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FLUENCY IN EDUCATION

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ABSTRACT: Critics of the United States educational system point out many contemporary problems and offer solutions based on what they perceive as the fundamental issues. How teachers measure student progress and define mastery rarely receive attention. The use of standard units of measurement and a standard graphical display have allowed Precision Teachers to uncover important features of learning. One such discovery, performance standards, has demonstrated that students can retain skills over significant amounts of time, perform at high rates with little performance decrement, and apply "element" skills to more sophisticated "compound" skills. Performance standards discovered by Precision Teachers allow a behavioral determination of fluency, or mastery. The recognition of Precision Teaching methods and results in regard to measuring behavior and determining mastery contributes to one of the most significant social issues in American society, education.
Key words: Precision Teaching, frequency, performance standards, fluency.

So much rests with the education of children. The future of our communities, states, nations, and ultimately the world depends on the competencies children gain through education. In many countries throughout the planet people talk about schooling in terms of reform, restructure, and reinvention (Crowson, Boyd, & Mawhinney, 1996). With no single plan in sight and a plethora of failed innovations, it does not appear these talks will end any time soon.

Indeed, in the United States a new set of the 3 R's pervade the educational establishment: reforming, restructuring, and reinventing part, or all, of education. Perhaps the high stakes associated with the outcomes of the educational process fuels the seemingly endless debate surrounding reform, restructure, and reinvention plans? Or more dishearteningly, maybe the never-ending discourse has become so entrenched because of the status of education, or what Carnine (1995) has dubbed a pre-professional status? Regardless of the cause, our society changes. And as our society continually evolves, the educational system must also adapt and make changes. A point in case, in the United States many manufacturing jobs have moved overseas, and the remaining jobs require an exceptional degree of technical competence (Darling-Hammond, 1997). The global society will increasingly demand more technically literate, critically thinking, and informed graduates. Talks concerning the 3 R's of revision will continue.

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A spate of proposed plans to alleviate students' educational mediocrity have flooded the professional literature. Propositions include several plans approaching the solution from different vantage points. Inception of educational reform stems from what each reformer perceives as the most critical problem of education. Reformers see problems resting with society, the political system, the educational structure, or contemporary educational practices (Pogrow, 1996).

For instance, Hodgkinson (1991) suggests that current social problems create "spectacular changes . . . in the nature of the children who come to school" (p. 10). He uses the metaphor of a "leaky roof" to project the difficulties in achieving reform. The necessary efforts should not focus on educational issues alone, but societal issues as well. Hodgkinson suggests that educators cannot "fix" the leaky roof singularly because the base of the problems involves other social service agencies.

In the realm of educational practices, the voluminous list for solutions includes both simple and complex proposals. These ideas span such topics as cooperative learning, heterogeneous grouping, multiple intelligences, computer-assisted instruction, curriculum-based measurement, and direct instruction to name a few. All ideas and implementations, however, do not evidence commensurate empirical truth. Take for example, the growing popularity of performance-based assessment.

Performance-based assessment seeks to measure student achievement through authentic means (Linn & Burton, 1994). Hudson and Penta (1998) provide case studies demonstrating ways schools alternatively assess performance. One school used music and dance to assess social studies while another used portfolios to capture the effects of multiple intelligences. Yet, performance-based assessments require greater subjectivity on the part of the scorers, and they cost more and contain fewer questions than traditional standardized tests (McEwan, 1998).

Keeping track of literature on the 3 R's of revision will overwhelm even the most erudite scholar. After distilling much rhetoric, a common element emerges in the ongoing thread of proposals. Most reformers share the goal of creating an educational environment that produces improved student learning, outcomes, and a qualitatively different level of student achievement. Although many reformers might agree with such broad and global objectives, what does it really mean? Stated differently, would it satisfy reformers if some new development yielded better attendance, higher graduation rates, improved performance on standardized tests, or higher grades in general? Would development of critical reasoning, higher order thinking, or exceptional problem solving skills appease the revisionists? Or would attaining "world class" standards and scores pacify the restructurers?

Reformers, revisionists and restructurers may very well agree on broad rhetorical statements concerning student improvement, and they all would most surely concur that every student should achieve mastery. In fact, any person associated with education would probably list mastery as a critical outcome. Researchers have found achieving mastery promotes several outcomes in addition to just effective learning. Enthusiasm, confidence, interest (Bloom, 1971), fun, understanding (Lindsley, 1995), retention, endurance or performance over extended time periods, and application or transfer to other skills and situations (Binder, 1984, 1996; Binder, Haughton, & Van Eyk, 1990; Haughton, 1972, 1980; Lindsley, 1995, 1996) highlight some of the discovered benefits associated with attaining mastery. But what does the term mastery really mean?

