The Morningside Model of Generative Instruction

We first introduced the formal characteristics of the Morningside Model of Generative Instruction in a special issue of the *American Psychologist* honoring B. F. Skinner (Johnson & Layng, 1992). Although the model, its conceptual history, and its foundations in selection science were discussed, space precluded elaboration of several key points. This chapter is a further specification of the Morningside Model of Generative Instruction. We first address the organizational history of Morningside Academy and its Chicago offspring at Malcolm X College. Next, we explain how the Morningside Model is an example of applied science, including further elucidation of generative instruction, instructional design features, retention-endurance-application-performance-stability (REAPS), and the importance of standard celeration charting. Finally, we provide a thumbnail sketch of 14 daily operational procedures of a classroom employing the Morningside Model.

A History

Morningside Academy: The Seattle Children's School

To develop the model of teaching presented here, Kent Johnson established a private, nonprofit (501 (c) 3) corporation—the Morningside Learning Center—13 years ago in Seattle, Washington. Initially, Morningside offered a broad array of academic and training services, letting the Seattle community determine its focus (Pennypacker, 1992; Skinner, 1971, 1981). These services included providing psychoeducational and vocational assessment, training human service personnel, teaching time management and study skills to college learners, and improving the academic skills of children and adults. Students, their families, or various social service agencies paid for the services. Within nine months, the parents of tutored children surfaced as the most frequent and stable users of Morningside's services. Since many of their children needed more intensive academic services than could be offered during weekly tutoring, Morningside Learning Center became Morningside School, a summer program for children with learning and attention problems. That fall, at the request of the parents of the summer-school children, Morningside became a full-fledged, year-round school, accredited by the state of Washington. Morningside Academy, a name its students eventually petitioned the director to use, is a basic skills catchup school; learners participate between one and three years before they are ready to be successful.
students elsewhere. The program teaches them the fundamental component skills necessary to learn successfully in a content class like history or biology. Learners who could achieve an "A" in such classes probably would not need to attend Morningside Academy.

The Current Morningside Academy Curriculum

The curriculum is a comprehensive sequence in the basics: reading, decoding, and comprehension; mathematics concepts, calculation and problem solving; language arts, including handwriting, composing, grammar, spelling, and mechanics; computer basics, including key-boarding, document organization, and word processing; time management, materials organization, and learning to learn; and critical thinking, reasoning, and argumentation.

The instructional materials represent a combination of Engelmann's Direct Instruction programs in reading (Engelmann & Bruner, 1988a, 1988b; Engelmann, Carnine, & Johnson, 1978; Engelmann & Hammer, 1988a, 1988b; Engelmann et al., 1988a, 1988b), writing (Engelmann & Davis, 1991; Engelmann, Arbogast, & Davis, 1991; Engelmann & Silbert, 1983, 1985, 1991, 1993; Engelmann & Grossen, 1993), and mathematics (Engelmann & Carnine, 1992a, 1992b, 1992c, 1993a, 1993b), Morningside's fluency supplements to Engelmann programs (e.g., Johnson & Kevo, 1993), Archer and Gleason's (1989) Direct Instruction programs in organizational and study skills and our own programs in mathematics (Johnson, 1993a, b, c, d, e, f, g, h, i, Johnson & Streck, 1993a, 1993b) and thinking skills (Layng, Jackson, & Robbins, in preparation). We plan to formally design and package all of our current instructional programs and fluency supplements.

Although many of its school functions, such as organized physical education during the lunch hour, monthly field trips, and parent potlucks, help create the atmosphere of a typical school, Morningside Academy is essentially a learning laboratory for designing instructional programs and classroom procedures, with a laserlike focus on the essential skills for school success and a 13-year research base (Binder, 1991a).

The Morningside Academy Guarantees At Morningside Academy, students typically gain between two and three grades in each academic skill per year, as measured by national standardized achievement tests (Johnson & Layng, 1992; Snyder, 1992). Table 14.1 presents Morningside students' gains over the past 11 years.

Due to its successes, Morningside Academy now offers parents two money-back guarantees. The first is for children who are two or more years behind in school. Many children in this group have been officially classified as "learning disabled" by public school personnel. These learners, who have rarely gained more than half a year in any one academic year, will gain at least two grade levels per school year or their parents will receive a tuition refund in proportion to the shortfall. The second guarantee is for any other learners who are not much behind in grade-level achievement but who stand apart from their peers because they do not coordinate visual and motor skills effectively, as is most apparent in their handwriting. These students are also highly distractible, hyperactive, disorganized, and have poor study and independent learning skills. Many children in this group have been officially classified by their pediatricians or other medical personnel as "attention deficit disorder" (ADD). Morningside Academy guarantees that these learners will increase their time-on-task endurance from their typical 1 to 3 minute spans to 20 minutes or more—an attention span longer than that.

<table>
<thead>
<tr>
<th>Year</th>
<th>Reading</th>
<th>Language Arts</th>
<th>Math</th>
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</thead>
<tbody>
<tr>
<td>1981-82</td>
<td>2.4</td>
<td>1.6</td>
<td>2.1</td>
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<tr>
<td>1982-83</td>
<td>2.3</td>
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<tr>
<td>1983-84</td>
<td>2.4</td>
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<tr>
<td>1984-85</td>
<td>2.5</td>
<td>2.7</td>
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<td>2.5</td>
<td>3.0</td>
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<td>1990-91</td>
<td>2.2</td>
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<td>3.9</td>
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<tr>
<td>1991-92</td>
<td>2.6</td>
<td>3.9</td>
<td>3.1</td>
</tr>
</tbody>
</table>

of the average college learner (Reese & Johnson, 1975). Morningside Academy also guarantees that students with visual or motor coordination deficiencies will learn word processing skills to communicate in writing. Furthermore, Morningside guarantees to bring these learners above the 65th percentile of their peer group nationally before they transition to another school. In the seven years since the assurances have formally been in place, Morningside has never had to refund tuition for failure to meet its money-back guarantees (Binder, 1988; Johnson & Layng, 1992).

Morningside Academy and the So-Called Learning and Attention Disorders

Morningside Academy began with no particular focus on learning disabilities or attention deficit disorders, populations with which it is now closely associated. Its strengths connected with a sector of the population that needed them in a microcultural evolution. Morningside Academy is now considered among the top agencies in the Northwest specializing in "learning and attention disorders," even though none of its faculty, including its director, has had any training in neuropsychology, a predominant field in the "treatment" of these "disorders." Behavior analysis has evolved a technology powerful enough to override certain hypothesized organic barriers to successful school functioning. By so doing, it created the irony of environmental effectiveness in an area most often approached from a physiological perspective.

The Seattle Literacy Project

In 1987 Morningside Academy began its adult literacy program, providing remedial basic skills education to minority youth and adults who did not have high school diplomas and were seriously deficient in reading, mathematics, and writing skills. Some participants took the Morningside Academy program concurrently with job-training skills programs, others as preparation for specific occupational-skills training courses. The project was funded by the Job Training and Partnership Act (1985), a revival of the Comprehensive Employment Training Act (CETA) program sponsored by Lyndon Johnson and the Great Society, and proposed by the unlikely duo of Ted Kennedy and Dan Quayle. Funding for the project was contingent on Morningside's proposal that no payment would be requested for any learner who progressed less than two grade levels.

Morningside's initial literacy project serviced 52 African American men and Asian American women. Forty-eight of these learners acquired skills at or above the national eighth-grade literacy standard and progressed more than two grade levels to do so (Johnson & Layng, 1992; Snyder, 1992). This was remarkable given the unstable lives of many of the participants, from homelessness to drug and other criminal activity. Learners advanced at an average rate of 1.8 grades per month (20 hours of instruction and practice)—a figure that contrasts sharply with the U.S. government standard of one grade-level progress per 100 hours of instruction (Binder & Watkins, 1989; Johnson, 1990, 1991; Johnson & Layng, 1992; Snyder, 1992). Part of the reason for the speedy progress was perhaps related to the economic contingencies: the faster learners advanced, the sooner Morningside Academy was paid.

