

The Sciences of Learning, Instruction, and Assessment as Underpinnings of the Morningside Model of Generative Instruction

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Abstract

This paper focuses on a subset of the practices that have created the powerful learning technology developed and disseminated by Morningside Academy in Seattle, Washington, U.S.A. We briefly describe this technology, known as the Morningside Model of Generative Instruction, and tell how it builds on the selectionist approach of B. F. Skinner and the pragmatic approach of John Dewey. We also describe the critical role Precision Teaching plays at Morningside Academy and its dependence on findings from the science of learning and the science of instruction, including placement of learners, task analysis, content analysis, instructional protocols, and principles of instructional design. Last, we acknowledge the symbiotic relation between effective Direct Instruction programs that teach skills to accuracy levels and Precision Teaching, which takes these accurate repertoires and systematically turns them into high frequency performances that take on the character of *fluent* repertoires. Over time, using Precision Teaching across multiple and successive repertoires also creates more agile learners.

Keywords: Assessment, Direct Instruction, Instruction, Learning, Precision Teaching.

Las Ciencias de Aprendizaje, Instrucción y Evaluación como Cimientos de la Instrucción Generativa del Modelo Morningside

Resumen

Este trabajo se enfoca en una serie de prácticas que han creado la poderosa tecnología de aprendizaje desarrollada y diseminada por la Academia Morningside en Seattle, Washington, E. U. Se describe brevemente dicha tecnología, conocida como el Modelo Generativo de Instrucción Morningside y se menciona cómo se construyó bajo la aproximación seleccionista de B. F. Skinner y la aproximación pragmática de John Dewey. También se describe el rol crítico que la Instrucción de Precisión juega en la Academia Morningside y su dependencia en hallazgos de la ciencia del aprendizaje y en la ciencia de la instrucción, incluyendo el papel de los aprendices, el análisis de tareas, el análisis de contenido, los protocolos instruccionales y los principios del diseño instruccional. Finalmente, se reconoce la relación simbiótica entre los programas de Instrucción Directa efectiva, que enseñan habilidades para lograr niveles de precisión y la Enseñanza de Precisión, que considera dichos repertorios precisos y sistemáticamente los convierte en ejecuciones de alta frecuencia que tienen el carácter de repertorios fluidos. Con el paso del tiempo, usar la Enseñanza de Precisión a través de múltiples repertorios sucesivos también crea aprendices más ágiles.

Palabras Clave: Evaluación, Instrucción Directa, Instrucción, Aprendizaje, Enseñanza de Precisión.

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Practices derived from the learning sciences and the philosophical underpinnings that guide them are combined to create a powerful learning technology at Morningside Academy in Seattle, Washington, U.S.A. This technology, known as the Morningside Model of Generative Instruction (MMGI), has resulted in changed learning trajectories for over 1,000 learners at the Academy and over 30,000 students in over 130 schools and agencies in the United States and Canada through the Morningside Teachers' Academy, the Morningside Summer School Institute, and countless presentations at the annual conference of the Association for Behavior Analysis International and other similar conferences.

Morningside Academy is well known as a Precision Teaching (PT) school. However, PT technology works only to the degree that it is faithful to the philosophical underpinnings of the learning sciences, analysis of the material to be taught, and elegant instruction that constitute the MMGI. The MMGI builds on five important streams of research: (a) generativity and contingency adduction; (b) content analysis, instructional design, and implementation; (c) program placement and modification based on continuous measurement; (d) classroom organization and management; and (e) critical thinking, reasoning, problem solving, and self-regulated decision-making (Johnson & Street, 2004b).

Writing for the Society for the Teaching of Psychology, Benassi, Overson, and Hakala (2014) describe "the interplay between the science of learning, the science of instruction, and the science of assessment" (p. 3) in the learning sciences, an excellent description of the work that is done at Morningside Academy. Morningside Academy is—to borrow from a taxonomy described by Jim Johnston (1996)—a third level research institution. That is, it is primarily service-oriented and rarely conducts basic research. Still, the Morningside leadership team and faculty are guided by a well-honed understanding and application of the basic and applied research related to these three sciences. In this article, we describe the ways in which these three sciences inform practices at Morningside, but we begin with the philosophical tenets that undergird them.

Philosophical Underpinnings

Morningside Academy's team is conversant with the science of learning and its philosophical roots. The Morningside Model of Generative Instruction blends the selectionist approach of B. F. Skinner with the pragmatic approach of John Dewey. Skinner (1969) "draws a parallel between the emergence of complex behavioral repertoires and the emergence of more complex and variably functional forms in evolutionary biology. The environment selects simple forms, and a more complex entity gradually emerges" (Johnson & Street, 2004b, p. 20). At Morningside, we see the selectionist principle as establishing the repertoire of the learner that forms the building blocks for more complex repertoires. As these building blocks become fluent, that is, "accurate, speedy, durable, smooth, and useful" (Johnson & Street, 2004b, p. 20), the selectionist principle builds more complex intellectual skills by combining the building blocks in ways that meet learners' learning needs.

We also draw heavily on the pragmatic functional approach espoused by John Dewey (1896, 1976, 1981, 1986). One of several Dewey tenets that underpin

MMGI is his emphasis on “natural influences over learning, taken from the student’s current activity, goals, and value systems” (Johnson & Street, 2004b, p. 21). Morningside’s process becomes organic as a student moves up the curriculum ladders. After mastering a core foundation of basic skills, when areas of interest that are important to one or more learners emerge for which their basic repertoires are not yet fully seeded or when learners are asking why a particular basic skill is important, the teacher may analyze the area(s) of interest or next steps in the curriculum to determine ways that learners’ current repertoires overlap with them and provide prompts that enable learners to engage successfully in the activities. For more on the organic approach, see Johnson and Street (2013).