An educational model that supposedly exemplified mastery learning (Block & Anderson, 1975; Bloom, 1976), argued "that under appropriate conditions virtually all students can learn well most of what they are taught" (Block & Anderson, 1975, p. 1). Bloom (1973) further maintained that with mastery learning provisions 80% of students could reach the same level of proficiency attained by what only 20% of the students achieve when taught under nonmastery types of instruction. When put into practice, the mastery learning approach did generate positive results from classroom applications in a variety of subject areas (Guskey & Gates, 1986; Guskey & Pigott, 1988; Kulik, Kulik, & Bangert-Drowns, 1990). The favorable effects generated excitement and interest worldwide among educators (Guskey, 1985).

The mastery learning instructional approach insisted teachers take certain steps to ensure their methods and materials facilitated mastery. Some of the methods included organizing learning units, constructing tables of specifications, and preparing formative and summative tests (Block & Anderson, 1975; Guskey, 1985). Block and Anderson (1975) discuss perhaps the most crucial variable in the mastery learning process, setting a performance standard. In their words:

> Again, let us emphasize that you must come up with standards that feel right for you. After all, you are the one who must satisfy yourself as to whether mastery approaches to instruction lead to better student learning than your present approach. If you find all three of the preceding approaches to setting standards to be too cumbersome for your purposes, then develop your own. Given the present infant state of the art of setting performance standards, it will be some time before we can provide you with less cumbersome techniques. (p. 23)

In summary, Block and Anderson (1975) suggest that no universal agreement on a performance standard exists. The determination for mastery, therefore, rests on the shoulders of individual teachers. Guskey (1985) recommended setting a standard of 80% to 90% correct on formative tests. He bases this on Block's (1970, 1972) research that certain consequences (e.g., interest and attitudes towards learning) vary regarding the particular standard chosen. Guskey (1985) did advise that some cases will require 100% accuracy as in teaching street crossing behavior or other critical skills that demand perfect accuracy. The vague direction on setting performance standards paints a telling picture. Leaders in the mastery learning model could not provide clear, unambiguous academic performance standards. If experts in "mastery learning" cannot provide explicit, objective benchmarks in performance criteria that signal adeptness, who can?

The mastery learning approach holds pandemic company when it comes to discerning performance benchmarks that promote mastery. Many teachers must subjectively choose what signifies mastery. As Knight (1985) stated, "The question of what constitutes mastery is a philosophical issue which must be resolved by each district" (p. 147). When teachers, districts, or even States set subjective performance standards for mastery, knowledge of effective teaching practices and student learning diminishes.

Measuring Performance: Percentage Correct and Frequency Measures

Using the scientific method serves as one alternative to philosophical, hypothetical, and conjectured determinations of mastery. The cornerstone of the scientific method, the "process of assigning numbers and units to particular features of objects or events" (Johnston & Pennypacker, 1993, p. 91) has led to unprecedented discoveries in the history of humankind. The application of the scientific method to the educational field can also lead to the same type of innovative and counterintuitive discoveries.

If performed correctly, the scientific method offers a rigorous account of a phenomenon under study. Critical to this analysis, the unit of measurement refers to the precise amount of some dimension of an event or object under investigation (Johnston & Pennypacker, 1993). The unit of measurement allows a scientist to quantify the effects of variables in the experimental setting. The more precise and unambiguous the unit of measurement, the greater information the scientist will attain. In many educational settings, however, percentage correct, or accuracy-only, typically suffices as the unit of measurement. With the established and widespread use of percentage correct metrics, impediments have arisen to systematic, objective, and precise investigations.

Wood, Burke, Kunzelmann, and Koenig (1978) give an example of a deficiency resulting from the percentage correct unit of measurement. Two children received the same score on a test: 9 correct out of 10. To any person reviewing these scores as they stand, distinguishing between the two children would seem virtually impossible. Further, if a teacher applied the mastery performance standard of 90% to 100%, both student's scores give the impression they have command of the material. But, if the first student took 10 minutes to score 9 out of 10 correct while the other took 30 minutes to attain the same score, a different picture develops. The speed of responses provides additional information about which student has more control over the subject matter.