Figure 14.1 illustrates the progress of four representative learners (KR, WB, DM, and JK) in the adult literacy project. The dot-dashed lines in each graph represent the individual's predicted gains, which were calculated by dividing the entering grade-level performances by the number of years spent in school. The dashed lines drawn on the diagonal of each graph represent the standard progress expected of the learner in school: one year of progress for one year of schooling. The solid lines represent the individual's gains in the Morningside program. In each case the participants' actual progress far exceeds both the standard and predicted progress.

Morningside Academy's literacy program attracted many visitors, including representatives from the U.S. Department of Labor, U.S. Department of Energy, the Washington State Employment Security Department, various Washington county youth employment and training programs, local television and radio personalities, and hundreds of parents, teachers, and professionals in medical and social service. (Curiously, no one from the U.S. Department of Education has ever visited.)

The Chicago Precollege Institute of Malcolm X College

In January 1991 T. V. Joe Layng became director of the Academic Support Center at Malcolm X Col-
learners gained an average of 1.1 years in reading (Johnson & Layng, 1992; Snyder, 1992). Malcolm X College's Precollege Institute (PCI) program now includes instruction in reading, mathematics, writing, and thinking skills for those who test below the sixth-grade level. Early follow-up data indicate that in addition to dramatic grade-level gains (Layng & Johnson, in press), following as little as eight weeks in the program, learners who finish their first semester in the college credit curriculum are exceeding the stated PCI goal of a 2.5/4.0 GPA and achieving some of the highest within and semester-to-semester retention rates in the college. All of these gains with children and adults in Seattle and Chicago occurred without any homework (to complete or to evaluate).

The Morningside Model as Applied Science

The Morningside Model of Generative Instruction is an outgrowth of applied science because it attempts to incorporate built-in, databased self-correcting procedures (Bronowski, 1965). It is instructional design, based on scientific findings—as electrical engineering is to physics. Every step a learner takes, every procedure a teacher uses produces data that they use to direct them to their next activity. The Morningside Model is designed so that both the instructional technology and the students' learning continually improve as more and more learners and teachers participate in its implementation. Self-correcting mechanisms are crucial to the evolution of a model. Such programs "have a life of their own," helping perpetuate their own survival.

They contain inherent features that both investigate the program's effectiveness and evolve improvements along the way.

As in all design, there is an artistic component—unspecified contingency-shaped designer repertoires—that is not easily subject to obvious self-correction. This component is determined by the complex histories of the designers. It makes each implementation a unique instance of the model. Each implementation maintains its stability and integrity, however, by adhering to the basic instructional design, related scientific findings, and the use of rate of change in learner performance to provide continuous self-correcting feedback.

The Role of Frequency Data

Experimental psychology had a strong influence on the measurement features of the Morningside Model. Some of the learning literature in experimental psychology, particularly the experimental analysis of behavior, uses frequency measurement, whether of responses or time between responses. Much has been written about the sensitivity of frequency measurement and the continuous orderly data it produces (Ferster, 1953; Skinner, 1953; Ferster & Culbertson, 1982; Ferster & Skinner, 1957). But perhaps the most important feature of frequency is that it can accurately predict future action (Ferster, 1953; Ferster & Culbertson, 1982). In everyday talk, terms such as habit, disposition, tendency, and personality attempt to predict what someone will do based on the frequency with which they have behaved that way in the past. For example, a person who "has a habit" of whistling tunes does so regularly and will probably do so in the future. Someone who "has a high disposition" or "tendency" to speak out about politics will do so when the occasion arises. Someone who "has an addictive personality" engages in behaviors that may be detrimental at high frequencies, such as drugging or gambling. Indeed, some (see Binder, Chapter 3 in this text) suggest that frequency may be considered a separate dimension of behavior along with the commonly accepted dimensions of duration, intensity, and form (topography).

From the outset, Morningside Model programs measured frequencies of accurate performance, and built performance to high frequencies, a technology Carl Binder called "fluency building" (Binder, 1977-1983, 1988, 1991b). Fluency performance is useful, permanent, and easily applied to new learning, features to which we return later in this chapter. Perhaps more important, Morningside Model programs use changes in frequency—acceleration of accurate learner performance—to develop permanent and useful learner success. This focus on acceleration meets the needs of children who have always progressed "slowly," as well as the concerns of parents who see the implications of having a child falling further and
further behind (decelerating). A focus on acceleration also alleviates the frustration of teachers faced with increasing differences in learner performance levels and progress within the same classroom, resulting in increasing teacher work and decreasing reinforcemen for that work (i.e., burnout from ratio strain).

Fortunately, a simple graphical chart — Ogden Lindsley's Standard Celeration Chart — is available to record learning accelerations (and decelerations). This chart is the fundamental teaching tool for a self-identified community of teachers with a distinct set of methods called Precision Teaching (Lindsay, 1972, 1990, 1991). The Standard Celeration Chart provides the foundation for setting fluency aims and for making students' learning accelerations the basis for curricular changes — everything from decisions about seating arrangements, to effective staffing, the use of commercially available material, and the design of materials and teaching methods. The Standard Celeration Chart appears in Figure 14.2.

Defining Academic Behavior I: Cumulative Programming of Intellectual Skills

The animal learning literature in experimental psychology influenced not only Morningside Academy's measurement practices, but also focused the model on acquisition, retention, endurance, and transfer of learning (Kling & Riggs, 1971). The verbal learning and cognitive processes literature provided further direction for teaching acquisition, retention, endurance, and transfer application. Current applications of the model focus on intellectual skills, those concepts, principles, and strategies that go beyond rote learning and verbal repertoires (Gagne, 1970). The distinction between verbal repertoires and intellectual skills is the difference between knowing

\[ \text{Figure 14.2. Daily Standard Celeration Chart. SOURCE: Reprinted by permission of and available from Behavior Research Company, Box 3351, Kansas City, KS 66103.} \]
about and knowing how (Gagne, 1970; Tiemann & Markle, 1990). We can know about Pythagoras and geometry, as demonstrated by what we say about him in a historical account (verbal repertoire); and we can also know how to find the length of the hypotenuse of a right triangle by applying the formula \( c^2 = a^2 + b^2 \) (intellectual skill). We can know about reinforcement by saying its definition. We can show reinforcement know how, by identifying it when we see instances of it in the real world and by applying reinforcement procedures when we deem them necessary.

Conceptual behavior, identifying instances of things and events, is the foundation for intellectual skills. Concept formation research with humans and other animals (Clark, 1971; Gagne & Brown, 1961; Johnson & Stratton, 1966; Tiemann & Markle, 1990) tells about how to teach conceptual behavior with a cluster of tasks that includes a range of positive and negative instances (examples and nonexamples). During discrimination training with a range of examples and nonexamples of a concept, experimenters reinforce learners’ identification of examples as examples and nonexamples as nonexamples. Identification of nonexamples as examples is either ignored (i.e., extinction) or corrected. Using these differential reinforcement and correction procedures, learner performance comes under the fine-grained control of the stimulus features that embody the concept. Once each concept is mastered, the resulting conceptual behavior can be related to others in a variety of ways to form more complex relations or principles (Tiemann & Markle, 1990). In the Morningside Model’s programs, learners know about their fine-grained intellectual skills as well, by learning to answer questions such as "Is this an example? How do you know? Is this one? Why not?" (Markle, 1991).

An example from Morningside’s study skills curriculum emphasizes intellectual skill building, beginning with conceptual behavior (Layng, Jackson, & Robbins, in preparation). Learners are taught to generate a special type of question as they study texts and notes. The questions they generate promote the continual hypothesis-testing behavior shown by experts within a given discipline. These "focusing" questions are special because they focus on material learners have not read but are about to read. Specifi-
cally, a focusing question must contain the following characteristics or attributes: (1) it must make a response request, (2) it must be about what one is preparing to read (not what one has already read), and (3) it must be a complete sentence.