In addition, based on the requirement of The National Council for Accreditation of Teacher Education’s (NCATE, 2008) for U.S. schools of education to specify the *conceptual framework* that underlies their educational preparation programs, two pseudo-philosophical positions have become prominent: constructivism and instructivism. Instructivism is a molecular approach to education, while constructivism is a molar approach. At Morningside Academy, we find the molecular approach which instructivism promotes to be advantageous for teaching new behaviors. However, we also find that looking at educational programming through the lens of the constructivists keeps Dewey’s concern for natural influences over learning in the mix. We use instructivist practices to seed the learner’s repertoire and thus prepare them to participate in constructivist practices such as Project-Based Learning. In other words, we attempt to turn the upside-down constructivist world that begins with composite, real-world activities right side up by seeding repertoires with component skills so that learners are competent to participate fully in the composite constructivist world.

The philosophies that underpin educational practice are thought-provoking, however, the focus at Morningside Academy is on ensuring that learners who begin the program lagging behind same-age peers are provided instruction that brings them to, or ahead of, the level of their peers, makes them good and productive scholars, and improves their scores on standardized tests. In fact, parents of learners enrolled at Morningside are offered money-back guarantees for their children’s tuition if their children do not gain at least two years on standardized tests for one year of participation in their area of greatest weakness. It is evidence of the effectiveness of its teaching technologies that, during the 34-year history of this pledge, Morningside has returned less than one percent of tuition. To ensure that the promised gains occur, Morningside’s team relies on relevant findings from the science of learning, the science of instruction, and the science of assessment.

Principles Derived From the Science of Learning

Findings from the science of learning are routinely incorporated in Morningside’s classrooms. First, teachers draw on the power of reinforcement, specifically, and feedback, generally. For example, Morningside’s Daily Support Card (Johnson & Street, 2004b), the conduit for distributing points for good performance, serves as a daily form of communication among learner, parent, and

teacher. Teachers provide a pre-determined maximum number of points based on each of four categories of behavior—academic, learning skills, organization, and citizenship. Each teacher defines and exemplifies rules related to each category early in the year and awards points immediately when desirable behavior is evident. Learners take their support cards home each day, and their parents have the opportunity to reward their hard work as well. When parents provide reinforcement from their own menu at home for work well done, it further strengthens the behaviors that will ultimately recruit reinforcement from others.

Second, observing a lesson at Morningside reveals that teachers apply findings related to the selection of effective prompts that can be withdrawn systematically and easily (MacDuff, Krantz, & McClannahan, 2001). Teachers are also conversant with the applied research on shaping (Pryor, 1999), discrimination and generalization (Tiemann & Markle, 1990), errorless learning (Terrace, 1963), stimulus control (Mayer, Sulzer-Azaroff, & Wallace, 2012), establishing and motivating operations (Laraway, Snyderski, Michael, & Poling, 2003; Michael, 1982), and schedules of reinforcement (Vargas, 2013).

A very important principle derived from the science of learning is the delayed prompting procedure. It underpins Morningside's reading and other comprehension procedures where learners need to make sense of what they have read or heard and apply it elsewhere. Based on the work of Touchette and Howard (1984), by delaying prompts for six seconds, learners are provided the least amount of prompting needed to respond correctly to a question. This reduces prompt dependence and the need to fade prompts later. It also provides an opportunity for learners to "show what they know" before help is provided.

Morningside teachers also focus on teaching students how to learn on their own. Many parents who brought their children to Morningside only to catch them up find that a more important result occurred: their children became effective learners. Effective learners demonstrate *generativity*. In a generative process, behaviors learned under prior conditions or circumstances are *recruited* by new, very different conditions to form new combinations or blends that serve a new or different function or outcome in a new context and in the absence of instruction. Generative Instruction involves arranging conditions that produce novel and complex behaviors, in new circumstances, without directly teaching them. (See examples that appear later in the article.)

To promote generativity, Morningside teachers apply strategy and problem solving research from the science of learning by arranging contingencies that recruit current relevant repertoires learned under one set of conditions for new purposes. (See, for example, Andronis, Layng, & Goldiamond, 1997; Epstein, 1991). In some circumstances, there is an obvious connection between what has been learned and what is now required, which improves the likelihood of successful recruiting. To promote more distant generative connections, Morningside has been influenced by the work of Whimbey (1975) and Whimbey and Lochhead, (1991) on reasoning and problem solving. Morningside's principal has adapted Whimbey and Lochhead's Think Aloud Pair Problem Solving approach for learners at Morningside, who learn to recruit current relevant

repertoires for figuring out how to solve a problem and complete novel tasks in the absence of instruction (Robbins, 2011, 2014).

Principles Derived From the Science of Instruction

There are at least five aspects of the science of instruction that play a prominent role in Morningside practices. They include a) *placement of learners* in groups for instruction; b) *task analysis*; c) *content analysis*; d) *instructional protocols* and e) *principles of instructional design*.

We briefly describe each in turn though, in practice, they are much more organically applied.

Learner Placement

The Joplin Plan, which was originally developed to facilitate gains in reading (Wahlberg, Reynolds, & Wang, 2004) is used at Morningside for placement of learners in all academic areas (Kulik, 2004). It is an ability grouping approach in which learners are placed with those whose skill levels are similar to their own. The Joplin Plan also facilitates another important aspect of the Morningside approach, peer coaching, which we describe later.

Task Analysis

In behavioral circles, task analysis began as a systematic way to dissect a specific task into the skills needed to perform it and the order in which the skills should be performed for maximum efficiency. Mayer et al. (2012) define task analysis as “breaking down a complex skill, job, or behavior chain into its component behaviors, sub-skills, or subtasks.” (p. 710). The Morningside team conducts this kind of task analysis when the situation calls for it, but it specializes in content-area level analyses using an approach described by Eric Haughton (1972).

