships between certain environmental features and each student's learning, to **design instruction** that is consistent with students' individual skills, preferences, and requirements; e.g., for less noise or more frequent feedback.

3. Methods for **evaluating the adequacy** of curriculum and instruction by keeping careful track of each student's (and the whole class's) learning, and revising curriculum and instruction accordingly.

**Precision Teaching**
Precision Teaching was developed by Ogden Lindsey and his associates, who have kept records on over 500,000 precision teaching programs conducted through the years (Binder & Van Eyk, 1990; Binder & Watkins, 1990; Haughton, 1980; Jordon & Robbins, 1972; Johnson & Layng, 1992, 1996; Kunzelmann, Cohen, Hulten, Martin, & Mingo, 1970; Lindsley, 1990, 1991, 1993, 1996; Potts, Eshleman, & Cooper, 1993). Lindsley based Precision Teaching on Skinner's discovery that the **rate** of a behavior (the number of occurrences per unit of time) is a **dimension** of the behavior, and not just a measure of the behavior. This implies that fluent (automatic, effortless, fast and accurate) behavior differs fundamentally from behavior that is not fluent. The major features of Precision Teaching are as follows.

1. **Teachers identify and teach the "tool skills"** (component or elemental skills and knowledge) needed to efficiently learn **complex** (composite or compound) skills and knowledge. For example, (a) skill at listening to a teacher, following her argument, and taking notes, combined with (b) fluency with math facts, the concept of ratio, and simple arithmetic operations, facilitate students' learning algebra. When students are **not** fluent with tool skills (e.g., reading and writing) they are **not** able satisfactorily to learn complex skills (e.g., comprehending text, solving math problems) in which the tool skills are **embedded--**no matter how hard students try, and no matter how creative the teacher is at using "relevant" examples and "discovery" activities. In other words, early dysfluencies are compunded. This **"cumulative dysfluency"** (Binder, 1996) yields low expectations of success, disruptive or withdrawn behavior, diagnosis of learning disability, and/or dropping out (McDermott, 1993; Montgomery & Rossi, 1994). For instructivist educators, this is a **failure of instruction**, not of students.

2. **Teachers provide carefully planned, short practice sessions** on older and new learning to strengthen fluency (i.e., skill and knowledge become second-nature), retention, and independence. These practice sessions are conducted with the same spirit and serve the same functions as work at the barre in dancing schools or teams practicing plays on the basketball court.

3. As students master component skills, teachers help students to **assemble component skills into complex activities**; for example, solving math problems or using basic knowledge of biology and experimental procedures to conduct a whole biology experiment.

4. Teachers help students **keep track of their own progress**; e.g., by counting and charting math problems solved per minute per day, or misspelled words caught and corrected. Counting and charting progress (as weightlifters count repetitions), enables students to become more independent learners; they know what to look for and how to improve their skills. It is also a powerful source of **self-motivation** to excel and pride in achievement.

**Direct Instruction**
Direct Instruction grew out of the work of Siegfried Englemann and Carl Bereiter with disadvantaged children (Bereiter & Engelmann, 1966). Over the past 30 years, it has been developed for teaching elementary through secondary language, reading, math, higher-order thinking (reasoning), writing, science, social studies, and legal concepts (Adams &

Engelmann, 1996; Kameenui & Carnine, 1998). Indeed, Direct Instruction provides complete K-6 curricula in reading and math. The teaching methods and materials have been **rigorously tested** in numerous experiments and field trials. This distinguishes Direct Instruction from other curricula and textbooks, which typically receive no testing before they are sold to schools and "tested" on children.

Moreover, Direct Instruction was compared with 12 other models in the largest education evaluation ever conducted, called **Follow Through** (1967-1995; one billion dollars; 75,000 children in 180 sites), sponsored by the U.S. Department of Education and conducted by the Stanford Research Institute (Bock, Stebbins, and Proper, 1977; Watkins, 1997). Other models included the Behavior Analysis Model, the Florida Parent Education Model, and several models (which would be considered constructivist) that were language-oriented, student-centered, and cognitive-developmental--including the High/Scope cognitive curriculum, the Bank Street College Model, Open Education, Responsive Education, and the Tucson Early Education Model. Scores on the Metropolitan Achievement Test, the Coopersmith Self-Esteem Inventory, and the Intellectual Achievement Responsibility Scale, showed that **Direct Instruction was superior both to controls schools and to every other model in fostering basic reading and math skills, higher-order cognitive-conceptual skills, and even self-esteem** (Adams & Engelmann, 1996; Becker & Carnine, 1981).

Finally, **follow-up studies** have been conducted with students taught with Direct Instruction. For example, Myer (1984) followed children (predominantly African-American or Hispanic) in the Ocean Hill-Brownsville section of Brooklyn who had been taught reading and math using Direct Instruction in elementary school. At the end of 9th grade, these students were still one year ahead of children who had been in control (nonDirect Instruction) schools in reading, and 7 months ahead in math. Similar results were found in a study by Gersten, Keating and Becker (1988). Former Direct Instruction students continued out-performing children who had received traditional instruction. In addition, Direct Instruction students have higher rates of graduating high school on time, lower rates of dropping out, and higher rates of applying and being accepted into college (Darch, Gersten, & Taylor, 1987; Meyer, Gersten, & Gutkin, 1983).

The major features of Direct Instruction are as follows (Engelmann & Carnine, 1991; Gersten, Woodward, & Darch, 1986; Stein, Carnine, & Dixon, 1998).

1. Direct Instruction focuses on **cognitive learning**--concepts, propositions, strategies, and operations (e.g., solving problems and writing essays). It is **not** rote learning. This is evident in the earliest Direct Instruction curricula for language, reading and math (Becker, 1971; Englemann, 1969).

2. Curriculum development involves three analyses: the analysis of **knowledge**, the analysis of teacher-student **communication**, and the analysis of (student) **behavior**. The curriculum developer first analyzes a knowledge system (e.g., mathematics, literature) into logical classes and relationships. Next, these are transformed into the precise wording of teacher presentations (instructional communications) designed to be **faultless**; i.e., so logically clear that students will induce the proper generalizations and discriminations and correctly use the concepts, propositions, and strategies. Finally, the curriculum developer specifies activities of students (e.g., answers to questions, responses to math problems and story texts) that will indicate whether students have made the proper generalizations and discriminations, and correctly used concepts, propositions and strategies. The curriculum consists of teacher-

student communications during **tasks** (e.g., first grade students write words that describe pictures) ordered into **lessons** arranged into **skill tracks** (e.g., picture comprehension) within **levels** (e.g., *Reading Mastery II*).