If any one of these features is missing, the question or statement would not qualify as a focusing question. For example, a section heading or topic sentence of a paragraph might begin: "Almost everyone wants economic growth." Examples of a good focusing question might be "Why does almost everyone want economic growth?" or "Distinguish between those who want economic growth and those who do not." Notice that although only one example is stated as a question, both make a response request, both ask about the text about to be read, and both are complete sentences. Nonexamples include, "People typically want more of everything" (no response request); "What do most people want?" (asks about material already read); and "Why economic growth" (incomplete sentence).

The teaching sequence begins by providing students with scripted instruction featuring the rules for identifying focusing questions, and exercises using examples and nonexamples of the concept. So-called generalization is taught, not left to chance. Examples are drawn from a wide variety of subject matters, types of things questioned (e.g., topic sentences, headings, captions, and charts), and complexity of text until students can identify new examples not previously encountered in instruction. Nonexample work concludes when students reject all new statements or questions that do not include all three of the critical features of the concept. As a result, the students learn to discriminate focusing questions from nonfocusing questions. This sequence provides them with automatic reinforcement (Skinner, 1957) from a discriminative repertoire with which they are able to judge whether the questions they later produce are focusing questions. That is, the learners are able to correct themselves or at least know when they need assistance.

Building on this discriminative repertoire, students are introduced to the more complex skill of writing a focusing question by simply showing them how to add a question word and an action word (verb) to the material being questioned and then check to see that
it is a grammatically correct complete sentence. They then practice writing focusing questions for a wide range of written material drawn from a variety of topics. Next, students apply their ability to write focusing questions to entire passages of text with and without headings. Once question writing is established, similar procedures are used to teach the students to generate brief answers to their questions, to read to answer their questions, and finally to compare their answers to the answers provided by the text—hypothesis testing.

Defining Academic Behavior II: Cumulative Programming of Concurrent Intellectual Skills

_Like student like teacher._ The skills that we teach teachers to implement with their learners require the same intellectual skill-building technologies that we use with the learners themselves. The faculty at Morningside learn concepts embodying positive approaches to decelerating behavior, such as Goldiamond’s (1974) constructional approach, differential reinforcement of other behavior (DRO), differential reinforcement of alternative behavior (Alt-R), differential reinforcement of low rates of behavior (DRL), and differential reinforcement of diminishing rates of behavior (DRD) (Sulzer-Azaroff & Mayer, 1991). Each procedure is taught as conceptual behavior through discrimination training with examples and nonexamples. As each successive concept is mastered and added to the cumulative mix of scenarios, the faculty are required to discriminate each one from all of the others.

Less formal applications of cumulative programming of concurrent intellectual skills occur when teachers require learners to integrate (i.e., discriminate among) the skills they are learning from typical textbooks. For example, most mathematics texts treat topics in isolation. Learners may solve addition story problems in one section and subtraction problems in the next section. However, learners rarely practice solving both types together. Teachers may apply cumulative programming principles by writing practice worksheets that successively and continuously add each new math topic to the preceding topics. Teachers have applied cumulative programming to other subject matters, such as grammar, social science, and natural science.

Component/Composite Analysis

At about the same time that Kent Johnson founded Morningside Academy, T. V. Joe Layng was collaborating independently at the Behavior Analysis Research Laboratory of the University of Chicago, with Paul Andronis and Israel Goldiamond, its director, on basic animal research on the conditions responsible for combining previously trained simple nonsocial behaviors, such as pecking a disk and walking back-and-forth between other disks, into complex untrained social patterns (aggression in this case), such as increasing the number of times another bird had to peck its disk for food (Andronis, Goldiamond, & Layng, 1983). This and other basic research both at Chicago and elsewhere (Epstein, 1985, 1991) led to formalizing some of the key practices at work in the model from the outset and later provided research protocols we are using to formally investigate the human intellectual skills that lie at the heart of the model.

Both Morningside Academy’s methods and the Chicago laboratory investigations were preceded by yet other contributing observations by both Johnson and Layng and their colleagues in the mid-1970s. These included Johnson's work with Carl Binder and Beatrice Barren teaching developmentally disabled adults the activities of daily living skills, such as showering, brushing teeth, and washing hands. Their work used Eric and Elizabeth Haughton's observation of the importance of establishing very basic component motor skills before training more complex composite skills. The Haughtons called their basic motor skills list the big 6 + 6, which included reach, point, touch, grasp, place, release, push, pull, twist, squeeze, tap, and shake. Layng's work in inpatient psychiatry with Paul Andronis led to the observation that so-called pathological composite behavior could often be traced to everyday component behaviors that had been established earlier in other contexts (see Layng & Andronis, 1984). A patient's "symptom choice," such as pulling up clotheslines while screaming that they were blasphemous representations of the cross, could often be understood as a reinforced composite of previously learned religious and other component social patterns that resulted in loved ones rallying to the patient's assistance in the past.
This relation between basic behavioral components and more complex composites of these components may be the single most-important reason the Morningside Model has had the successes reported to date. Component/composite analysis is the foundation of the Morningside Model.

By combining (1) component/composite analysis of behavior with (2) cumulative instruction that includes a range of positive and negative instances of the component skills and (3) procedures that increase the frequency of the component behaviors, a powerful technology of instruction emerges—one that addresses performance acquisition, retention, and application. When practitioners apply this technology, new and complex repertoires emerge as a function of simply presenting a context for their combination, such as an activity, game, or simulation; component behaviors taught in the instructional sequence combine into new, untaught complex behavior as a result of the requirements imposed by the game, activity, or simulation. The application of fluent skills to new contexts and combinations without the need for instruction is the result, and therefore the meaning, of generative instruction (Alessi, 1987; Epstein, 1991).

Three Examples of Morningside Instructional Design

Let us take a brief look at the teaching of three complex academic skills—factoring equations in algebra, sentence writing, and debating—to illustrate component/composite analysis, cumulative teaching with positive and negative instances, and building the component skills thus acquired to higher frequencies. The composite behavior, factoring an equation like \(4x^2 - 10xy + 4y^2\), stumps many beginning algebra learners. Much has been written about teaching such mathematical problem solving, including some direct, programmed instruction produced by people of a behavioral bent (Eraut, 1970). Nearly all of this literature supposes that teaching the complex skill requires a complex algorithm and fairly elaborate methods. Cognitive science research in education, the whole language movement, and even the elaborate programmed instruction procedures that incorporate fading and chaining procedures based on task analysis, attempt to teach skills at the level of their observed complexity.

In contrast, the Morningside Model builds the component skills involved in factoring equations from the bottom up. Number writing, addition facts (i.e., numbers with sums to 18; Johnson, 1993a), subtraction facts (differences between numbers through 18 minus 9; Johnson, 1993a), multiplication facts (through 9 times 9; Johnson, 1993b), isolating and solving for \(X\) in a simple linear equation (Johnson, 1993e), squaring and factoring squared numbers (Johnson & Streek, 1993), and certain organization and sequencing skills are first firmly established and then practiced until they occur at high frequencies. With high-frequency (fluent) component skills, learners learn how to factor within minutes by simply learning which operations go in which position within which set of parentheses to produce the answer: \((4x - 2y)(x - 2y)\). This complex skill is not learned by complex teaching procedures, but by a quick, three-step method: (1) show and tell the operation, (2) provide mnemonics to remember the sequence (i.e., FOIL—first numbers, outside numbers plus inside numbers, last numbers give the equation), and (3) discrimination training/testing with examples and nonexamples (e.g., "Is this equation factored correctly? Why not? Is it factored correctly now? How do you know?" and so on; Johnson, 1993b).

English textbook authors usually spend several pages teaching learners how to write and correctly punctuate appositives like that illustrated in the middle of the following sentence:

John F. Kennedy, president of the United States in the early 1960s, was assassinated in 1963.