Haughton, who worked with severely mentally handicapped adults, found it most effective to identify three sets of skills his learners needed to function in their environment: tool skills, component skills, and composite skills. *Tool skills* are the basic skills in a field, those which are necessary to acquire higher-level skills. Haughton specifically compiled evidence that there were 12 self-help tool skills—he called them the “big 6 plus 6” (DesJardins, 1980). Haughton’s second-level skill set are *component skills*—skills which depend on one or more tool skills. *Composite skills* are “authentic, higher-level performances that socially validate a learner’s mastery of a content area” (Johnson & Street, 2013, p. 41; also see Johnson & Street (2013) for our analyses of reading, writing, and arithmetic.)

For example, in teaching reading, a tool skill might be accurately saying the sound(s) of each letter presented individually and in combinations. A component skill might be phonetically reading regular one to three syllable words. A related composite skill might be reading passages with expression. The categorization of

an objective as tool, component, or composite depends not only on the content being analyzed but also on the incoming skill of the learner.

Haughton (1980) also introduced the concept of learning channels. The learning channel describes the way in which the learner comes in contact with a stimulus (an input) and the way in which the response is to be composed (an output). Haughton identified seven potential inputs including, among others, taste, see, and hear, and eleven potential outputs including, among others, mark, match, say, do, and write. Thus a learner might see (input) and then say (output) the names of letters of the alphabet (abbreviated "see/say" names of letters of the alphabet) or hear/say words composed of sounds presented one at a time. Haughton believed, based on evidence he had compiled, that a learner isn't automatically able to transfer across learning channels. That is, because they can accurately see/write math facts doesn't necessarily mean they can hear/say math facts.

Content Analysis

Content analysis categorizes the skills that have been identified in a task analysis into different types that are best served by differing instructional and practice procedures. The two educators who are credited with first providing content analysis taxonomies are Bloom (1956a, 1956b) and Gagné (1965). Their work was followed by that of Engelmann and Carnine (1982) and Tiemann and Markle (1978, 1990). The Morningside team finds Tiemann and Markle's approach to be the most user-friendly of these four approaches. Tiemann and Markle posit nine types of learning and provide the reader with specific steps and sample programs for encouraging learning of each. The three umbrella terms in their model are psychomotor learning, simple cognitive learning, and complex cognitive learning. Psychomotor learning is made up of single responses, response chains, and kinesthetic repertoires; simple cognitive learning consists of associations, (verbal) sequences, and verbal repertoires; and complex cognitive learning is made up of concepts, principle applying, and strategizing.

Instructional Protocols

Instructional protocols is a generic name for the manner in which concrete tasks that have pre-specified outcomes are presented to learners. Gilbert (1962a, 1962b) established the four-step protocol known as *mathetics*, which continues to inform instructional design today. In Gilbert's protocol, the teacher first *demonstrates* the skill. Second, the teacher *guides* the learner through the use of prompts. Gilbert called the third step *release*, in which the teacher provides the learner with an opportunity to perform the skill on his or her own. The last step, *delayed release* or *spontaneous completion*, occurs after either time or other items are interposed with the target before returning to it. Gilbert's mathetics was recursive; that is, the teacher would demonstrate, then move to the guide stage when the learner appeared to be ready to do the skill with prompts. However, if the learner was unsuccessful, the teacher would immediately return to the

demonstration stage with more examples. Similarly, if the teacher had moved ahead to the release phase and the learner made errors, Gilbert's model called for reverting to prompted examples before introducing another release trial. Continuing the basic protocol, an unsuccessful response to the stimulus after a delay would return the learner to the release phase until the learner appeared ready to try again with a delayed release trial. In Engelmann and Carnine's (1982, 1991) Direct Instruction scripts, *model, lead, test*, and *delayed test* are equivalent to Gilbert's demonstrate, guide, release, and delayed release phases. Archer's (See Archer & Hughes, 2011) *I do it. We do it. You do it. You do it again* are similar equivalents. Like Gilbert, both Engelmann and Carnine and Archer and Hughes instruct teachers to use the process recursively. An important aspect of the protocol is that it works for all the different kinds of learning where a pre-specified answer is called for—for example, in teaching the steps in long division, as well as in teaching concepts, such as identifying examples and non-examples of Romantic music, classifying plant phyla, or distinguishing fair from unfair social relations. If the learner is unsuccessful at any of the stages, the teacher drops back to the previous stage, seeking the point where the learner is successful and then moves forward again in an iterative process.

Two additional protocols that are most often attributed to Engelmann and Carnine (1991) significantly improve teaching scripts: signaling and faultless communication. Signaling—for example, the teacher tapping his pen on the whiteboard or snapping his fingers—cues learners when responding is required and appropriate. The skilled teacher hears when a learner is struggling with the task and can do a quick error-correction procedure until the learner is responding correctly and on signal with others in the group. Teachers also strive for *faultless* or *unambiguous—communication* as described by Engelmann and Carnine (1982). Both Adams and Engelmann (1996) and Engelmann and Colvin (2006) describe features of official Engelmann Direct Instruction programs,

Instructional Design

When there currently exist no workable protocols for teaching instructional objectives that are important to creating well-rounded learners, the Morningside faculty and leadership team develop their own materials, using their adaptation of a "System of Instruction" model that was developed by Markle and Tiemann (1967). This adaptation (See Figure 1), along with the influence of Markle (1990), Gilbert (1962a, 1962b), and Engelmann and Carnine (1991) forms the basis for the instructional design work that is done at Morningside.