3. Instruction teaches concepts, strategies and operations to **greater mastery and generality** than typically is the case. As Binder points out:

> (E)ducational programs will be more effective in the long run if they produce a more focused, but truly mastered, repertoire rather than a broad but fragile repertoire. The latter might be said to characterize the usual educational approach in America, which introduces but never ensures mastery of a broad range of skills and knowledge. (Binder, 1996, p. 179)

Therefore, Direct Instruction focuses on **big ideas** (Kameenui & Carnine, 1998).

> Big ideas are those concepts, principles, or heuristics that facilitate the most efficient and broadest acquisition of knowledge. They are the keys that unlock a content area for a broad range of diverse learners... (S)tudents, from the brightest to the most challenged, are likely to benefit from thorough knowledge of the most important aspects of a given content area. (Kameenui & Carnine, 1998: p. 8)

For example, big ideas in a Direct Instruction science curriculum include "the nature of science, energy transformations, forces of nature, flow of matter and energy in ecosystems, and the interdependence of life" (Kameenui & Carnine, 1998, p. 119). These ideas "are essential in building a level of scientific literacy among all students that is necessary for understanding and problem-solving within the natural and created world" (Kameenui & Carnine, 1998, pp. 121-122). In addition, big ideas foster **generalization** of knowledge to other areas, and are a context of prior knowledge to which students assimilate new learning.

4. Concepts are **not taught in isolation** from each other. Instead, instruction involves **strategic integration** (Kameenui & Carnine, 1998) within and across subjects. For example, the concepts density, heat, and pressure overlap in a science curriculum. Instruction on each concept is a **strand** leading to a larger concept (e.g., convection cell) that integrates the strands. As a big idea, convection is illustrated with air circulating in a room, liquid boiling in a pot, and mantle, ocean and ocean-land convection (Kameenui & Carnine, 1998, p. 121). In other words, the aim is to help students acquire knowledge that is rich in detail, integrated (e.g., synthesizing math, science, writing and reasoning), and generative of new questions and activities.

5. The analysis of knowledge (numbers 2-4, above) is used to create student-teacher **communications** that are **"faultless"** (logically clear) so that **all** students will:

a. Grasp the concepts and their relationships; and

b. Engage in activities (e.g., reading, solving math problems) that reveal understanding and provide practice.

6. Lessons (e.g., 10 to 45 minutes) are **arranged logically** so that students first learn what they need to grasp later concepts. (Notice the connection with Precision Teaching's attention to component and composite skills.)

7. Lessons (typically in **small groups**) are **formatted** so teachers know what to say to provide faultless communication, and what to ask that enables students to reveal understanding and/or

difficulties. The strategy to help students get concepts (e.g., a balanced equation) is at first **explicit**, or **conspicuous**, so students learn to use the strategy **themselves**. In other words, Direct Instruction teaches students to think skillfully.

8. Lessons (e.g., on reading) are followed by **independent and small group activity** (e.g., writing stories) to give students practice and generalize skills to new materials.

9. Gradually, instruction moves from a teacher-guided to a more **student-guided** format. This is called **mediated scaffolding** (Kameenui & Carnine, 1998). The move to less scaffolding is achieved by teaching students problem-solving strategies, fading assistance, and introducing more complex contexts--to help students distinguish essential and inessential details (Becker & Carnine, 1981). In other words, Direct Instruction fosters independence and higher-order thinking.

10. Short proficiency tests are used about every ten lessons to ensure that all students have mastered the material and to determine which concepts need firming. Frequent evaluation sustains the quality of instruction and students' education; it prevents the drift towards mediocrity or failure.

In summary, Direct Instruction has nothing to do with training meaningless bits of behavior or coercing students into docility. It is a sophisticated way of: 1) determining what students need to succeed with meaningful material; 2) arranging the learning environment (e.g., the physical setting, curriculum, student-teacher communication, and peer relationships) so students receive what they need; and 3) helping teachers and students keep track of progress and difficulties so curriculum and instruction can be improved (accountability). Let us turn now to principles of learning that underlie Direct Instruction

## IV. Principles of Instruction and Classroom Organization Derived From Research On Learning

### Knowledge Base

Direct Instruction curricula rest on 100 years of experimental and naturalistic research. This research shows that **the sorts of behavior changes called "learning"** (i.e., changes in knowledge, skill, or competence) **are lawful**. Persons acquire skills and knowledge, and alter actions in certain ways, under certain conditions as they interact with their environments. In addition, Direct Instruction draws on the work of scientific philosophers (e.g., John Stuart Mill, in *A system of logic*) who discovered strategies for inducing (figuring out) causal relationships and communicating the essence of a concept. The founder of Direct Instruction, Siegfried Engelmann, saw that these thinkers provide principles for analyzing knowledge systems and preparing faultless communication (instruction) (Engelmann & Carnine, 1991).

In addition to the enormous literature on concept and skill learning, instructivist educators draw on:

1. Social exchange theory and conversational analysis--how individuals teach and learn from each other during interaction (Helm, 1989; Homans, 1961; Hamblin et al., 1971; Kozloff, 1988, 1994).

2. Ecological psychology--how the structure of routine tasks and activities in a person's round of daily life help a person organize actions into larger classes and sequences (Arreaga-Mayer,

Carta, & Tapia, 1994; Barker, 1963, 1968; Bronfenbrenner, 1979; Connolly & Dalgleish, 1989; Fogol, 1992).

**Learning Principles**
Learning occurs as individuals and groups *interact* with **physical environments** (e.g., an icy sidewalk), **other persons in social exchanges and activities** ("Hey! Great job." or "Maybe if you used both hands..."), **and** their own **stream of behavior** ("Okay, where's my belt?"). The crucial thing is that interaction is **communicative**; we act and receive information of three kinds: **signals**, **consequences**, and **prompts**. Each kind of information helps persons learn more about how the world works and how to change actions in the direction of greater competence.

***Signals.*** **Signals provide information that something is about to happen or that there is an opportunity to take action.** Examples include the sight of an unbalanced equation (a signal to perform certain algebraic operations); and a range of requests, questions, gestures and models from other persons (signals to answer, approach, imitate, and perform hundreds more actions).