However, at Morningside Academy, when we brought the component skills—relative pronouns (e.g., who, which), nonrestrictive relative clauses (e.g., who was president of the United States in the early 1960s), and the linking "to be" verb (e.g., am, was)—to fluency first, instruction in appositives for our middle school students was errorless after two-rule sentences:

Appositives are like nonrestrictive relative clauses using which or who and a linking verb. However, in an appositive, the relative pronoun and linking verb are left out.
With only three examples, all five learners so instructed immediately began fluency building in opposites. No learner ever made an error.

How about debating? Morningside begins with argumentation rules from one of Engelmann’s Direct Instruction programs, like “Just because two things happen at the same time doesn’t mean one causes the other” (Engelmann, Manner, & Haddox, 1980). One rule is taught at a time. Learners apply the rules to short passages that follow or violate the rules:

The rooster crows on my farm every morning before the sun rises. I think I better bring him with me on my trip to New York City. They don’t have roosters there, so the sun may rise later than usual, if at all.

Argumentation rules are cumulatively programmed. Learners eventually catch the violations of many rules simultaneously in lengthy prose passages through discrimination training procedures (e.g., “What argument rule does the passage violate? How do you know? Is a rule broken in this passage? How about this one? Which one?” and so on).

Learners also build these skills almost to their reading rates. For example, a learner who can read 100 words per minute should be able to detect faulty logic in passages at his reading rate divided by 1.2, to account for covert reasoning skills (a little “thinking time”). Thus, 100 divided by 1.2 = 80 words of faulty logic detection per minute. Such automaticity guarantees retention of the skill and thereby its immediate availability for combination with related debating skills to form a new and complex composite skill. When skills are not at our fingertips they may be temporarily forgotten, or may occur only after a long delay, as when we get into bed and remember how we could have countered a colleague’s argument earlier that morning.

The debating instructional program gradually shifts from written passages to vocal statements requiring listening skills. Finally, the rules of debating protocol are learned by discrimination training with examples and nonexamples and cumulative programming. Learners serve as debate referees who catch violations of debating rules at higher and higher frequencies in live simulations, before they practice them on their own.

As in the algebra factoring problem, the complex repertoire, seen in the act of actual debating, is a function of simpler component skills. In our approach, as skills get more complex they actually get easier to learn, because they are combinations of simpler high-frequency repertoires. Because the more complex repertoires are easier to learn, they are also easier to teach. The tendency is to add more interventions, more directions, more teaching to complex situations. But our experience has taught us that this is not necessary. Morningside teachers do not follow elaborate algorithms or programmed sequences to teach debating. In its later stages, teaching debating is about guiding or coaching—like inserting brief tips and quips to steer an ongoing, complex, generative repertoire when it goes off-course. Intensive, teacher-directed instruction occurs in the early stages, when component skills are learned.

Contingency Adduction

Component skills, initially shaped under separate circumstances, may be recruited in a substantially different context into a new composite skill. Andronis and Layng call this sudden combination of component elements contingency adduction (Andronis, 1983; Andronis, Goldiamond, & Layng, 1983; Layng & Andronis, 1984; Johnson & Layng, 1992). The examples of factoring equations, sentence writing, and debating illustrate contingency adduction. The Morningside Model of Generative Instruction is itself an instance of adduction from teaching repertoires that embodied applied experimental science, frequency measurement, a focus on multiple learning processes, and cumulative programming of sequences of component skills, derived from component/composite analyses, and established through discrimination training. All of these examples of contingency adduction illustrate the rearranging of existing repertoires (after Ferster, 1965) through rules, prompts, and activities.

When teachers use the Morningside Model, they need to be on the lookout for an increase in unintended contingency adduction. Learner repertoires may combine in ways other than those planned. The school environment may interact with and adduce repertoires without any rules or instruction! An example of unintended contingency adduction occurred in our adult
literacy program at Malcolm X College (Johnson & Layng, 1992; Snyder, 1992).

At one point in *Morningside Mathematics* (Johnson & Streck, 1993), learners are introduced to word problems involving fractions. This is a terrifyingly difficult juncture for most learners, as many of us who never really mastered the fractions word problem skill can attest. Universal, defective conventional instructional practices prevailed in our thinking that surely no addition would occur at this juncture. Indeed, as we reported earlier (Johnson & Layng, 1992), on a course pretest of problem solving with fractions, four learners’ performance ranged from 3 to 7 problems correct out of 14. Significant component skills that were weak or nonexistent at the time of the pretest, however, were now occurring at high frequencies. These repertoire included the elements of problem solving with whole numbers and fractional computation. Now, with no instruction or even a mention of problem solving with fractions, learner performance ranged from 13 to 14 correct out of 14. Assessing for contingency addition saved teachers and learners many hours of instruction! The learners simply completed fluency-building exercises to assure the retention of this adduced repertoire.

This is why every lesson in the *Morningside Mathematics* program (Johnson & Streck, 1993) contains a short addition exercise, consisting of each of the component and composite skills to be taught in the lesson, to be sure that the learner really needs the instruction before it occurs. Since different learners bring their histories to the classroom, different numbers of them skip the instructional portion of each lesson, and either practice the skills taught in the lesson to high frequencies, or move to the next lesson if already automatic. As the program proceeds, more and more skipping occurs as an ongoing, complex, generative repertoire snowballs. We call these contingency-adding repertoire *curriculum leaps* (Johnson & Layng, 1992).

**Stability, and Fluency**

The Morningside Model of Generative Instruction is an adduction of many findings in experimental psychology over the last five decades. Increased learner contingency addition was one unintended result. Another was the discovery of criterion frequency dimensions that predict that behavior will be retained after significant periods of no practice, will endure over extended periods, will be easily applied in more complex situations, and will be stable in the face of distractions. The discovery of retention-endurance-application-performance-stability (Haughton, 1980, 1981) led Precision Teachers—most notably, Eric and Elizabeth Haughton, Bev Barrett, and Carl Binder—to coin and use the term fluency to describe behavior that meets REAPS. Thus began a distinction between accurate and fluent performance. Accuracy, unlike fluency, rarely predicts whether performance will be retained, endure, transfer to more complex situations, combine with other repertoires under the same contingencies, and remain stable during distracting conditions. For example, learners may be taught to spell words that follow the rule: double the final consonant before adding an ending that begins with a vowel. The typical teacher complaint is that many learners, even those who spell the words with 100% accuracy on the Friday spelling test, misspell them when writing their compositions. This occurs because the new skill is accurate but not fluent and can therefore be disrupted when it must occur along with other skills or in new situations.

The discovery of REAPS led many Precision Teachers to abandon goal setting and competency defining by norm-based frequency criteria. Three norm-based criteria have been used most often. One derives the average performance in a school or work setting, such as the rate of math facts per minute of all fifth-graders at a certain school or district. A second method derives the average from people judged to be "truly competent," such as all kids scoring above the 90th percentile on the California Achievement Test in Math Computation at a certain school or district. A third method derives the average rate of math facts per minute of people who choose a certain career, such as all tellers at all branches of U.S. Bank. REAPS significantly altered the selection of criterion rates by focusing on rates of math facts that ensure retention, endurance, transfer, and stability.

Seven Tenets of the Morningside Model These two discoveries—contingency addition and REAPS—were unintended additions that crys-
tallized the seven tenets of the Morningside Model of Generative Instruction, illustrated in Figure 14.3.

1. Identify the component elements of instructional objectives.
2. Measure their frequency until true mastery, defined by REAPS, reached (Binder, 1988).
3. Establish a component behavior through highly interactive, contingent exchanges between learner and teacher, until behavior stays accurate at gradually increasing frequencies.
4. Build the component skills to fluency aims to ensure remembering.
5. Build the endurance of component skills that are repeated in succession en masse in the real world.
6. Include application activities that allow multiple component skills to combine in ways that define the higher-level complex activities of an expert in a field.
7. Alter the procedures for implementing the Morningside Model according to the data collected.