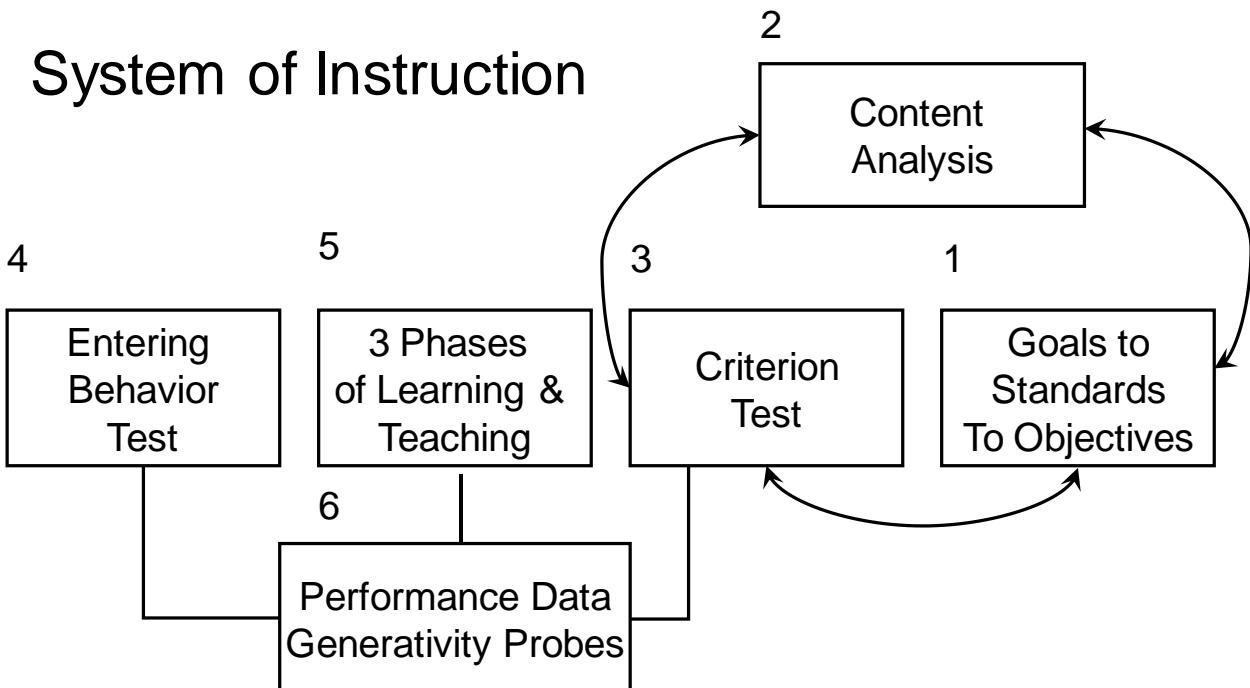


Figure 1. System of Instruction, adapted from Markle and Tiemann (1967).

The system of instruction model works equally well with a curricular strand within a field of study or for the entire field. Thus, it can be applied to a curricular strand such as phonemic awareness within the field of reading or to reading as a whole. The critical aspects of the work include a thoroughgoing analysis of the content area or curricular strand; selecting and using one of the learning typologies that we've discussed earlier, determining the correct ordering of elements in the curriculum so that learners' progress is seamless, finely tuning the instructional protocols, and ensuring that data are collected that provide evidence that the design has been learner verified when a substantial percentage of learners achieve mastery.

In addition, Morningside's programmers review new and promising materials that come on the market and—after obtaining appropriate permissions—use or modify them to expand its bank of programs. For example, Morningside programmers designed a direct instruction script and practice worksheets based on *Word Workout* (Lewkowicz, 1994), a program designed to teach learners to decode complex multi-syllable words. Sometimes individual teachers complete less formal adaptations when current materials aren't achieving the desired level of mastery. For example, one Morningside teacher adapted the vocabulary development work of Beck and her colleagues (Beck, McKeown, & Kucan, 2002) to improve her students' mastery of vocabulary.

Morningside also creates programs *de novo* when there are none available that meet the Academy's standards. In these cases, they begin with Morningside's "system of instruction" as the basis of the programs, conduct a

component/composite analysis, clarify the types of learning involved and appropriate learning channels for the objectives, and write scripts that use mathetics, signals, and faultless communication. Two examples include their recently available program related to computation (Johnson & Melroe, 2014) and a soon-to-be-available word problems program (Johnson, Isbell, Delgado, & Leon, 2015). Available from Morningside Press, these programs include a direct instruction script as well as practice sheets appropriate for Precision Teaching practice.

Principles Derived from the Science of Assessment

According to Malmquist (2004) “a hallmark of Morningside’s procedure is the continuous interplay between instruction and assessment” (p. 52). Malmquist proceeds to describe three levels of assessment used at Morningside: micro-level, meta-level, and macro-level.

Three Levels of Assessment

The Micro Level: Precision Teaching (PT) serves as the micro-level assessment at Morningside. Originating from the work of Lindsley and his students at the University of Kansas in the 1960s (Johnson & Street, 2014), PT provides a mechanism through which changes in performance frequency can be tracked. Frequency—the number of performances of a tool or component skill over time—provides a reliable mechanism to determine the fluency of the skill.

Lindsley chose frequency as the best indicator of fluency because frequency measurement is much closer to direct observation of behavior than percent correct, percent of intervals, or time samples of behavior and is a true measure of behavior in time. Frequency also very accurately represents the probability of future action. Thus, Lindsley believed that building behaviors to high frequencies would make their future performance more likely (Pennypacker, Gutierrez, & Lindsley, 2003).