***Consequences.*** **All acts have results, or consequences.** These consequences (including the absence of something happening after an act) provide informative feedback on the effects, and on the effectiveness, of actions. For example, certain ways of interacing with an icy sidewalk result in remaining upright and stable; other ways of interacting with an icy sidewalk result in slipping and falling. These consequences teach what happens when we act in certain ways. We use this information either to continue acting the same way or to alter action. It is therefore important at first, and especially when persons have learning difficulties, to create environments with consistent or reliable consequences (information), so students can induce generalizations enabling them to predict the effects of actions and therefore guide their actions.

***Prompts.*** Prompts are a third source of information. Prompts direct attention to signals ("Listen to this."); help craft ongoing actions in a more competent fashion; or help direct attention to the results of past actions ("Did the solution turn pink?"). Prompts include: 1) **gestures** (a teacher points to a trouble spot in an equation); 2) **suggestions**; 3) **instructions** ("Pour acid INTO water, not water into acid."); 4) **highlighting** features of the setting (e.g., crucial information in a text is in italics); and 5) **models** ("Try it like this...").

Direct Instruction pays close attention to prompts students may need. If students can overcome a difficulty (say, in a math problem) by trying again, a teacher encourages this, because trying again, or persistence, is an important aspect of behavior. If students are not overcoming a difficulty, the teacher identifies a minimal prompt to help students succeed. Otherwise, students make the same errors again and again, and see themselves as incapable of mastering the task. Direct Instruction teachers also teach students to prompt themselves.

***Building ComplexSkills.*** Direct Instruction teachers are alert to information (signals, consequences, prompts) students need to learn difficult concepts and skills. In addition, teachers help students assemble component skills into complex tasks and activities. Many activities are long sequences of steps. For example, riding a bicycle begins with pulling the bike upright, mounting the bicycle, pushing off, getting on course, and peddling steadily. Likewise, solving a math problem or writing an essay are sequences. Many steps must be accomplished to do the task well. Some skills are taught by working on the whole sequence at once--"whole task presentation." Other skills and activities have so many steps that students may not learn the activity by working on the whole sequence. Therefore, teachers and students work on manageable chunks. For example, a teacher might teach math problems by first ensuring that students can do the first step; e.g., identify variables from a written text. "One train is going 40 miles an hour heading East..." When students can do the first step, the teacher helps them do the first plus the second step; and so on until students do the whole sequence. This is called **"forward chaining."** The whole task (more naturalistic) method is preferred. However, if a task is too long or too complex, some students will be lost and give up, and so part-to-whole methods works better.

***Stimulus Equivalence.*** Stimulus equivalence refers to emergent knowledge that is not taught directly. For example, if students are taught that A = B and that B = C, students generally make the (unprompted) inference that A = C (Catania, 1998). Instructivist educators help students to develop complex concepts and skills by designing instruction based on the large literature on stimulus equivalence.

***Eight Phases of Learning and Instruction.*** There are eight very important ways that knowledge and skills can change. If we only work on a few of them, we have not helped students become as competent and independent as they could have become. We have not served them well. ***The eight phases are acquisition, fluency, endurance, behavioral momentum, generalization and discrimination, adaptation, retention, and maintenance.*** Following is a brief description of the changes signified by these terms and the instructional methods or environmental conditions that foster the changes.

***Acquisition*** is the earliest phase of learning, when skills are initially formed; that is, a person's actions become more accurate and/or more successful. Specifically, a person: 1) learns how to accomplish tasks (such as writing essays or solving math problems); and/or 2) learns concepts (e.g., democracy) and principles (e.g., borrowing from the tens column). Regarding strategies and operations, acquisition includes learning:

1. What is to be accomplished; e.g., answers to a word problem and steps for solving word problems; and

2. To perform effective component actions at the right spots in an activity sequence, leading to a successful conclusion; e.g., a solved problem or a cogent essay.

Regarding, concepts and principles, acquisition includes learning:

1. **The essential features that define a concept** (e.g., democracy might be defined by participation of all members of a group in decision making) vs extraneous features (e.g., the language that members speak).

2. To choose between (discriminate) positive examples and negative examples (e.g., to identify groups as examples of democractic vs aristocratic forms of rule).

3. To use rules of logic to **induce generalizations**; e.g., "The more X, the less Y."

Quite often, the phase of acquisition is when a person learns skills that are components of subsequent or more complex skills. For example, punctuation rules, spelling and vocabulary must be acquired before competent paragraph writing will develop. Similarly, students must acquire basic computation facts and skills before they will be competent at solving complex math problems.

***Fluency-building*** generally follows acquisition. Acquisition is the phase when students' actions become more accurate or successful. Fluency-building is the phase when students also learn to enact an activity or to use concepts, propositions and strategies **accurately, smoothly and quickly**. By learning to act smoothly, quickly and accurately, and by internalizing strategies for performing the activity, students develop the ability also to employ their skills in novel settings and in novel ways (Dougherty & Johnson, 1996; Johnson & Layng, 1996). In reading, fluency means that a person pronounces words clearly, moves quickly from one word to the next, moves quickly from the end of one line to the start of the next, and modulates stress and tone in response to punctuation marks.

Much research documents the importance of going beyond acquisition (successful or accurate performance) and working on fluency (accurate, rapid and smooth performance). This is because when we are fluent:

1. We enjoy performing tasks at which we are skilled and employing knowledge we feel we have mastered.

2. We remain proficient at the task over time with minimal practice, or we regain proficiency relatively quickly after a period of dormancy.

3. We almost automatically know how to reassemble different skills into new or creative combinations. This is called "response adduction" (Binder, 1996; Binder and Watkins, 1990; Binder, Haughton, and Van Eyk, 1990; Dougherty and Johnston, 1996; Haughton, 1980; Johnson and Layng, 1992, 1996; Jordon and Robbins, 1971; Lindsley, 1990, 1996). For example, if a student is fluent in the component concepts and operations of measuring volume and weight; reading instructions; finding and putting on goggles; etc., the student will more easily (and more on her own) assemble these into the composite task of conducting a chemistry experiment.

4. We can perform successfully in the face of distractions.

5. We can perform for long periods of time without fatigue.

Fluency is fostered by providing students with frequent and (initially) guided or scaffolded practice on components skills, just as dancers, martial artists, and athletes practice "the moves."

***Endurance*** means that a student is not only fluent, but is able to engage in an activity for an **extended period of time**. Unfortunately, teachers rarely attend to students' endurance; they focus more on students' "getting the answers right" or finishing. However, the importance of endurance is obvious. If students are not able to sustain skillful activity, their skill will be of little use in environments where endurance is needed; e.g., an engineering lab where colleagues spend hours and hours working on the same problem. Endurance is fostered by:1) **continually practicing and improving component skills** (e.g., math facts, math operations); 2) **gradually increasing the duration** of practice sessions; and 3) moving from practice environments **to more naturalistic environments**.