West, Young, and Spooner (1995) draw attention to another insufficiency of percentage correct. When using accuracy-only measures to evaluate a student's grasp of information on a test, the score conceals the true nature of incorrect responses. For example, some incorrect responses may occur because the student skipped an answer or did not try to answer it. The percentage correct measure identifies all incorrect responses as a mistake. The resulting effect: teachers have compromised diagnostic information.

In a scientific examination of educational ecology, percentage correct masks dimensions of an object or event under study. Hence, Johnston and Pennypacker (1993) aptly categorize percentage correct as a "dimensionless quantity." In other words, the quantitative parameters of a phenomena lose dimensions needed to place it in time or space. Therefore, researchers, teachers, or others using a dimensionless quantity such as percentage correct must interpret their measurements without benefit of comparison in terms of some standard unit of measurement. Corollaries seem almost humorous: A person receives a speeding ticket for doing 77%. Johnson (as cited in Snyder, 1992) captures the extreme limitations of using percentage correct:

> When you put behavior in a time unit, then you are talking about reality, . . . Percent correct takes it out of reality, because it has no time frame. It's very unclear. The question is really, "100% in how long and how many?" (p. 34)

Police officers do not give tickets based on assessments derived from imprecise measurements. Miles, or kilometers per hour serve as a precise metric from which to judge who breaks the law. Yet, the educational establishment routinely makes use of educational decisions based on inexact assessments such as percentage correct.

To better understand human behavior, the educational system must move beyond the confines of the dimensionless quantity percentage correct and choose a measure that best represents, communicates, and describes dimensional quantities of skillful student performances. Frequency, a workhorse measure common of the "hard sciences" such as physics, can radically surpass current limitations associated with accuracy-only measures.

Frequency signifies a count over the recorded time of observation and represents a standard unit of behavior (Johnston & Pennypacker, 1993; Pennypacker, Koenig, & Lindsley, 1972). Typing 70 words in 1 minute, walking 400 paces in 1 hour, writing 2 books in a year, driving 50 miles per hour, all represent a frequency count. In education, frequency measures might include solving 30 math facts per minute, writing 100 words in 15 minutes, or 20 teacher/student interactions per hour.

The use of frequency has tremendous advantages over percentage correct measures. First, frequency has a dimensional referent, time. For every observation made, all counted occurrences transpire in a counting interval. The resulting product renders a standard measure enabling a precise description. For example, student one reads 40 words per minute with no errors. Student two reads 120 words per minute also without error. Both achieve 100% accuracy, but the first readers' performance may sound hesitant, slow and labored while the second readers sounds quick, flowing and automatic. Applying frequency measures to a wide variety of behaviors and skills facilitates the congruence of subjective descriptions of poor, good, and excellent performances with the quantitative precision afforded by a standard unit.

Frequency measures afford other advantages when critically examining student performance. Specifically, an observer records incorrects, and a review of the errors will determine which category the responses fall under: incorrects, skips, or nonattempts. For example, an addition test contains 50 single-digit problems. A student answers 35 correct, 5 incorrect, and skips 10 in a 1-minute counting time. Using percentage-correct alone generates a score of 70%. Yet the student attempted only 40 problems. The incorrect answers might have occurred because the student didn't understand certain operations, ran out of time, or knew the answers to the other problems better. Counting skips as incorrects blurs the accurate portrayal of the performance.

Using daily, weekly, monthly, or yearly frequency measures has yet to impact contemporary measurement practices in classrooms and research settings. Since its inception in 1964, Precision Teaching (PT) forms the exceptional rather than the rule. Precision Teaching has methodically put to use frequency units for measuring performance. The empirical results discovered in Precision Teaching classrooms have quietly contributed to the scientific knowledge base of mastery by examining academic and social performances. A recent estimate indicates that well over 1,000,000 charted learning performances have come from Precision Teaching classrooms (Calkin, 2000).

Precision Teaching

Founded by Ogden Lindsley, Precision Teaching embodies a set of methods and practice procedures promoting the systematic and precise evaluation of instruction or curricula (West & Young, 1992; White, 1986). A group of tenets capture the Precision Teaching method: (a) Basing curricular decisions on the child's performance (i.e., "The child knows best"); (b) Using frequency for measurements; (c) Using a standard celeration chart to display frequency data; and (d) focusing instruction and practice on directly observable behavior (Lindsley, 1972; White, 1986). As a result, Lindsley made the scientific method accessible for teachers and children in the classroom (Binder, 1988).