Fluency, as a qualitative concept, has been described as performance that is “flowing, flexible, errorless, automatic, confident, second nature, . . .masterful” (Johnson & Street, 2013, p. 21). Although most people recognize a fluent performance when they see it, they would be hard pressed to say the frequency required to achieve that end. That’s why, over time, fluency has been defined by its by-products, of which five have emerged to date: (a) The behavior is at a *frequency* where it is *maintained* and thus is easily executed when needed (Haughton, 1972; 1980); (b) it has *endurance* necessary to stay in play for as long as real-world contingencies require (Binder, 1985); (c) it has *stability* in the face of distraction (Johnson & Layng, 1992, 1994, 1996); (d) it is available for real-world *applications* that require it (Haughton, 1972, 1980); and (e) it results in *generativity* (Johnson & Layng, 1992, 1994, 1996; Johnson & Street, 2013) and thus “is easily combined with other performances as necessary to solve novel problems” (Johnson & Street, 2013, p. 28). A mnemonic--“Get the MESsAGE!—helps novices remember these by-products. Morningside’s team has identified frequency ranges in reading,

writing, and arithmetic (See Johnson & Street, 2013) that correlate well with these by-products.

Practice in a PT classroom is far from the “drill and kill” approach, in which practice was an end in itself. In the Precision Teaching approach to practice, learner performance is timed, most typically in one-minute intervals. The learner and his teacher or a peer coach then review his performance with respect to a goal based on the previous day’s performance and the learner’s ultimate aim, the frequency that “gets the MESsAGE.” Typically learners will practice a skill several times a day within the time set aside for practice and most will meet their daily goal. When a learner fails to meet his goal, the teacher will review his chart and may talk with him and his coach to determine the reason for the challenges he is facing. Two of many possible courses of action include slicing back to an earlier piece of the curriculum or isolating items which were causing particular trouble onto a new practice sheet (Johnson & Street, 2004b, 2013). The teacher assigns these new sheets as the next day’s practice. Practice at Morningside is daily, highly structured, and individualized. Progress toward frequency goals is charted every day.

The Standard Celeration Chart (SCC; see Figure 2) is the vehicle through which changes in frequency are tracked. Johnson and Street (2013) report that the SCC shares the following charting conventions with some other charts: It is “(1) standardized, for easy communication, and chart and program comparison; (2) calendar-based, not session-based, to show the effects on performance of programs when they are in place and when they are not; (3) focused upon frequencies, not percent correct; and (4) focused on learning, not performance” (p. 30).

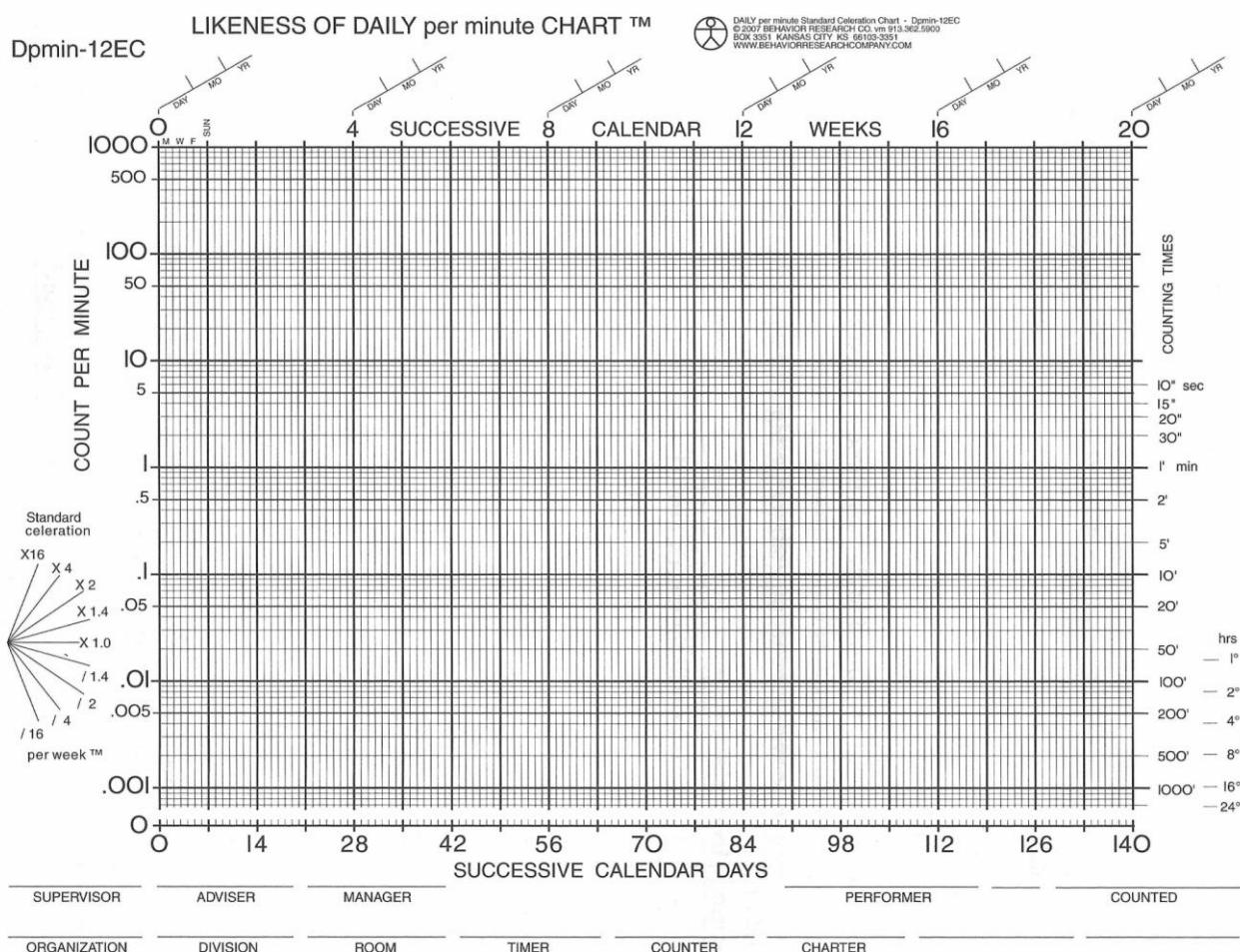


Figure 2. Likeness of a Daily per minute Standard Celeration Chart. Standard Celeration Charts are available at Behavior Research Company, Box 3351, Kansas City, KS 66103-3351. VM 913-362-5900, www.behaviorresearchcompany.com