***Behavioral momentum*** (Plaud & Gaither, 1996) means that a student's activity (e.g., reading, solving problems) is **fluent despite distractions**; e.g., other students' talking. As with endurance, teachers focus so much on "correct answers" or finishing lessons that they seldom help students to carry on despite little aches and pains, noise, or frustration. Therefore, their students' skills are actually quite fragile; they will not be sustained in the outside world. Momentum is fostered by: 1) practicing to the point of fluency and beyond; 2) practicing in the presence of increasingly intrusive distractors; and 3) introducting into the setting events that have been associated with students' success (e.g., music).

***Generalization*** (sometimes called "application" or "transfer") means that a student learns to **use skills or concepts acquired in one environment in other environments**. For example, generalization of reading skill would involve reading at home and in class; reading from newspapers, posters, and computers as well as school books; reading different type faces; and reading for various purposes (e.g., pleasure, following recipes, and crossing streets) (Mundschenk and Sasso, 1995). Unfortunately, most teachers take generalization for granted, or fail to think about it at all. However, teachers cannot expect that one or two lessons or experiments or projects will be enough to teach students: 1) the essential concepts, principles, strategies and operations; and 2) when the concepts, principles, strategies and operations apply and when they do not in environments outside of class. Therefore, instructivist educators thoughtfully facilitate their students' generalizing concepts and skills in several ways. They do this by:

1. Helping students practice to the point of fluency.

2. Teaching in a way that increases the chances of generalization. For example:

a. Giving students learning opportunities in a variety of settings; e.g., math problems with different content.

b. Using natural signals, prompts, and consequences.

c. Teaching skills that are functional, valued, expected, and for which there will be frequent opportunities and models in other settings.

3. Providing specific instruction on generalization by using **general case instruction** (Albin & Horner, 1988) or **sequential modification** (Haring, 1988).

a. In **general case instruction**, the teacher uses (and helps students to understand the similarities and differences among), a wide range of juxtaposed examples; e.g., different species of plants, different minerals. This prepares students to handle novel situations outside of the classroom. For example, a Spanish teacher has students listen to and translate the Spanish of persons with different accents and dialects.

b. In **sequential modification**, the teacher works with students in one setting or with one kind of problem. When students are skilled with the one exemplar, the teacher **probes** the extent of students' generalization to a second situation. If there is little generalization, the teacher helps students to apply the skill acquired in the first setting to the second setting. The process of assessing skill generalization in a new setting and then teaching in the new setting, continues until a wide enough range of settings has been covered. Adaptation is not to be confused with generalization.

***Adaptation*** involves **altering** (not simply transferring) a concept, principle, strategy or operation **to suit the circumstances**. This could mean drawing upon different skills. Teachers informed by instructivist principles foster their students' capacity to adapt skills and knowledge to new situations by ensuring that their students' tool skills (the basics; e.g., hitting, running, throwing and catching in baseball) are sufficiently broad and fluent that students can creatively recombine them into new sequences.

***Retention*** means that a student **remains skillful despite the passage of time between practice or performance**. For example, a student remembers a poem after many years without reciting it. Very few teachers do anything to foster retention. When a unit is done, it is done, and they go on to the next. However, if students do not retain what they learned, all of their hard work was literally for nothing. When they realize this, they come to believe that school itself is for nothing. Therefore, teachers skilled at instructivist theory and methods foster retention by working with their students on fluency, endurance, and adaptation, and by ***strategically integrating*** earlier skills and knowledge with new ones being taught.

***Maintenance*** means that a student remains skillful in the absence of instruction or assistance. In other words, the student has become independent. As with the phases of learning discussed above, few teachers think about maintenance. Therefore, their students' skills quickly weaken when the students are on their own. This is another example of wasted education. Instructivist educators try to ensure maintenance in the following ways.

1. They provide prior instruction to a high degree of skill and fluency.

2. They slowly fade instruction and assistance.

3. They teach students how to self-evaluate their performance and to follow a problem solving sequence; e.g., a guideline such as "Try another way" or reciting rules of procedure.

## V. Description of a Class Where Direct Instruction is Used

### A Direct Instruction Curriculum

The general principles of Direct Instruction for designing, modifying and evaluating a curriculum are: 1) organizing the curriculum around the **big ideas** in a knowledge system; 2) using **strategies** for solving problems that are so **conspicuous** that students learn to use the strategies themselves ("covertizing"); 3) using **mediated scaffolding** (i.e., providing as much or as little modeling, supervision, and feedback as students need, but gradually fading it); 4) **strategically integrating** different knowledge strands into larger wholes; 5) assessing, if necessary providing, and properly placing students' **background knowledge** in a sequence of instruction; and (6) **judiciously reviewing material** (Kameenui & Carnine, 1998).

These principles can be used to teach virtually any knowledge system, including social studies, law, medicine, and logic. However, to date, the most well-tested Direct Instruction curricula address reading, language arts (writing, reasoning), spelling, and mathematics for grades K-6. The curricula for these four subjects are divided into levels. For example, *Connecting Math Concepts* (Engelmann, Carnine, Kelly, & Engelmann, 1996) consists of levels A through F. And each level has anywhere from 30 to one hundred or more lessons, each of which takes 45 minutes to an hour (perhaps spread over several periods). Lessons strategically integrate concept strands. For example, a lesson on subtraction would involve 10 minutes on regrouping, followed by 5 minutes on estimation, followed by 5 minutes on facts, ending with 10 minutes on word problems. This organization: 1) sustains student's attention; 2) provides for the early introduction of essential concepts; 3) systematically integrates the different strands; and 4) easily leads from concept learning to application (Engelmann et al., 1996).

**The School Day**

The Direct Instruction curriculum consists of programs in Reading, Reasoning and Writing and Math for grades K-6. There are a small number of curricula for middle schools, and a series of videdisk lessons on math and science for grades five through seven, approximately (Adams & Engelmann, 1996). Each program is divided into levels that roughly correspond to grades. However, when a class of kindergartners starts with Direct Instruction from the very beginning, they can be expected to complete Level Six in all subjects by the fourth grade. **Direct Instruction accelerates learning to the point that makes this goal very reasonable**.