The discoveries generated in Precision Teaching classrooms have emerged under the auspices of standard units of measurement (i.e., frequency of academic responding often measured in 10-second or 1-minute counting times) displayed on a standard celeration chart that shows proportional growth (Pennypacker, Koenig, & Lindsley, 1972). For instance, graphing behavior frequencies successively on a standard celeration chart revealed celeration, another dimension of behavior. Acceleration or deceleration describes the changes behavior frequencies may undertake. Thus, the root word celeration represents that change (White, 1986). Precision Teachers most often report the value of celeration as the change of frequencies per week or month periods (i.e., the multiplier or divisor per week or per month). The length of a week allows Precision Teachers to detect changes in frequencies and modify the instructional program if needed (Pennypacker, et al., 1972).

Placing a standard unit, such as frequency, on a standard graphical display permits the evaluation of performance leading to precise, standard, informative, and valuable information that can never materialize through percentage correct metrics. Perhaps the most dramatic development of standard celeration charting has occurred with the phenomenon known as "fluency." The rest of this article focuses on the exciting effects of fluency as discovered through an empirical system of knowledge. Interested readers, however, can examine the following sources for a more thorough review of the evolution, progress, and discoveries of

Precision Teaching (Binder, 1996; Lindsley, 1992, 1993; Maloney, 1998; McGreevy, 1983; Pennypacker, Koenig, & Lindsley, 1972; Potts, Eshleman, & Cooper, 1993; White, 1986; White & Haring, 1980).

Precision Behind Mastery: Fluency

Many people have extolled and encouraged the use of practices that promote the fluent development of masterful behavior. Called by many names, overlearning, automaticity, and fluency all appear germane to one another and may even refer to the same set of behavioral events (Dougherty & Johnston, 1996). Many words such as “smooth” (Schreiber, 1991), “rhythmically” (Harris, 1970), “effortless” (Zutell & Rasinski, 1991), “automatic” (LaBerge & Samuels, 1974), and “second nature” (Lindsley, 1996) have described fluent performances. Unfortunately the description of fluent, masterful behavior often remains at the level of narration.

The distinguishing characteristic of masterful and expert behavior lies in both quick and accurate performance of a skill or behavior (Binder, 1996; Bloom, 1986; Ericsson, Krampe, & Tesch-Römer, 1993). It logically follows that when practicing and testing for mastery that one include the dimensions of time and count. As Haughton (1972) observed, before accurate and universal methods of timing existed, we could only describe the outcome of a race by whom won. Information such as the speed of the winner, differential comparisons of others in the race or even distinguishing between an Olympic performance and one of 5-year-old children disappears when examining an accomplishment without the time referent. Yet in education, the use of accuracy only, or percentage correct measurements prevail unabated. Without the quantitative measure of frequency, teachers using percentage correct will have difficulty discriminating between acquisition and mastery (Binder, 1988).

Binder (1996) defines true mastery or fluency as “the fluid combination of accuracy plus speed that characterizes competent performance” (p. 164). Further, Binder indicates fluency “is a metaphor . . . referring to a collection of observations about relations between response frequency and critical learning outcomes” (p. 164). Binder’s definition corresponds in description to the measurable dimensions of fluency or automaticity (i.e., frequency, speed, or pace and accuracy or quality). Fluency describes proficient, masterful, expert, and automatic performances (Binder, 1988, 1993, 1996; Bloom, 1986; Ericsson, Krampe, & Tesch-Römer, 1993; Haughton, 1980; Johnson & Layng, 1996).

The consistency of agreement among the fundamental characteristics of fluency, coupled with the advent of a technology providing a method for producing fluent performances (i.e., measuring performances with standard units such as frequency and viewing this on a standard celeration chart), places education on the forefront of a new era. An era where performance standards guide curricular decisions, enhance proficiency and dexterity with instructional content, and direct the practice of education toward the technical competency enjoyed by other professions such as medicine or engineering.

Fluency and Performance Standards

Stated earlier, Block and Anderson (1975) recognized the difficulty in setting performance standards for mastery even though they espoused the “mastery learning” approach. The solution to this vexing problem comes from research conducted with “fluency.” Because many qualities assigned to fluent performances align with most conventional descriptions of mastery (Binder, 1996), a student who attains fluency also has achieved the functional equivalent of mastery. By itself, fluency does not serve as a performance standard. As Johnson and Layng (1996) point out: “To move beyond a mostly metaphorical use of the term fluency, we need to specify outcomes that indicate fluent performance and select dimensions of behavior in time that will indicate that fluency has been achieved” (p. 285).