The Standard Celeration Chart differs from other instruments in that it plots ratios of frequencies, not raw performance frequencies, over time. “The growth that learners make is proportional to their previous growth. Proportional growth is much more representative of the way people really learn” (Johnson & Street, 2013, p. 30). An inspection of Figure 2 reveals the ratio scale up the y or left axis of the chart. Rather than being equidistant from each other in a linear fashion; they are arranged by multiples of 10, more like charts or graphs that one sees in the physical sciences than it is like those used in education. Lindsley was drawn to the ratio scale because he believed that, just like other things in nature, behavior changed in relation to where it was when one started charting it (White & Haring, 1980). The chart also accommodates virtually any behavior since the range of possible frequencies is from .001 per minute to 1,000 per minute.

The chart was named the Standard *Celeration* Chart because Lindsley (1992) was more concerned about the rate of growth over time in performance than he was about performance at any point in time. He coined the word *celeration* to refer to the rate of growth (acceleration) or deterioration (deceleration) in learning. Because celeration measures how much time it took for a learner to reach a frequency aim, Lindsley (2001b) thought of celeration as synonymous with learning. The chart is designed in such a way that celeration is easily determined by drawing a line from the first frequency the learner posts to the prescribed frequency, when it is achieved, and comparing the slope of the line with the *Standard celeration per week™* legend on the left side of each chart. (See Figure 2.)

As evidence has emerged that higher frequencies appear to be characteristic of “expert” performance, precision teachers have attempted to find ways to increase learners’ celerations. Two benefits have emerged from encouraging higher frequency performance on tool and component skills. The first is what the staff at Morningside call *curriculum leaps*-learners require little if any instruction or practice to acquire next steps in a curriculum series when the previous steps are at prescribed frequencies. For example, a learner may acquire long division with minimal practice if both math facts and estimation are at high enough frequencies. The Morningside team estimates that approximately 33 percent of the curriculum is acquired in this manner. The second benefit is that new learning channels emerge with minimal practice when other channels are at prescribed frequencies. For example, a learner who is fluent with a “see/say” also is fluent with a “see/write” or a “hear/say” related to the same content with no or only minimal additional practice.

Later in his life, Lindley (2001a) talked about a relation between celeration and agility as akin to the relation between frequency and fluency. An agile learner is one who is mentally quick and resourceful, able to adjust quickly to unfolding events in learning something new. The Standard Celeration Chart shows growth in agility as steeper and steeper slopes across time and across performances. Lindsley thought it was possible and even likely that speedier celeration on several sets of related behaviors would improve the ability to acquire other related behaviors more speedily (Lindsley, 2001a). We have seen some compelling evidence of this phenomenon at Morningside with some of our more advanced learners. Although we have not consistently documented agility patterns in our students’ data, others are beginning to do so. (See, for example, the work of Meyer, Newsome, & Newsome, 2013).

The Meta Level: Meta-level assessments occur less frequently than micro-level ones, but more frequently than macro-level assessments. Morningside has adapted curriculum-based measurement (CBM) procedures (Deno, 1985, 1989; Shinn, 1989) to track growth on important curriculum indicators in reading, writing, and mathematics. These adapted CBM measures both validate the results that learners are charting on their SCCs—their mini-level assessments—and suggest how learners are likely to perform on the macro-level assessments at the end of the year. To do this, using the previous year’s data, the team conducts a simple linear regression between the scores at a particular point in time on a standardized

meta-assessment and scores on the macro assessment. This regression line then allows them to determine what the current year's learner needs to achieve on each meta-level assessment to achieve the promised two year gain (Gire, Testa, & Johnson, 2010). Typically, Morningside collects meta-level assessment monthly or bi-monthly and, when learners aren't on track to make the gains that parents have been promised, faculty and the leadership team huddle to determine programmatic changes that are likely to increase the learner's growth to be consistent with expectations. (For more on the history of Precision Teaching or Lindsley's legacy, see Binder, 1996; Johnson & Street, 2014; and Potts, Eshelman, & Cooper, 1993)

The Macro Level: Macro-level assessments utilize published criterion- and norm-referenced tests to compare the performance of learners from the beginning to the end of the year in relation to a designated peer group. This is the "show me the money" part of the assessment process for two reasons: 1) for those enrolled in the laboratory school in Seattle, these tests determine whether the school or the parents get to keep the learner's tuition; and 2) for partner schools who participate through the Morningside Teachers' Academy, pre- to post-score gains on these tests determine eligibility for federal funding. It is also how many of them determine whether or not to renew their contracts with Morningside Teacher's Academy.

The standardized tests we use for the pre- to post-test comparisons are the state-approved tests in states where participating programs are located. They change periodically; however, Morningside stays current with the state's selection so that comparisons with other schools in the state are possible.

Putting it All Together

We build our instructional programs using our adaptation of Markle and Tiemann's (1967) System of Instruction (Figure 1). One very important piece is in box 5: The three phases of teaching. These three phases are instruction, practice, and application. It is this three-stage model that is at the heart of the Morningside Model of Generative Instruction. Learners typically begin new content with the first phase—*instruction*—during which the instructional protocols we described earlier are evident. In this phase, we *establish a new repertoire*; that is, the learner *acquires* a performance that she could not perform previously. The format of the lesson is determined by the learning channel and learning outcome it is designed to teach.