Developers of Direct Instruction, led by Siegfried Engelmann at the University of Oregon, decided to develop a curriculum that would "leave nothing to chance." That is, the curriculum would contain all of the exercises, content and specific instructions for the teacher, and would be **extensively field tested and revised** to ensure successful implementation and students' learning. This contrasts sharply with almost all other curricula, which contain glaring deficiencies in theoretical foundation, organization of content, instructional methods and ongoing evaluation of students' progress, and therefore have led to low achievement in students and to general confusion in education about how children actually do master basic and higher-order skills and knowledge.

No curriculum will succeed without good teaching, just as no airplane will fly without a pilot. Therefore, as a second kind of quality control, **Direct Instruction involves extensive training and coaching programs for teachers** as well as thorough management systems to allow teachers to monitor students' and classes's progress.

Programs consist of formatted or scripted lessons that are complete and require no further development by teachers. Teachers must learn techniques for effective instruction, such as staying with the script, pacing, error correction procedures and group management skills, however. Each lesson is designed to be completed in 45 minutes to an hour, thereby fitting into most school day schedules.

Since reading skills are central to success in other classes that address specific content (e.g., history), and in solving math problems, **Direct Instruction emphasizes the reading curriculum.** When a complete implementation of Direct Instruction is not possible, the first program to be started is reading. Many times in Direct Instruction schools, reading is taught first thing in the morning, and virtually all school staff take part. Support staff in the main office or on the maintenance crew look forward to teaching groups assigned to them. All are carefully trained and assisted during the time they are developing adequate skills.

A Direct Instruction lesson involves numerous activities, which require students to respond actively, either as one voice in a choral group, as individuals, or by filling in their workbooks, which become a permanent record of progress. Indeed, **Direct Instruction involves active engagement at all times**, either listening and watching other sudents or the teacher, or responding to the teacher or to other students. Especially in lower grades, the typical lesson often finds eight to ten students in a semi-circle around the teacher where they can easily see the book the teacher is using and can be clearly heard by the teacher during group responding.

In upper grades, the teacher may work with classes of 20 or more, but each oral response as well as each written response (e.g, on math problems) receives just as much evaluative scrutiny as in lessons with younger students. Moreover, in upper grades, students' activities become more complex; e.g., writing paragraphs or short stories. Teachers therefore find themselves spending much time reading and evaluating students' writing. However, since teachers do not have to spend time preparing lessons, this time commitment evens out.

A school that uses Direct Instruction does not necessarily use it all day long. Rather, Direct Instruction would most likely be used at the beginning of some class periods, to review previous concepts and to give students instruction on new concepts that build on previous learning. The rest of a class period would be individual or small group work that involves generalizing or adapting what was learned to new material or problems. For example, a class period might begin with Direct Instruction on atmospheric convection. This might be followed by students searching the internet for websites that have data on weather patterns illustrating convection. This might be followed by students' writing papers that describe their computer search. In writing papers, students would use big ideas and strategies learned in earlier classes on spelling, reasoning and writing (strategic integration). **The essential thing is that the students get the main concepts, principles, strategies and operations before they are asked to use them.**

Math and reading instruction is done in **temporary ability groups** that may consist of students from different grade levels coming together for one hour, and then going back to their home rooms. These groups are **not tracks**. A student might be in a fast achievement group in math and in the average-pace achievement group in reading. However, if the student's reading progress accelerates, she would be moved to the fast group for reading. Temporary ability grouping is in stark contrast to the **"invisible tracking"** in schools that occurs despite teachers' apparent commitment to egalitarianism. Invisible tracking is the systematic, differential treatment of students in the usual "mixed-ability groups," in which teachers pay more instructional attention and give more approval to higher performing students, which leads to the self-fulfilling prophesy of achievement for a few students and underachievement for the many (Grossen, 1996). Direct Instruction confronts head-on real differences in students' needs and the right of all students to achieve. It does this by **providing instruction tailored to identified strengths and needs of the students, as determined by short placement exams**. Therefore, all students have a maximum chance of learning all of the material. All can succeed. Moreover, the ability groupings are constantly evaluated. The continuous data yielded by Direct Instruction lessons enable teachers to alter group membership; e.g., to move some students to a faster group. Although Direct Instruction Reading, and Reasoning and Writing curricula include excellent content in science, history and literature, schools often augment the curriculum with classes in these and other areas, such as art.

**Direct Instruction Lessons**
Following are features of Direct Instruction lessons.

First, **the teacher is an instructional leader.** The curriculum (e.g., *Reasoning and Writing* or *Reading Mastery*) specifies the goals, lessons and tasks, and the teacher presents these to her students. However, as students master the material, their activities are more open-ended or student-guided. For example, the curriculum still specifies what students are supposed to learn during a lesson (e.g., story writing), but students decide what they will write about.

Second, **the teacher closely supervises and coaches** students' during lessons and when students are working alone or in small groups. The point is for all students to master every concept, with no exceptions. This is possible because, after many field trials and curriculum revisions, teacher presentations are so logically clear that most students induce the proper generalizations and discriminations (i.e., "get it"). In addition, after years of research and field testing, even error identification and correction are formatted. Even so, to strengthen (acknowledge, praise) students' correct or improved actions, and to correct every mistake on the spot, teachers and students are engaged continuously so teachers can foster high rates of student activity; and attend, evaluate and respond to students' actions.

Third, **lessons are quick-paced**. The developers of Direct Instruction learned early on that a quick pace is essential for proper learning to occur. The pace sustains attention, encourages thinking (there is no time to day dream), increases the number of opportunies to participate, and reduces problematic behavior, as students are so engrossed.

Fourth, as said, **the absolute outcome of instruction on any lesson must be mastery**. Every student in the group must be able to perform the skill independently and without mistakes--firm and fluent. Much research has shown that mastery occurs when lessons have the following phases.

**1. Attention and Focus.** No program can be successful unless everyone is focused at the start of every lesson. If necessary, the teacher teaches attention and focus directly. Usually, this does not take long. Lessons begin with an attention signal such as, "Okay, everyone, watch this."

**2. Orientation or Preparation.** The teacher orients students to the lesson by pointing out how the lesson builds on prior work. This is written into teacher presentation scripts. Following is an excerpt from *Connecting Math Concepts Level D* (Engelmann, Carnine, Kelly, & Engelmann, 1996).

**Exercise 2. Fractions. Multiplication.**

"You've learned to add and subtract fractions.

The rules in the box show how to multiply fractions. I'll read what it says.

Follow along: (Students have their own books.)

When you multiply fractions, you multiply the top numbers and write the answer on top. Then you multiply the bottom numbers and write the answer on the bottom."