These are seven tenets, not procedures. A range of possible procedures can be used to achieve each step. The arrows next to the boxes in Figure 14.3 also indicate that procedures for meeting the goal of each step could be implemented in overlapping fashion. For example, some learners could begin building fluency while still establishing their skills; others need to wait to build fluency until establishment is complete. Individual-learner performance data should dictate which procedures to use to meet the goals of a step, when work on a new step should begin, and when return to a previous step for more work is warranted.

The simple-to-complex sequence of tasks learners encounter in the Morningside Model contrasts sharply with currently popular cognitive science and whole language approaches. These methods attempt to use complex activities to teach component elements. For example, debating is used to teach argumentation, and conducting a scientific experiment is used to teach observation skills. Indeed, cognitive science approaches may not bother with the component elements.
at all (e.g., Engelmann, 1992; Resnick, 1988)! Learning by activities, as illustrated by whole language and other cognitive science approaches to teaching, stand the Morningside Model on its head!

Self-Correction and the Three-Contingency Tenet 7, the dynamic mechanism, is what makes the Morningside Model applied science. The self-correcting mechanism operates at the level of the three-contingency: the presentation of a moment of instruction, the learner’s performance at that moment of instruction, and the immediate consequences of the learner’s performance: confirmation and praise, or corrections, depending on the adequacy of the learner’s performance (Sherman & Ruskin, 1978). The self-correcting mechanism is defined by reverberations through the three-contingency. Any given presentation of information, materials, tasks, or problems, including course procedures, may or may not be appropriate to the learner’s current knowledge and skills—learner performance helps teachers adjust the presentation until the learner is successful. Likewise, learner performance determines the nature of consequences: praise or corrections. The consequences also help adjust the next moment of instruction, and so on, through cycles of presentation-performance-consequence reverberations that make the system viable for each learner.

More frequent opportunities for learner performance increase the interactivity of the teacher and the learner, reverberations through the three-contingency, and thus self-correction (see Howard, Chapter 21 in this text). Optimal interactivity, defined by reverberation frequency, depends on the complexity of the task presentation, learner performance, and performance consequence. Optimal interactivity also depends on the efficiency of learning—reverberations produced by unnecessary tasks and learner responses that occur too frequently don’t alter the presentation-performance-consequence cycle and thus delay mastery of skills. The most efficient use of the model occurs when teachers and learners take the largest instructional step that produces successful performance.

**Selectionist Versus Essentialist Applied Science**

By operating under the assumption that complex performance can be understood as a product of simpler elements, the Morningside Model is an example of a selection science, like evolutionary biology and paleontology. Selection sciences seek to find the more molecular processes that are sufficient to produce molar order (Donahoe, 1986, 1991; Palmer & Donahoe, 1992). Such sciences are in stark contrast to those Palmer and Donahoe (1992) called essentialist in character. Essentialist sciences, often typified by cognitive science, view complexity as an expression of inherent processes operating at the level of observed events. Every observation has its proposed mechanism to explain it. For example, some cognitive theories explain the activity of remembering by ascribing to it a structure (memory) that is composed of highly organized semantic networks (Palmer & Donahoe, 1992). A selectionist science, often typified by behavior analysis, explains remembering as just that—an activity that describes particular occasion-behavior relations that were initially reinforced and now occur at a later time (Palmer, 1991).

Essentialist-designed instruction attempts to teach complex skills at the same level of complexity that is observed in an expert or highly skilled performer. Indeed, instruction that is essentialist in nature often eschews any attention paid to simple components or their sequence (Resnick, 1988). Cognitive science approaches to instructional design (e.g., Stahl & Miller, 1989; Stepih, 1991), and the educational movements on which they are loosely based (e.g., whole language), exemplify this approach.

By contrast, instruction designed according to principles of selection science focuses on the simple elements that comprise complex behavior (Layng, 1988, 1989, 1991). When the elements occur at high frequencies, activities, games, and simulations can be arranged to promote the addition of complex repertoires. The Morningside Model exemplifies this approach. *It assumes that learning and teaching get easier, not harder.* It is only the accumulation of weak component skills that makes learning harder and harder. As we noted in an earlier paper (Johnson & Layng, 1992), of the nearly 10 million learners who make it to high school mathematics courses each year, only 800 go on to earn doctorates in math (Mullis et al., 1991). Cumulative ignorance may be a primary cause of the fallout. For most of us, studying calculus is like climbing a mountain with a bag of bricks on our
back, each brick representing a weak component skill. When instruction is designed from the bottom up, people may be able to learn calculus at a cocktail party on a napkin!

A selectionist approach also calls into serious question most tutoring practices and remedial approaches to learning. Learners who are tutored almost invariably have deficient component repertoires, yet are kept afloat in their studies by tutors who focus on the complex repertoires needed for next week’s chemistry or history test and neglect the very component skills that would make addition of the complex skills likely. The problem is that learners move through the educational system based on their age and on the credits they have accumulated, not on their competencies. The time available to study for next week’s chemistry test makes it unlikely that either the tutor or the learner will focus on learning any deficient component skills needed for the test.

An insidious problem results from the educational establishment’s developmentalism (see Stone, Chapter 6 in this text). Learners react emotionally to the suggestion that they are not appropriately placed in a particular academic sequence based on their age or the time they have spent in school. Eric and Elizabeth Haughton met much resistance from McGill University students to their approach to helping learners who were doing poorly in calculus. Students wanted help in differential equations, not number-writing skills, math facts, adding, and the like. However, with no tutoring in calculus and instead focusing on simple component elements that were deficient, learners substantially improved their calculus grades. The problem presented is not always the problem to solve!

**Daily Operation of a Class Period or Course**

**Physical Space**

Figure 14.4 shows a typical arrangement of a Mo-ningside classroom. At station 1, learners work with a teacher in small groups to establish new component skills. There is a desk or at least bookshelves at station 1 for the teacher to keep materials for immediate use. At station 5, learners build fluency individually, in pairs, or in triads, and may work with a fluency coach, who may be the teacher, a teacher’s aide, or an ad-

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**Figure 14.4.** Recommended floor plan.
vanced learner. Somewhere in the classroom, each learner has a personal shelf or cubby space to store materials. In larger settings, learners may have personal desks at which to study or an area for self-study. In applications with children and youth, there is an area, 6-7, for leisure activities. The area contains activities for reinforcement, such as construction toys, computer games, cards, books, puzzles, and board games. Children earn points throughout the class or school day that can be exchanged throughout the class or day for minutes in the leisure-time activities area.

**Personnel and Their Roles**

In addition to designing instruction and teaching new skills, instructors usually serve as supervisors of the system, making sure materials are readily available, recordkeeping is organized and up-to-date, and daily operation is smooth, especially in making databased adjustments for learners. Supervisors also monitor their staff in vivo and provide written and oral feedback on their performance.

In addition to the instructor, learners are assisted by coaches before working by themselves and with each other to build their skills to fluency. In programs for children and youth, coaches can be the teacher, teacher aides, parents, or other paraprofessionals skilled in the subject matter. Coaches can also be learners in higher grades or otherwise advanced in the subject matter, in a kind of cross-age tutoring (see Miller, Barbeta, & Heron, Chapter 20 in this book). Ultimately, coaches need to come from the ranks of the learners in the program.

In programs for college and adult learning, coaches can be the teachers themselves or tutors hired by a university, college, or learning center. As with children and youth, coaches can be advanced students working for credits; eventually learners in the course can dominate coaching.

Much has been written about *peer coaching*, particularly at the college level (Johnson & Ruskin, 1977; Sherman, Ruskin, & Semb, 1982). Strain (1981) edited a comprehensive book on the use of children and youth peers as classroom behavior-change agents. Unfortunately, almost nothing has been written about the minutiae of coaching to increase skill frequency to fluency aims. The procedures involved in training peer coaching are beyond the scope of this paper. The job description is clear, however. Coaches increase the opportunity for practice, measurement, and feedback and contribute significantly to the self-correcting reverberations of the system. They help maximize learner and teacher productivity by increasing the number of performances that can be monitored, praised, and corrected. Coaches can also be the incidental locus for learning organizational, observational, and learning-to-learn skills. Coaches are also the source of interpersonal social reinforcers in the system, and are often the best source for adjusting the system for the learner's benefit. Coaches can be formally trained to provide all these services.