Students and teacher engage in a highly interactive lesson that focuses on only one performance or skill at a time and they are then combined as accuracy emerges. During this phase, learners are dependent on prompts, make errors early on, and are distracted by extraneous stimuli. It is also in this phase that response topographies are shaped and discriminations among and stimulus control by novel and familiar stimuli is assured. As Johnson and Street (2004b) note, "Student performance comes under the control of the parameters that define acceptable variability of stimuli and acceptable latitude for responses" (p. 99). Instructional lessons are characterized by increasingly higher rate volleys with the teacher providing continuous feedback about the correctness of the response. As learners

become more and more confident and their responses are very nearly always correct, they move to the second phase: *practice*.

At Morningside, students spend as much as 40% of their school day practicing in highly structured and timed activities. Practice is goal-oriented and continuously monitored. Practice activities exist on paper, on computer, and/or with flashcards for each major tool and component foundation skill in the curriculum. Continuous monitoring, which is critical to achieving efficiency, occurs as a function of Morningside's well-oiled peer coaching system (Johnson & Street, 2013). Learners use Lindsey's Timings Chart (See Figure 3) and his Daily per minute Standard Celeration Chart (Figure 2) to track performance and to suggest and verify that the learner is improving—accelerating—at the prescribed rate. Performance aims are established to tell the student how many of a skill they should be able to do in the timing period, based on the celeration aim for the task. The learner and his peer coach use the Timings Chart, which accommodates up to 10 practice sessions per day, to track the learner's daily performance and celerations and to ensure that he stays on the prescribed trajectory for the skill. At the end of the daily lesson, the teacher, peer coach, or learner charts the learner's best performance on her Daily per minute Standard Celeration Chart. Based on the learner's performance and her celeration, the teacher—following discussion with the peer coach—may recommend an alternate form of the current day's practice, recommend that the learner move on to the next practice sheet in the sequence, or suggest that a new practice sheet be created that includes a subset of items on the sheet on which the learner virtually always stumbled during the day's practice session.

The third phase of teaching is *application* and *generativity*. Application, strictly speaking, refers to the learner's ability to use a newly acquired skill in real world situations that are similar but not identical to those that were practiced. For example, a good application of see/say words in isolation on a practice sheet is correctly reading them on a bus schedule and a good application of hear/write numbers is to write correctly on one's hand one's friend's phone number. To ensure these important characteristics of learning, Morningside's teachers provide explicit compound and composite tasks including simulations, games, and real-world applications to encourage generalization of what has been learned in the world of practice.

Generativity—also called contingency adduction—is different from application in that it is the recombination of previously acquired skills to solve a *novel* or unfamiliar problem (Epstein, 1991, 1993; Epstein, Kirshnit, Lanza, & Rubin, 1984). New environmental contingencies *recruit* behaviors learned under different contingencies to solve a novel problem. Morningside students have successfully solved many problems that were slated for explicit instruction without it. For example, students have (a) sounded out new words that are re-combinations of taught words; (b) solved fraction word problems by applying the algebraic equation procedures taught for whole number problems, and using fractions computation skills instead, (c) made a prediction at a certain point in reading a selection, after learning how to draw a conclusion, (d) identified an author's bias after learning how to identify an author's point of view, and (e) written sentences

with appositives, (i.e., The candidate, a surly and arrogant man, lost the election.) after learning how to modify nouns with adjectives in the standard way (i.e., a surly and arrogant candidate lost the election.).

Both types of skill extensions—application and generativity—are critical for learners to be efficient. They also account for what we described earlier: curriculum leaps. We noted this earlier when we said that once tool and component skills are learned to levels that promise the by-products of fluency, some learners are able—without further instruction or practice—to achieve frequencies on other skills in the curriculum on their first opportunity.