**3. Model. I**n the next phase, the teacher demonstrates concepts, propositions, strategies and/or operations addressed in that lesson. The teacher makes the concepts, rules and strategies explicit or conspicuous. The particular ways teachers demonstrate are carefully designed; they are called "formats." For example, continuing with the lesson on multiplying fractions, the teacher says,

"You can see the problem 3-fourths times 2-fifths.

The multiplication problem for the top is 3 times 2. That's 6. You write 6 on top.

The multiplication problem for the bottom is 4 times 5. That's 20. You write 20 on the bottom. I'll read the whole equation: 3-fourths times 2-fifths equals 6-twentieths."

In some lessons, the model is repeated several times with different examples so the children do not focus on **irrelevant** aspects of the demonstration that would cause them to induce or learn the wrong rule. For instance, if all the denominators in the math lesson were "2," the students might conclude that the rule only applies to fractions that are halves. Demonstrations are carefully designed to eliminate such ambiguous communications. Again, a major premiss in Direct Instruction is that students learn what they are taught. If students make errors, they were taught errors.

**4. Lead.** Often, the next step is leading students through the operation just modeled. This step is **guided practice**; teacher and students work problems, sound out new words, or read passages together. The teacher transitions to having students respond alone when she feels the time is right. If students are not accurate, she may go back and demonstrate again, then do it with them (lead), then have them do it alone. This often occurs as a group response, but every individual in the group must respond precisely on signal. However, students are never singled out for corrections--to prevent embarrassment or even the accidental reinforcement of attention-seeking. Instead, if one student hesitates or responds incorrectly, the whole group goes through a brief correction procedure until all children are firm. The point is for students to **internalize** the concepts, principles and strategies previously modeled by the teacher so they can apply them to more complex/advanced concepts in subsequent lessons. This facilitates generalization, adaptation and maintenance.

**5. Test.** "Tests" occur immediately after the teacher stops demonstrating and leading. She looks for accurate and quick (firm, fluent) actions from students in response to her signals (e.g., questions). When students appear to be firm, the teacher gives opportunities for students to more **independently** use what they appear to have learned. This "test" does two things: a) It gives students a chance to practice with less scaffolding or assistance (the principle of "mediated scaffolding"); and b) It enables the teacher to identify precisely what each student gets and does not get, so she can prepare error correction procedures. Continuing with multiplying fractions, the teacher now says,

"Your turn. Use lined paper. Copy problem A and write the answer.

Remember, multiply the top numbers and write the answer on top.

Then multiply the bottom numbers and write that answer on the bottom.

Raise your hand when you've worked problem A.

2/9 x 4/2 = ___

Check your work. You multiplied the top numbers, 2 times 4, and got 8 on the top. Then you multiplied 9 times 2 and got 18 on the bottom. 2-ninths times 4-halves equals 8-eighteenths.

Raise your hand if you got everything right.

2/9 x 4/2 = 8/18 6.

**Feedback.** The teacher provides timely and **genuine praise** for new learning, reading and solving problems without errors, and persistence. Following are examples from Becker, Engelmann, & Thomas (1971).

(1) [To the group, while a student is trying] "Gill is working hard. Just watch. He's going to figure it out. If you work hard, you'll get it."

(2) [To the group, while a student is trying] "Betty will learn this. It is tough, but she's a smart person." [Later, as Betty continues working] "She's working hard. She's going to show you."

(3) [To the group, when the student has gotten it] "What did I tell you? She kept working hard and she got it. She knows that if you work hard you'll get it."

**7. Error correction.** Teachers are alert to mistakes and teach students to identify and correct them. **This is because uncorrected errors will be learned.** And if mistakes linger uncorrected, it is harder for students to learn new material. Helping students correct errors does **not** make students dependent on the teacher. In fact, correction procedures teach students to observe and improve their own behavior. The general error correction procedure is first to identify whether errors are the result of a student's inattention and/or whether errors are errors of facts, component skills or strategies. If a student is paying too little attention, the teacher might increase praise for small increases in the attention and/or would praise other students for paying attention, to provide models for a less attentive student. In either case, the teacher uses the same correction procedure; that is, she models the correct answers or procedures again, leads students through the tasks again, and then "tests" learning by giving **new** examples. If the teacher decides that a student has not mastered previous skills, she may drop back to a previous lesson and teach the prerequisites. If it is an attention or behavior problem, she repeats the routine and uses praise as described above.

**8. Additional material.** The lesson continues with additional material (e.g., mutliplication problems) using the **same** strategies. This fosters generalization. A major technique to show how things are alike (i.e., the same concepts, propositions, rules, strategies and operations apply) is to compare two things that are very **different**, except for a shared critical element, and treat them **alike**; e.g., call them the same thing. However, to show how things are different (i.e., to foster discrimination), the teacher juxtaposes examples (e.g., math problems, passages of poetry, plants) that are very **similar**, except for an unshared critical element, and treats them **differently**.

**9. In future lessons**, the teacher introduces, models, leads and tests problems in which different strategies are used. Then the teacher gives students problems in which students alternate between one and another strategy. This teaches students to discriminate types of problems and to select relevant strategies. Gradually, lessons pay less attention to skills learned, and only review them occasionally. This strengthens retention of strategy and operation knowledge.

As seen above, **important presentations** (e.g., in math and reading) **are formatted or scripted**. The scripts are in the published materials that teachers use.

> The rationale for the scripted presentations is that if the teacher presents an adequate set of examples with clear consistent wording, students will learn the material with less confusion... Another advantage of the scripted presentations is that Direct

> Instruction teachers do not have to create the details of instruction through elaborate lesson plans; teachers just follow the script. Usually, the result is mastery. (Adams & Engelmann, 1996, p. 10).

Following is an excerpt from a script for Exercise 3, Coordinate System, Graphing Points, from Level E of *Connecting Math Concepts* (Engelmann, Carnine, Kelly, & Engelmann, 1996, pp. 86-87). This script is only part of a larger unit on the concept of mathematical relationships. After the lesson (on the basic concepts of the values of variables and coordinate points, and on graphing coordinates and examining revealed relationships), students would apply (generalize) the knowledge to a variety of data sources. Notice as the presentation goes on that the teacher gives less and less instruction--**mediated scaffolding**. Also notice at the end that the teacher provides a rule for solving problems, and then leaves it to the students to use the rule to evaluate and improve their work. The teacher is reading from her "Presentation Book." Students are following in their textbooks.

a. Find part 2.
You're going to make points on the coordinate system and write
a letter next to each point.
Points are little dots. The points you'll make will
**always be at the corners of squares on the coordinate system.**
The description tells about the X value and the Y value for each point.

b. Point A: X equals 5, Y equals 7.
You follow those directions by starting at zero.
You go some places along the X axis. How many places? (**Signal.**) 5.