The best peer coaches have skills that overlap with the learners' current skills to a far greater degree than an expert such as the instructor (Skinner, 1957; Johnson, 1977; Johnson & Ruskin, 1977). Overlapping repertoires produce more fine-grained, frequent changes, and learning proceeds at a more rapid pace. Athletes show such judicious selection of coaches when they select their practice partners from those who play just a little better than they do. Many of the staff in the adult learning program at Malcolm X College built their component teaching skills in shifts to positions of more responsibility in the system. One person recently moved in steps from coach to supervisor, another from adult literacy student to coach.

**Daily Operational Procedures**

The following is a thumbnail sketch of 14 daily operational procedures employed in a typical Morningside Model classroom. The suggested time frames assume that 60 minutes are available each day.

1. Lesson plan. Divide up the daily course or skill area class period into three parts. All three parts can occur simultaneously, but for different learners at different times. Each of these three daily segments can be divided into several specific tracks, each focusing on a different skill. Every day the teacher must map the course the learner is to follow the next day, based on careful analysis of the learner's performance that day. We strongly recommend daily classes over classes that meet only one or two days per week. The more
infrequently a course or skill is studied, the less efficient the learner's daily map may be, due to variations in dysfluent skills from one class period to the next, and the slower the learner's progress will be.

2. Precision placement. Pretesting learners frequently keeps the instructor current on what skills they need to learn. Learners bring entering repertoires to a course or class, and new repertoires may be added during a course of study. A beginning course or program pretest will give information about entering repertoires. Individual lesson pretests will tell more details about entering behavior, plus any new repertoires that have been added since the course began. No learners should participate in an instructional episode if they already have the skills to be taught. The composition of instructional groups should change from day to day, according to pretesting results. Careful pretesting can greatly improve the efficiency of learning and teaching, and may play a large role in the grade-level gains that we have reported thus far.

3. Public progress records. Entering and added behavior can be marked on a public wall chart that lists the learners on the vertical axis and the lessons to be mastered on the horizontal axis. Teachers can refer to the chart to call only those learners to the instructional table who need to learn the skills taught in the lesson. As learners establish and build fluency on the skills in the lessons, additional marks can be made on the chart. At Malcolm X College, learners, with their instructors or coaches, make a small circle in the cell of a lesson when they have participated in instruction. They make the circle larger after they have successfully built some frequency with coach support and then completely color in the cell when they reach the fluency aim. The progress chart is also used as the occasion for daily meetings between the instructor and coaches. Public progress records also help maintain the pace (Johnson & Ruskin, 1977) and quality (Van Houten, 1980) of performance.

4. Tool skill fluency. Each course or skill has a number of fundamental component elements or tool skills. For example, an analysis of addition and subtraction of whole numbers reveals nine tool skills that are fundamental to the majority of their concepts and operations, including number writing and reading, math facts, and math language skills with symbols and terms (Johnson & Streek, 1993). Reading has prerequisite pointing, decoding, and scanning skills. Writing has critical transcription and dictation tool skills, with both pen and paper and computer keyboards. Studying has critical organizational and cooperative learning tool skills.

Learners should be given ample time to practice three to four tool skills daily. Typically, five to ten minutes is sufficient practice to make a noticeable improvement in one tool skill compared to the previous day.

5. Establishing new skills. In the Momentide Model, instructors provide highly interactive lessons to establish new skills and knowledge. Lessons are taught to small groups of no more than 12, and only to those who need them. Instructors examine the public wall chart for a particular lesson and call only the learners who have blank cells. The other learners practice the objectives until they are fluent and work on other fluency assignments.

At least three instructional procedures contain the ingredients necessary for establishing new skills efficiently. The first is Engelmann's Direct Instruction (DI) (e.g., Engelmann & Carine, 1982; Kinder & Carine, 1991). The second is Programmed Instruction (PI) (e.g., Markle, 1991; Gilbert, 1962; Evans, Homme, & Glaser, 1962). The third is Keller and Sherman's Personalized System of Instruction (PSI) (Keller, 1968; Sherman & Ruskin, 1978; Sherman, Ruskin, & Semb, 1982). We will describe our applications of each of these instructional strategies in turn.

In Direct Instruction at Momentide, a small group of learners gather with a teacher at a horseshoe-shaped table for 20 to 30 minutes. During that time, the teacher stands in front of the group, either in front of a blackboard or next to an overhead projector. Next to the teacher on a music stand is a scripted instructional presentation, which he or she refers to when necessary. The script provides the exact lines the teacher will use for instruction. The lines are relatively brief, allowing learners to chorally respond to the teacher on signal approximately 10 times a
minute, an excellent frequency for beginning skill establishment.

Rapid recognition of progress and correction of errors occurs throughout the instructional episode, maximizing the self-correcting mechanism of the system at this important step. Instructors teach two to three DI groups in a given subject per day.

The learners' choral responding in interaction with the instructor during DI lessons is very rhythmic and enthusiastic, like singing and dancing in the classroom. Children, youth, and adults alike enjoy and learn. Various parents and community leaders in Chicago's African American community have likened it to the "call and response" African oral tradition that is evident in some church services even today! Reward, Coulson, and Narayan (1989) provided an excellent introduction to choral responding.

Direct Instruction teaching procedures comprise a complex system that requires training in its own right. Kinder and Carnine (1991) provided an excellent introduction to gaining competence in Direct Instruction. Janie DeNapoli and Paul McKinney (1992, of J/P Associates, have created excellent DI training videotapes.

Direct Instruction procedures are highly teacher directed. The live, oral manner of presentation is a very efficient approach to teaching basic skills like reading, arithmetic, and writing. As learners increase their competency in these basic skills, instruction can become less teacher dependent while maintaining a highly interactive nature. Programmed Instruction, or textbook/study guide concoctions typical of PSI courses, are examples.

In Programmed Instruction the teacher's scripted lines are text to which learners respond in writing at their own pace (Marke, 1969,1991; Skinner, 1954,1968). The text may be in a book, computer program, or audiovisual format. Each response the learner makes is followed by an answer to which learners compare their answers. Sometimes the program will direct the learner to specific remedial sequences if an error was made.

In PSI courses teachers write a study guide to accompany standard text (Keller, 1968; Sherman & Ruskin, 1978; Sherman, Ruskin, & Semb, 1982). The study guide contains tasks for the learners to complete as they study the text. Usually these tasks are not as bite-sized as the tasks presented in programmed instruction sequences—there may be only 2 or 3 tasks presented per textbook page. The study guide also contains clarifications, corrections, and additions to text, and is most successfully presented in a personalized framework, as if a tutor or study partner were present when the learner is studying the text. In most PSI courses learners do not receive confirmation of their responses to the teacher's tasks; they must take the initiative to clarify any problems they have with course personnel before testing. This relatively sophisticated format for learning puts PSI procedures at the other end of the continuum of establishing procedures: Direct Instruction-Programmed Instruction-Personalized System of Instruction.

6. Sprinting. Immediately following Direct, Programmed, and/or Personalized Instruction, learners put the finishing touches on establishing new skills by engaging in sprinting exercises for five to ten minutes with a coach (Johnson & Layng, 1992). The coach may be the instructor who continues this work with the learners, or another person who steps in. A number of learners may test out of Direct, Programmed, or Personalized Instruction, and go directly to sprinting.