Through many years of research and classroom practice in Precision Teaching, performance standards for setting instructional aims for fluency have emerged (Beck & Clement, 1991; Mercer, Mercer, & Evans, 1982). Once a behavior or skill reaches an established aim or performance standard, empirically validated outcomes occur. Haughton originally used the acronym R/APS, to stand for retention, application, and performance standards, to signify the effects related to fluency, but later changed this to REAPS, for retention, endurance, application and performance standards (Lindsley, 1995).

Repeated, direct frequency measurements graphed on standard celeration charts have paved the road to performance standards. Because of its sensitive and precise nature, monitoring performance through frequency units has generated performance ranges that advance REAPS. Ninety-eight point six degrees Fahrenheit, and the resting pulse equaling 60 to 80 heartbeats each minute with an accompanying 10 to 15 respirations, depict physical ranges that indicate a healthy person (Haughton, 1982). With the arrival of frequency ranges for performance standards, education now has a yardstick to gauge how well an individual performs. Examples of performances falling in the fluency range include: seeing and saying (see/say) words in context or oral reading at 180 to 200 or more words per minute, seeing and writing (see/write) math facts at 70 to 90 digits per minute, and thinking and writing (think/write) connected alphabet letters at 150 or more words per minute (Beck & Clement, 1991; Freeman & Haughton, 1993a, 1993b).

Reaching a performance standard for a given skill facilitates critical learning outcomes that delineate mastery. The humane and liberating outcomes, retention, endurance, and application have come out of years of Precision Teaching classroom applications. These discovered effects of fluent behaviors in a Precision Teaching paradigm form an inductive database that came from thousands of teachers attempting to quantitatively and qualitatively improve learning for students (Lindsley, 1990).

Retention

Retention has a long and distinguished history in the study of learning. For example, a publication by Herman Ebbinghaus, *Memory: A contribution to experimental psychology* (1885/1913) detailed a series of self-experiments that drew attention to memory and retention. For many years researchers in psychology and education have studied the conditions surrounding retention. Moreover, the main goals of education include retention and mastery of instructional content (Berquam, 1981).

The term retention specifies the relationship "between behavior frequencies at two points in time, between which the individual has had no opportunity to emit the behavior" (Binder, 1996, p. 164). Depending on the skill, how well a person retains can have profound consequences. Learning first aid procedures and not fully retaining the skills during an emergency could result in a life-threatening situation. In educational contexts, when a behavior or skill does not retain, relearning, refreshing, and reteaching must occur. This reteaching produces a significant problem for the students and teachers.

Performance criteria that exclusively apply percentage correct sometimes relate weakly to retention, such as seemingly ubiquitous 90% to 100% criterion for the grade of an "A." To support retention, teachers must review data coming from direct, continuous frequency counts falling within fluency aims or performance standards for a behavior or skill. Studies have demonstrated the relation between skills and behaviors that reach higher performance frequencies. Orgel (as cited in Binder, 1996) found that people who could say flashcards at a frequency of 50 or more a minute could retain twice as much knowledge as those who achieved lower frequencies. Berquam (1981) found using fluency procedures produced better retention than just providing extra practice. Other studies have also demonstrated the critical relationship between retention and fluency based procedures (Bullara, Kimball, & Cooper, 1993; Kelly, 1995; Olander, Collins, McArthur, Watts, & McDade, 1986; Ritseman, Malanga, Seevers, & Cooper, 1996; Shirley & Pennypacker, 1994).

Endurance

The discovery of endurance represents a significant contribution to understanding another dimension of fluent performance. Namely, endurance refers to how long a person performs a behavior over prolonged amounts of time (Binder, 1984, 1996; Binder, Haughton, & Van Eyk, 1990). If a student lacks endurance, engaging in a task may result in an inability to remain focused for extended periods of time. The endurance deficit also increases errors and experiences of "negative emotional behaviors" (Binder et al., 1990).