Then you go up some places for Y. How many places? (**Signal.**) 7.

Then you make a dot and write a small capital A above the dot. Do it.
Make the point for A. Raise your hand when you're finished.
(**Observe students and give feedback.**)

c. Point B. What does X equal? (**Signal.**) 8.
What does Y equal? (**Signal.**) 10.
Go 8 places for X and 10 places for Y.
Make the point and write the letter B above that point.
Raise your hand when you're finished.
(**Observe students and give feedback.**)

d. Point C. What does X equal? (**Signal.**) Zero.
What does Y equal? (**Signal.**) 2.
Make the point and write the letter C above the point.
Raise your hand when you're finished.
(**Observe students and give feedback.**)

e. Point D. What does X equal? (**Signal.**) 3.
What does Y equal? (**Signal.**) 5.
Make the point and write the letter D above that point.
Raise your hand when you're finished.
(**Observe students and give feedback.**)

f. Check your work. Take your ruler and very carefully draw a line through the points you made. Draw the line from one edge of the coordinate system to the other. If you do it the right way, all your points will be on the same line. If your points are not all lined up, you made a mistake. Any point that is off the line is in the wrong place. Check that point and correct it.

Below is an excerpt from a script from *Reading Mastery V* (Engelmann, Osborn, Osborn, & Zoref, 1995, pp. 74-76). This curriculum consists of 120 daily lessons that cover vocabulary, decoding and comprehension of stories, writing, classic and modern fiction and prose, and the analysis of characters, settings, plots and themes. The script is from lesson 77.

**EXERCISE 1 Word Practice**
1. Everybody, find lesson 77, Part A in your skillbook. *Wait.*
Touch under each word in column 1 as I read it.

2. The first word is **linen.**
3. The next word. **Frenzy.**
4. *Repeat step 3 for each remaining word in column 1.*
5. Your turn. Read the first word. *Signal.* **Linen.**
6. Next word. *Signal.* **Frenzy.**
7. *Repeat step 6 for each remaining word in column 1.*
8. *Repeat the words in column 1 until firm.*

**EXERCISE 2 Word Family**
1. Everybody, touch column 2. *Check.*
All those words begin with the letters **i-o-u-s.**
Touch under the first word. *Pause.*
What word? *Signal.* **Precious.**
2. Next word. *Pause.* What word? *Signal.*
**Delicious**.
3. *Repeat step 2 for each remaining word in column 2.*
4. *Repeat the words in column 2 until firm.*

**EXERCISE 4 Vocabulary Development**
**Task A**
1. Everybody, touch column 4. *Check.*
First you're going to read the words in column 4. Then we'll talk about what they mean.
2. Touch under the first line. *Pause.*
What words? *Signal.* **Deserve credit.**
3. Next word. *Pause.*
What word? *Signal.* **Linen.**
4. *Repeat step 3 for each remaining word in column 4.*
5. *Repeat the words in column 4 until firm.*

**Task B**
Now let's talk about what those words mean. The words in line 1 are **deserve credit**. When you succeed in something you **deserved credit** for doing that thing. Here's another way of saying **She**

**succeeded at solving the problem: She deserved credit for solving the problem**.
Everybody, what's another way of saying **She succeeded at solving the problem**? *Signal*. She deserved credit for solving the problem...

**EXERCISE 5 Vocabulary from context**
**Task A**
1. Everybody, touch column 5. *Check.*
First you're going to read the words in column 5.
Then we'll talk about what they mean.
2. Touch under the first word. *Pause.*
What word? *Signal.* **Discontent.**
3. Next word. *Pause.* What word? *Signal.* **Appetite.**
4. *Repeat step 3 for each remaining word in column 5.*
5. *Repeat the words in column 5 until firm.*

**Task B**
1. Everybody, find part B in your skillbook. *Check.*
I'll read those sentences. You figure out what the underlined part of each sentence means.
2. Sentence one. She was very unhappy about a lot of things, but she was most **discontented** about the mess that was in the basement. *Call on a student.* What could **discontented** mean?
Idea: Dissatisfied.
3. Repeat step 2 for each remaining sentence...

This portion of the lesson is followed by students reading a story (about Midas and "The Golden Touch"), and then answering questions that have to do with decoding and comprehension. For example, "Why did Midas think this god paid him a visit?" "How would a golden touch work?" "Is Midas thinking clearly?" "What do you think is going to happen when he tries to eat breakfast?" Note that, **with practice, the teacher's initially scripted presentation will be a fluid conversation with her students**--a conversation that, in contrast to the usual forms of instruction--involves great attention to detail--the right words (concepts, questions, assistance) at the right moments.

**Combining Direct Instruction and Precision Teaching**
Precision Teaching can be easily joined with a Direct Instruction curriculum. For example, in addition to whole class instruction, small group instruction, and independent work on the lessons, students could have **daily practice sessions on tool skills** (e.g., simple math) **and on the larger composite tasks** (solving equations) being worked on. At first, practice sessions are would be **very short ("sprints")--only a few minutes long.** Gradually, the sessions would be **lengthened to build endurance**--5 minutes or so. During practices, there would be a lot of enthusiastic coaching from the teacher and other students. Students would set long-term fluency goals; e.g., to correctly solve 10, one-unknown equations per half hour (or one in three minutes). Students would record and chart their rates each day (Johnson & Layng, 1992). Students and teachers together would use these data to identify weak tool skills or concepts that require extra instruction.

## VI. Correcting Negative Myths About Direct Instruction

There are several myths about Direct Instruction These myths are easy to correct by:1) reading books and articles that report research on Direct Instruction; and 2) visiting schools and classrooms where Direct Instruction is used. Important authors include Adams and Engelmann (1996), Gardner et al. (1994), Lindsley (1990), Schloss and Smith (1998), and Sidman (1989). Important journals are *The Behavior Analyst*, *Effective School Practices*, the *Journal of Applied Behavior Analysis*, and the *Journal of Precision Teaching*. Let us now examine and correct various myths.