During sprinting, learners gradually increase the frequency of the new component skills that they have learned, and the coach ensures that these skills don't break down as frequency is increased from 10 to 20 or more per minute. Coaches introduce activities such as, "How many can you complete in twenty seconds? Let's see. Then we'll see if you can get more done in the next round," or "Let's see how long it takes you to complete three of these. Say 'done' when you're done. I'll tell you the time it took you. You write that down. We'll see if you can beat that time in the next round." As learners practice, they record their frequencies and/or durations. Coaches rotate among learners as they put some rate behind their skills, noting and changing elements of their practice that slow them down, and further firming their accuracy if errors begin to occur as their rates increase. Coaches let the learners who are doubling their frequencies leave the group to fluency-build with one another; they continue to coach only those learners who need further guided practice.
Establishing involves not only making component skills firm (accurate at 10 or so per minute), but also setting them in celeration motion, to new frequencies that predict retention, endurance, and application. Thus, establishing is a combination of Direct Instruction and Precision Teaching, with their foci on accuracy and charted daily frequencies of performance (Kinder & Camine, 1991; Binder & Watkins, 1990; Lindsley, 1972,1990). Establishing charts the course of initial lower frequencies of performance and helps guarantee that steep celerations will occur with further practice.

7. Fluency building with peer coaches. Once learners have doubled or tripled their rates in short spurts without making errors, they engage in timed practice with each other to build their frequencies until they meet fluency aims. Fluency aims are those frequency ranges that predict retention, endurance, and application. For example, the fluency aim for math facts is 80 to 100 per minute; for oral reading 200 to 250 words per minute; for solving math word problems 12 to 15 per minute, for writing paragraphs 20 to 25 words per minute. Miller and Reward (1992) provided a detailed description of timed practice procedures (see also Miller, Barbetta, & Heron, Chapter 20 in this text). Visitors to a MorningSide classRoom liken sprinting and fluency building to an academic gymnasium, complete with warm-ups, sprints, longer endurance training, monitoring, coaching, stretching, and resting.

For 15 to 20 minutes each day, each pair of learners fluency-builds the skills learned in the day’s instruction, along with other recently learned skills that need more practice to be fluent. They also keep track of their progress on recording sheets. Peer-coaching procedures allow learners to become independent of teachers by the end of the course. Under these procedures, star learners emerge as fluency coaches (and instructors!). Peer coaching requires training, a description of which is beyond the scope of this paper.

Fluency building is a combination of Precision Teaching (PT), with its focus on daily timings and charting, and the Personalized System of Instruction, with its reliance on the peer as a proctor to guide individual learning. As such, it is about instruction and practice intertwined, but differently than the way they are intertwined during establishment. There, the accuracy of accelerating performance is at issue; here, the issue is celeration itself and how to increase it.

Instructional materials. Sprinting and fluency building require multiple timers with features that allow the timing of duration and the length of a specific period. The timers must electronically signal the latter, with a beep or ring, to prevent the learner from having to continually check the timer while completing the exercise. (So stop watches and sandglasses are out.)

Teachers must also make a great many copies of practice exercises, because each learner will complete multiple timings, over several days, to reach a fluency aim. An alternative is to cover a practice sheet with Mylar. By using a hard-tipped marking pen, each timed practice can be easily erased with a moist sponge.

Design. As in establishing skills, many instructional design considerations should be followed to construct practice sheets and set fluency aims for them. Further description of sound instructional materials design is beyond the scope of this paper. To keep the focus on REAPS and to avoid using norm-referenced fluency standards, we offer the following beginning points.

To design a practice sheet and set a fluency aim for it, an instructor sums the basic reading and writing tool skills that the learners will be required to use while completing the tasks to be practiced and divides this number by 1.2 to allow for a little thinking time. Consider our earlier example of building fluency with argumentation rules, in which learners identify faulty reasoning in text passages. One design option is to write 50-word passages that contain 0-2 broken rules. Learners can identify the broken rules by writing the number of the rule that the argument breaks next to the sentence that violates it. The tool-skill aim for writing numbers is 160-180 per minute. The tool skill aim for reading text is 200-250 words per minute. In a 2-minute timing, learners could read 4-5 passages and write their numbers. To allow a little think time, the teacher could set the aim at 3-4 passages per minute.
Sometimes learners are not fluent in their basic tool skills. It is extremely important for teachers to make tool-skill fluency building a priority for these learners. The rate of learning more complex skills may be impossible without fluent tool skills. Complex skill learning may also accelerate with fluent tool skills (Gagne & Foster, 1949; Haughton, 1972; Johnson & Layng, 1992).

While learners with deficient tool skills are building tool-skill rates, teachers can set fluency aims by dividing their current rates by 1.2. For example, if a learner reads at 150 words per minute, the aim for the argumentation rule task would be 2-3 passages per minute. This procedure is chancy, however; learners' argumentation skills might not automatically increase with their tool-skill increases. If they do not, the learners will not have reached fluency and the skill may be forgotten. Periodic checks during tool-skill building will reveal whether additional practice with argumentation rules is necessary.

Several versions of a fluency practice sheet should be designed to avoid memorization. The learner responses should also be as efficient and task related as possible. We could ask learners to write out the broken argumentation rule each time faulty logic in the passage occurs, but practice in writing the rule is not the point of the exercise; catching faulty logic is (Markle, 1991)! A minimum of page turning or cross-page referencing will guarantee that the materials themselves don't impede building of the skill. The practicing should also be learner paced, not teacher paced, for the same reasons (Binder, 1977-1983; Precision Teaching Project, 1984; White & Haring, 1980).

Using class time wisely. Figure 14.5 shows the relative proportion of time learners engage in various activities specified by the Morningside Model of Generative Instruction. Fluency building is by far the predominant activity, involving 70% or more of the learner's time, depending on what the data show. Conventional classroom time is proportioned in reverse, with about 70% spent establishing skills, 20% practicing, and 10% testing. When the authors provide training in the Morningside Model to schools, districts, and colleges, many teachers' first reaction to the "happy learner" is disbelief: "How can you spend so much time practicing? I barely cover the year's curriculum (or the course's objectives) with much more time devoted to establishing. How can you produce two to three year gains this way?" The answer lies in the inefficiency of instruction that is too-heavy in establishment. Unless learners become fluent in the skills established, they lose them. There is also far less likelihood of curriculum leaps. Learners in classrooms that are too-heavy in establishing recycle through learning and forgetting and relearning during "review" sessions. The learn-forget-review-forget cycle is far more time-consuming than Morningside's learn-it-once-and-for-all approach.

8. Standard celeration charting. In Morningside programs, learners use standard celeration charts to monitor fluency building. Learners plot the daily frequency of each skill. They also draw minimum celeration lines on their charts to show daily progress that doubles in frequency each week. They first examine their charts for yesterday's performance frequency and record it on a practice record form. Next, they set the day's progress aim by determining what frequency would keep them on or above their mini-

![Figure 14.5. The happy learner (SOURCE: adapted from a transparency by Eric and Elizabeth Haughton, 1978).](image-url)
mum celebration line, and record this information. Next, learners practice until they meet the day's progress aim. Once this occurs, the instructor or fluency coach is called to give a final timing, which verifies the achievement. The learner then plots the final timing on the chart.

Learning how to use the standard celebration chart is easy. The interested reader may consult several sources for good training (e.g., Precision Teaching Project, 1984; Pennypacker, Koenig, & Lindsley, 1972). In one article, 5-year-old Stephanie Bates tells her friends how to chart while her father takes notes (Bates & Bates, 1971).

9. Decision-making and fluency-building interventions. In most cases, timed practice itself is the intervention needed to build fluency. Sometimes, however, learners will experience performance locks (Elizabeth Haughton, personal communication, August 1978). Try as they may, they don't achieve x 2 (read "times 2") weekly progress through repeated timings. This is more often the experience of learners with learning and attention problems. There are a multitude of procedures to help learners build fluency when their performance is locked, but these are beyond the scope of this chapter. The interested reader should consult a variety of resources to gain these competencies; most notably, Haughton (1980) and Binder's (1977-1983) Data-Sharing Newsletter.

At Morningside, fluency-building interventions occur whenever learners fail to double their acceleration each week. Some of these interventions require the instructor's skills, others a coach's skills, and still others can be implemented by the learners themselves. An important goal of any Morningside program is to teach all learners to make their own interventions.