Binder, Haughton, and Van Eyk (1990) report a study illustrating the effects of endurance. A group of over 75 students ranging from kindergarten through 8th grade served as participants. The teachers had students write digits from 0 through 9 as quickly as possible. Students wrote digits at 15 second, 30 second, and 1, 2, 4, 8, or 16-minute intervals on different days. The results demonstrated that the students who could write digits at 70 per minute at 15-second intervals could perform similarly for the 16-minute intervals. The students who could not write digits quickly soon declined in their performance as they progressed through the interval. Some of the students who wrote at the painfully slow, yet accurate, frequency of 20 digits per minute quit before the interval ended.

The discovery of endurance led Binder et al. (1990) to reconceptualize attention span in terms of the relationship between student's performance level and length of the performance interval. Teachers can use a practice technique involving "sprints" (Haughton, 1980), or short intervals of performance (e.g., 6-second counting times, 10-second counting times), to allow students to experience success and build endurance. As a student gains competency with short sprints the practice intervals expand (Bourie, 1980; Desjardins, 1981).

Application

Retention and endurance emphasize necessary exigencies for attaining empirically validated performance standards; the revelation of application has cemented the magnitude of achieving frequency ranges defining fluency. Although retention, endurance, and application do not lie on a continuum of ranked importance, each adds another piece to the puzzle of why some students do not develop to their potential.

Performance of simple skills, called "elements," relates to the acquisition and performance of more complex skills, termed "compounds." The convergent relationship of elements and compounds depicts "application" (Barrett, 1979; Haughton, 1972, 1980). Data from classroom performances appear in the seminal article by Haughton (1972), demonstrating the operation of application. The "clincher" as Haughton put it, came from a discussion he had with a school principal. The two could not understand why some students did not achieve instructional aims in math even though the students practiced daily and did not make many errors. They found the problem: the math problems required students to write digits very quickly, but the students physically could not write more than 20 digits per minute. Because the element skill of handwriting speed did not reach a high frequency, valence or application of the compound behavior, answering written math facts quickly, could not occur.

The application relationship extends to all compound skills predicated on element skills. In math, if a student has slow or underdeveloped basic computation skills (e.g., adding), the application to complex operations will proceed awkwardly if at all. This occurs because students must interrupt their flow of thoughts and recall math facts. When re-engaging in the complex operation, the student may have to remember where he or she left off and possibly the work just completed (Johnson, 1996). Reading, writing, spelling, mathematics, and any other skill based on proficient element performances will sustain marked decrements in the compound form if basic foundational skills do not meet the required frequencies for fluency.

Precision Teaching and Fluency in the Classroom

Fluency based procedures, in combination with existing curriculums, have functioned to create spectacular effects when applied to school systems. To illustrate the dramatic success of Precision Teaching used on a large scale, a public elementary school and a private nonprofit school speak as testimonials for what happens when teachers use fluency-based procedures with students in schools.

Sacajawea Elementary School in Great Falls, Montana served as a site for a schoolwide application of Precision Teaching. Beck, the past director of special education in Great Falls and Clement, the former principal of Sacajawea, detail the development of Precision Teaching. Initially designed as a program to help children with special needs in a special education setting, teachers set high performance standards such as correctly answering 70 to 90 digits per minute for math facts. Both the teacher and students operated under an observed set of standard celeration chart "decision rules" ensuring students could capably progress through a curriculum sequence (Beck & Clement, 1991).

According to Beck and Clement (1991), the move from special education classes to general education classes came after Sacajawea teachers visited other classrooms using Precision Teaching. General education teachers overcame initial fears of their inability to manage a classroom of charts and soon discovered they had more instructional time, not less. This occurred because students achieving high performance standards could rapidly apply their skills and progress through the curriculum.

Precision Teaching procedures used with the 450 Sacajawea students produced impressive gains. The following list contains some of the positive outcomes: Teachers noted that improved self-esteem accompanied the graphical display of the standard celeration chart; Students "remediated" never again returned to needing additional remediation; After three years students gained 20 to 40 percentile points on standard achievement tests compared with the same cohort that did not experience Precision Teaching instruction (Beck & Clement, 1991). The time costs for improvements from the use of Precision Teaching equaled 20 to 30 minutes a day (Binder & Watkins, 1989). An exceptionally large return for such a small investment.

Johnson and Layng (1994) discuss the evolution of Morningside Academy from a tutoring and summer program to an accredited year-round school in Washington state. Many learners who attend the academy have classifications of "learning disabled" or "attention deficit disordered" when they enter. The students primarily have deficient component skills in fundamental areas that make progressing through a typical school curriculum difficult. Students attend Morningside for a period of 1 to 3 years and then make successful returns to other schools.