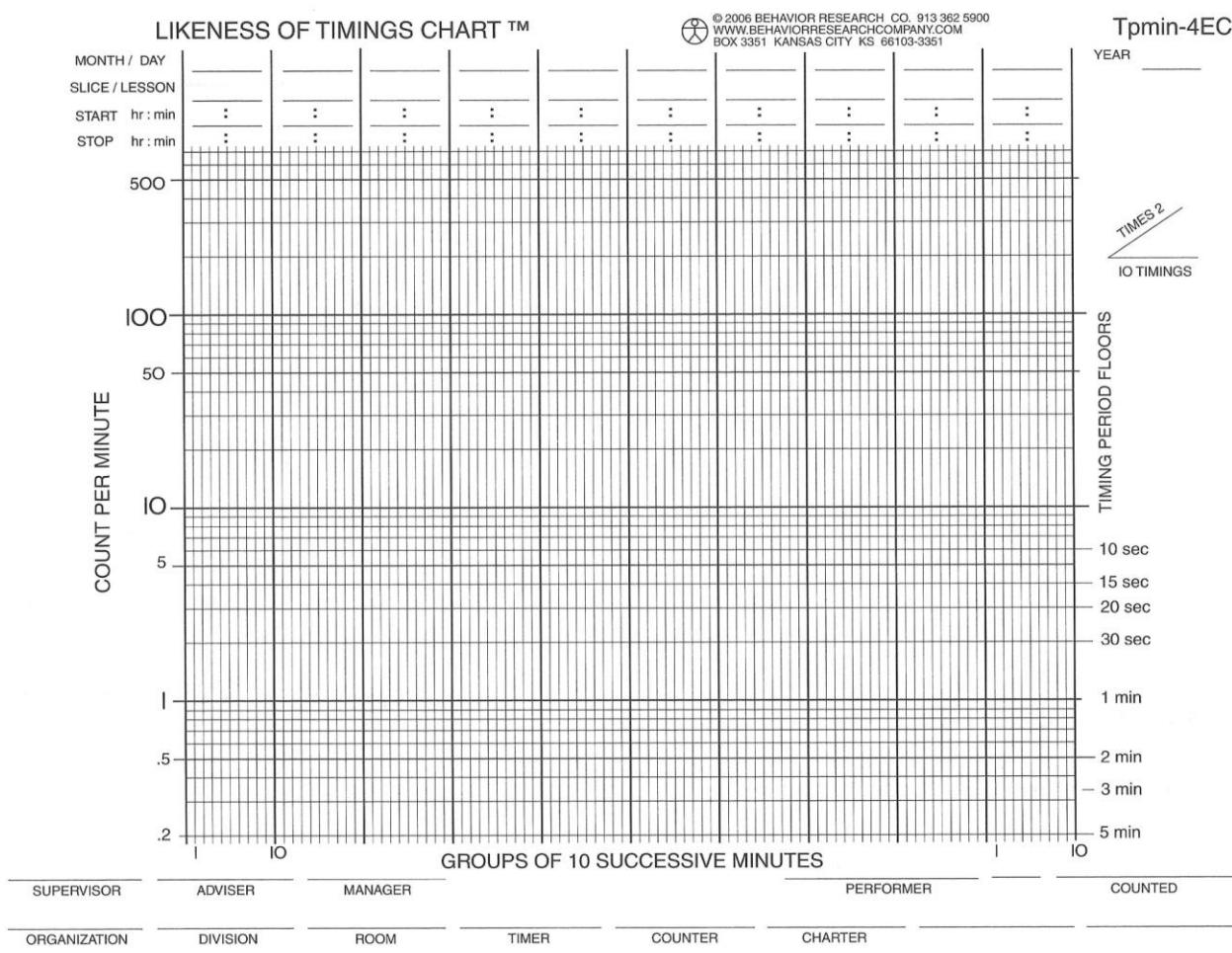


Figure 3. Likeness of a Timings Standard Celeration Chart. Standard Celeration Charts are available at Behavior Research Company, Box 3351, Kansas City, KS 66103-3351. VM 913-362-5900, www.behaviorresearchcompany.com

Results

Morningside has consistently produced results in learners who attend the program in Seattle, Washington that far exceed their historic performance. In fact, pre- to post-test scores on nationally standardized tests reveal average growth of two grade levels for each year of instruction in reading and mathematics for the past five years. Although the gains are not as great at schools which have contracted for services from Morningside Teachers' Academy, they too are impressive. For example, at an early implementation of the Morningside Model of Generative Instruction in a First Nation school—Ft. Frasier—in British Columbia, Canada, learners whose reading scores on the *Canadian Test of Basic Skills* (King-Shaw, 1995) at pretest were in the 20th percentile earned scores on end-of-year posttests at the 50th percentile within two years and above the 60th percentile by the end of the fourth year of implementation. In five years, students' percentile ranks in mathematics jumped from the 22nd percentile to the 74th percentile. During the five-year period, the school's ranking went from 13th in a district of 25 schools to second in math and fifth in reading.

Similar changes in growth trajectories are evident in the data (available on request) when Riverside Indian School in Anadarko, Oklahoma, the second largest of the Native American off-reservation boarding schools in the U.S., contracted with Morningside Teachers' Academy for assistance in reading.

Summary

Morningside Academy is nearing its 35th anniversary and, during that time, it has led the way through its combination of a variety of learner-verified curricula, its adoption and strengthening of practices that have been pioneered by others, and its creation of new programs. As we noted at the beginning of the article, Morningside Academy is best known as a Precision Teaching school. Precision Teaching has, over the years since Ogden Lindsley first conceived it, incorporated the findings of scientists in the fields of learning, instruction, and assessment. At Morningside, learners don't begin to chart data until they are at very close to 100% accuracy, a very high standard according to most other school systems. Morningside's teachers and leaders know that percent correct standards don't fare well in the face of evidence that supports building performance frequencies to levels that correlate with fluency and that makes all the difference.

Further, anecdotal evidence compiled over the more than 35 years of operation of Morningside Academy suggests that learners who achieve both accuracy and speed display confidence and competence not only about what they have learned, but also about how to learn new content. They recognize dysfluency in themselves and take their learning into their own hands to ameliorate the situation. Still, they and the Morningside faculty are indebted to those who have developed efficient and effective *DI* and *di* programs that ensure accuracy which is a necessary condition for achieving the frequencies which correlate with fluency. Morningside's team believes that these two parts of the work they do are in a symbiotic relation, each feeding on and being fed by the other. They also set the

stage for engineering application and generativity opportunities, which allow students to widely apply their learning in everyday circumstances and to figure out how to think and to do many things they did not learn in school—the signature of a smart, successful adult.

However, there is still more work to do. While our primary goal is to provide a service to our students, this has not kept Morningside's leadership team from posing questions for which answers derived from a rigorous program of basic research would allow its staff to further strengthen and perhaps even streamline procedures. We have described these questions elsewhere (Johnson & Street, 2004a, 2004b, 2012) and invite readers who conduct basic research to consider them as candidates for their own research agendas.

For those wishing to learn more about Direct Instruction, we recommend Engelmann and Carnine (1991) as well as Stein, Kinder, Silbert, and Carnine (2006) and Carnine, Silbert, Kame'enui, and Tarver (2009). For those wishing to learn more about Precision Teaching, we recommend White and Haring (1980), which—though dated—is the classic “how-to” book for teachers. In addition, Pennypacker et al. (2003) is the classic procedural handbook. Finally, Johnson and Street (2004b; 2013) provide details about the Morningside Model of Generative Instruction and the role Precision Teaching plays in creating its results.

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