10. Clearing a backlog. It may take several days or even a week or more to reach the fluency aim of a given skill. Periodically, learners will accumulate more skills established in instructional lessons that need fluency building than there is time in the day or class period to practice, leaving no time to attend new establishing lessons. This is okay. At Morningside Academy and Malcolm X College, learners may skip a day or two of new instruction until they reach fluency on the skills established in previous days. The number of skills that constitutes a backlog and hence an instruction-skip day will vary according to the amount of time devoted to daily practice. As a general rule of thumb, each skill requires about 10 to 15 minutes of daily practice. If 45 minutes of daily practice is allotted, learners would skip instruction if they needed to practice more than four skills that day.

11. Endurance building. Some skills need to be repeated at high frequencies for longer periods than others. For example, column addition and subtraction lasts 15 minutes or more when balancing a monthly checkbook statement. Reading a chapter in a textbook may last 45 minutes or more. Editing a paper may take two hours or more. Writing or typing may occur for a whole day! We set endurance aims by multiplying the fluency aim by the number of additional minutes required for endurance. For example, our silent-reading fluency aim is 500 words per minute; our 15-minute silent-reading endurance aim is 500 x 15 = 7,500 words in 15 minutes.

Although reaching a fluency aim often predicts the skill will endure for longer periods, this is not always the case. Sometimes reaching a higher fluency aim produces endurance; other times learners need to practice the skill over the anticipated time period. (See Johnson & Layng, 1992, for a more in-depth discussion.) Judicious examination of the curriculum, particularly at composite skill junctions, is necessary to identify skills slated for endurance building. These skills should be written in their appropriate places in the sequence on the public progress charts so that the work won't be overlooked.

Sometimes learners will show endurance problems even while building fluency. For example, some children and adults diagnosed with so-called attention deficit disorder slack off in performance frequency during a one-minute timing. Teachers can ascertain suspected endurance problems during fluency building by keeping track of frequencies during successive ten-second intervals of the minute. If frequency diminishes, learners need to gradually build their rates
over successively longer intervals up to one minute. Binder, Haughton, and Van Eyk (1990) have described excellent procedures for accomplishing this.

12. Applying. Once several component skills are fluent, instructors can schedule planned activities to promote the complex and creative behaviors characteristic of experts in a field. There are at least three kinds of activities to promote such contingency adduction. The first kind promotes a relatively simple transfer of training from one context to another, as when learners apply cumulative decoding skills learned in controlled basal readers to reading newspapers and magazines. A second kind of activity promotes chaining of separately taught repertoires, as when learners consult a dictionary or thesaurus for an adjective to describe a feeling as they write a composition about the winter holiday season.

A third kind of activity promotes a recombination of components, an intertwining of behavior, as when learners debate, solve a math problem, write a research paper, create a stock exchange simulation in their classroom, or publish a classroom newspaper. Planning these latter adduction activities involves assembly of skills from multiple domains, as component skills from seemingly disparate subject areas can be brought into play. For example, creating a stock exchange involves component skills learned from mathematics, language arts (e.g., persuasive writing), organizational skills, and reference skills. With such extended sequences of instruction, learners may take six months of instruction before they are ready to design a classroom newspaper or a personal budget; they may take two or more years of a course of study before it will be fruitful to arrange a debate, or the design of a school yearbook or scientific experiment.

Games and simulations can also be scheduled to bring together component repertoires. Thiagarajan and Stolovitch (Stolovitch & Thiagarajan, 1980; Thiagarajan, 1990; Thiagarajan & Stolovitch, 1978) have written extensively on this motivating approach to applying component skills.

13. Unintended contingency adduction: Monitoring for curriculum leaps. As mentioned earlier, curriculum leaps will occur at junctures other than during planned activities, games, and simulations. Component skills will combine at odd times, in complex and unusual ways, additively or multiplicatively, to the higher complex skills exhibited by experts. Curriculum leaping will accelerate as learners progress through a course of study. Careful pretesting before each lesson will ensure that a learner doesn't miss a chance to skip instruction and accelerate progress.

14. Integrity between criteria and progress. Morningside instructors make the contingencies between reaching criterion and progress through the program explicit at each step, every minute of the day. Each reverberation through a three-term contingency, at each learning step—establishing, fluency building, endurance building, and applying—tells instructors to either go forward or to provide the extra instruction or practice necessary for learners to achieve success. Skinner (1968) estimated that 42,000 contingencies probably occurred during a 50-minute observation of his daughter’s elementary school math lesson! Adjusting the learner’s contact with the Morningside system on the basis of even a small fraction of the three-term contingency reverberations will make a big difference.

A Summary and Conclusion

Table 14.2 summarizes 14 daily operational steps to a successful implementation of the Morningside Model of Generative Instruction. Several places in the overview contained in this paper need to be magnified with greater attention to detail. Direct Instruction training, Standard Celeration Chart training, fluency-building procedures training, peer-coaching training, and instructional materials design training may all be necessary.

Besides the usual classroom materials, teachers will need timers for practice; one-third the number of learners in the program will be sufficient. Standard celeration charts are required, as well as a wall chart for marking progress through the program. If copying is at a premium, the teacher will also need sponges, Mylar, and marking pens. Since learners will perhaps be more self-directed than teachers have been used to,
Table 14.2 Summary of daily procedures in the Morningside Model of Generative Instruction

1. Arrange each class period to allow for new instruction, tool skill fluency building, and sprinting/fluency building of skills recently established.
2. Pretest learners at the beginning of the course and before each lesson. Place students in instruction precisely matched to their current performance levels.
3. Keep public progress records to direct daily learner activities and reinforce progress.
4. Build prerequisite tool skills to high frequencies, to facilitate the mastery of curriculum objectives.
5. Use Direct Instruction to establish new skills with learners who don't have fluent reading, writing, and studying skills; use programmed instruction, or texts with study guides in a PSI format with experienced learners.
6. Coach the gradual beginning of skill acceleration with sprinting exercises.
7. Use peer coaching and testing to build skills to fluency aims, those levels of performance that guarantee retention, endurance, and application following significant periods of no practice.
8. Monitor fluency building on standard celeration charts.
9. Use acceleration criteria: change fluency-building procedures whenever skills are not doubling their rates per week.
10. Include catchup days of all practice and no instruction whenever a learner gets backlogged.
11. Build skill endurance on certain skills and sets of component skills.
12. Arrange application activities for contingency celeration.
13. Skip instruction when students make curriculum leaps.
14. Guarantee that the contingencies for reaching criterion are met before learners move forward in the program—every minute of the day.

the teachers should make sure that the learners don't have to ask for materials.

Instructors have a threefold job during class sessions: alternating between teaching from scripts, troubleshooting with learners who need special fluency-building procedures, during sprinting or peer fluency building, and reinforcing learner-coach and learner-learner interactions. For a year the teacher will be busier teaching than ever before. Eventually, however, the system will perpetuate itself and the teacher will find that very little daily preparation is needed. If the teacher has never taught with others, there will be a need to adjust to the cooperative nature of the Morningside Model. Instructors have three levels of meetings with their coaches: daily meetings, using the wall chart as a point of departure; weekly work sessions, with the wall chart and standard celeration charts governing their interactions; and monthly training sessions to teach new skills.

Anything can be taught with the Morningside Model. Its use, however, may be circumscribed by three factors: (1) local policies and procedures that place constraints on curriculum, teaching methods, or the availability and use of paraprofessionals and advanced learners; (2) courses in which goals cannot be specified; and (3) courses designed to select, rank, or sort learners (Sherman & Ruskin, 1978).

We have argued that certain generative effects—occurring as they do without direct intervention and often described as intuitive leaps, insight, problem solving, sudden realization, and expert knowledge—are a product of the contingency addition of interacting alternative contingency sets that have in the past occurred independently at high frequencies. Although we have accumulating evidence to support our argument, the research effort and its application is in its infancy. Many questions still need to be answered, and more still have to be asked. The model we present here is designed to promote this research effort, increase its efficiency, and make it available to everyone.

References