Parents enrolling their children in Morningside get two money-back guarantees: students will progress two grade levels each school year and a student's ability to focus or "time-on-task" will expand from an average of 1 to 3 minutes to 20 minutes or greater. Reese and Johnson (as cited in Johnson & Layng,

1994) note that this attention span exceeds typical college learners. Morningside has yet to return money because it has not met its guarantee (Binder, 1988; Johnson & Layng, 1992).

Students at Morningside achieve remarkable success. Over a 10-year span, each year students routinely advance anywhere from one and a half to almost four grade levels in reading, language arts, and math (Johnson & Layng, 1992). Perhaps most significant, these gains came from students with learning disabilities and attention deficit disorders. Morningside is now considered one of the top agencies in the Northwest handling such disorders (Johnson & Layng, 1994).

The extraordinary successes achieved by Sacajawea and Morningside students highlight the effects of attaining mastery through fluency building procedures. When students reach fluency or master material, they retain skills and teachers do not have to offer "refreshers" or "catch up" lessons. Students work for longer periods of time in an engaged, loud, and active classroom. Further, students apply element skills they learn to new, compound skills or sequences.

Conclusion

As our global community changes and moves towards a more technological and advanced state, demand for a well-educated populace becomes exceedingly acute. Publications such as *A Nation At Risk* (1983) emphasized the enormous weight placed on our school system and the value of a quality education:

> Our concern, however, goes well beyond matters such as industry and commerce. It also includes the intellectual, moral, and spiritual strengths of our people which knit together the very fabric of our society. The people of the United States need to know that individuals in our society who do not possess the levels of skill, literacy, and training essential to this new era will be effectively disenfranchised, not simply from the material rewards that accompany competent performance, but also from a chance to participate fully in our national life. A high level of shared education is essential to a free, democratic society and to the fostering of a common culture, especially in a country that prides itself on pluralism and individual freedom. (p. 7)

The powerful message appearing in *A Nation At Risk* warns us that our children and society will meet major economic and civic sanctions imposed by inadequate education. Such menacing forecasts not only call for future planning but demand immediate action. Yet, in years since the publication of *A Nation At Risk*, how much meaningful action has transpired? The answers appear in newspaper headlines, magazine articles, news broadcasts, journal entries, books, and other media at a conspicuously alarming rate. For example, a headline in a newspaper reads "No diplomas for 11,000 who failed test" (Alford, 1998). The article detailed the plight of 11,000 students who will not receive a high-school diploma because they failed to pass a ninth-grade proficiency test.

When states use competencies from the ninth-grade as proficiency standards for graduating twelfth-grade, a discouraging message materializes. Eleven thousand students in one state failing to pass minimal competencies delivers a demoralizing affirmation. Outcomes demonstrating students' failure to attain minimum proficiencies, comparative studies with other countries showing lower scores among American students (e.g., Beaton, Martin, Mulls, Gonzalez, Smith, & Kelley, 1996a, 1996b), and reports in the media all increase pressure for restructuring, reforming, or reinventing schools so our students will perform better.

People calling for change in the educational system have placed blame with attitudes and work ethic among students, teachers, parents, and administrators. Other factors include length of school day and year, vouchers enabling school choice, national standards, and alternative assessments. Although many other factors could embellish this list, any proposed or implemented initiative will have only limited capacity to effect critical student outcomes without awareness of fluency. Next to the curriculum and its implementation by a teacher, fluency defined in standard units (i.e., frequency) and displayed on a standard celeration chart comprises the most crucial variable for student success.

Without careful attention directed towards fluency, even masterful plans can languish in mediocrity. For example, pundits calling for higher paid and more motivated teachers can not ensure students will retain information after significant periods of no practice. Further, collaborative learning, computer assisted instruction, and active learning will not necessarily permit students to perform at a high level over increased periods of time and in the face of environmental distraction. Even the most research-based curriculum to date will not guarantee all students will apply knowledge to complex concepts. To provide *all* students with retention, endurance, and application of instructional content, teachers must monitor performance with clear and universal measures and make decisions from fair and standard displays.

Although a complex task, reformers, revisionists, restructurers and all others committed to meaningful improvements in the educational system face a host of environmental factors interacting in sometimes unknown ways. Through applications of behavioral science however, Precision Teachers have uncovered elements proven essential for student success that could play a considerable role in educational reform. The American educational establishment can significantly improve learning and the future of all students by embracing fluency in education.

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