**"Direct Instruction Reduces Students to Stimulus-Response Relationships"**
First, as stated earlier, the mission of instructivist educators is to work with consumers (students, parents, teachers) to design humane and rich educational environments so that students can: 1) acquire knowledge and skill enabling them to lead more enjoyable lives; 2) take charge of their own learning and development; and 3) extend their growth far beyond what is ordinarily achieved in schools. An enormous amount of research says that this mission is achieved when teachers are well educated in the instructivist approach.

Apparently, the few technical terms used in Direct Instruction ("signals," "prompts," "error correction") lead some persons to believe that Direct Instruction teachers and curriculum developers regard students as akin to pigeons and rats trained by experimental psychologists. Nothing could be further from the truth. The purpose of technical terms (words with precise meaning) is to enable teachers to **communicate effectively**. The word "signal," for example, directs attention to events that come before students' actions. Therefore, if one teacher says, "I think my signals are ambiguous," the other teacher knows what to look for.

Moreover, technical **terms themselves do not depersonalize**. Direct Instruction teachers know that a few words do not capture all there is to a person. The words merely point to certain aspects of the environment and students' actions. This is the same as in medicine, where physicians speak of cells, tissues, organs, symptoms, and illnesses. This does not mean physicians see clients as nothing more. If a physican sees her clients that way, it suggests she is inclined to do so; the terms do not make her do so.

Finally, consider the words pistel, petiole, and petal to describe a rose. The words do not make a rose ugly, or reduce it to nothing but parts. In fact, these concepts make the flower more wondrous by drawing attention to how it is beautiful and how it works. Likewise, the terms "component skills," "response adduction" (bringing together) and "composite skill" do not degrade children and their learning; the concepts make it possible to see how amazing it all is.

**"Direct Instruction Destroys Creativity and Interest By 'Drill and Kill' Teaching."**
Direct Instruction is grounded in experimental research on the effects of massed practice (drill) vs distributed practice. For this reason, Direct Instruction teachers and curriculum developers are **more disgusted than other persons by mindless drill.** However, they do not throw out useful practice. The creative, skillful and life-long art of dancers, martial artists, painters, writers, musicians, good cooks, and athletes show the necessity of practice, practice, and more practice for accuracy, fluency, endurance, momentum, retention, and maintenance (i.e., independence). Instead of "drill and kill," Direct Instruction employs **"perfect practice"**--practice carefully scheduled to help students "iron out the bugs," discover and improve gaps in skill or knowledge, and foster fluency.

Practice sessions may be as short as 30 seconds. "Let's see how many misspelled words we can find in this paragraph. Ready? Go!" Gradually, the amount of time is increased (but only up to ten minutes or so) to foster endurance. Ray Charles was asked if, before concerts, he practiced the pieces he was going to play. His answer was that he practiced the scales--the basics. Practicing the basics is what Michael Jordon and his team mates do before and between games. Without practice to the point of fluency (perfection) they would not be stars; they would just be tall. (See "Developmentalism: An obscure but pervasive restriction on educational improvement," by J.E. Stone.)

**"Direct Instruction Formats Dehumanize Teachers."**
Some teachers may not like certain features of Direct Instruction; e.g., brisk pacing, close attention to students' learning, error correction, and formatted presentations. However, it is an exaggeration to call these dehumanizing. It is doubtful that actors are dehumanized by saying the lines Shakespeare wrote (because the lines are beautiful), that chess players feel dehumanized by moving pieces according to rules, or that dancers feel dehumanized by performing the moves scripted by a choreographer. Indeed, a careful reading of Direct Instruction teacher presentations reveals the genius and beauty in the wording and in the sequencing of concepts. Moreover, as with dancers, painters, poets, athletes, surgeons, and anyone following a protocol, individuality is manifested in personal style and competence. In addition, just as teachers initially scaffold students' learning, Direct Instruction formats initially scaffold teachers' communication with students. As teachers learn formats, the formats become invisible. The teacher "owns" what she says, just as actors live their parts. The teacher expresses individuality and creativity in how she arranges practice sessions, modifies lessons, and creates activities for students' independent and small group activity (Adams & Engelmann, 1996).

**"Direct Instruction is All Teacher Centered."**
"Teacher directed" (or "teacher centered") and "student directed" (or "student centered") are unfortunate terms. They make it seem as though these are opposites, when they are not. Morever, the term "student directed" (or "student centered") implies that teachers are do little directing. This, too, is not the case. "Student-centered" teachers are simply **more subtle** in their directiveness.

Moreover, it is not true that Direct Instruction is all teacher centered. Teachers are more directive during the **early phase** of acquisition (when students work on basic skills and knowledge needed to solve complex problems and do projects). Later activities on generalization and adaptation of knowledge are more student directed. For example, after a small group Direct Instruction session on reading new words, the children independently read books (with the new words) for a few minutes, and then come back for another group session to discuss the story. The same applies to science: first a short session in which the teacher and students work on basic concepts, and then a more "open" activity (e.g., experimenmt) in which the teacher gives help ("direction") as needed.

**"Direct Instruction Only Teaches Rote Responses or Basic Skills and Knowledge. What About Higher-order Thinking?"**
These statements reflect a misunderstanding of skillful activity and Direct Instruction. First, the dichotomy between so-called "lower-order" behavior (memorization [rote] and basic concepts) and "higher-order" behavior (problem solving, reflection) is misleading. All human activity involves both kinds of behavior. During a chemistry experiment, for example, students assemble the apparatus (rote), label chemicals (rote), solve equations (higher-order),

and inspect their work (higher-order). Second, aside from necessary introductory lessons on reading sounds (phonics) or math facts, virtually all of Direct Instruction on reading, reasoning, writing, and math concerns higher-order thinking--classifying, adducing rules, making inferences, testing generalizations, analyzing arguments, and solving problems. (See "Applications and misapplications of cognitive psychology to mathematics education," by J.R. Anderson, L.M. Reder, and H.A. Simon.)

## Summary and Conclusion

The overriding mission of Direct Instruction is that all students master all of the material. Towards this end, Direct Instruction curricula transform knowledge systems (e.g., language arts, science, math) into carefully crafted sequences of lessons. These lessons--built around the principle of faultless (logically clear) communication--are conducted in tight-knit classroom learning communities in which children acquire essential concepts and propositions and the strategies and operations for using them with meaningful materials. Research on Direct Instruction shows that when curricula are properly implemented, the mission of Direct Instruction is largely accomplished. At a time when so many competing voices clamor for education reform, and ideological and political interests are more likely to be served than the interests of children and families, Direct Instruction offers the most empirically validated and effective curricula that we have for all children.

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