Academy of READING

▶▶▶▶ **RESEARCH**

Scientific Validation of Effective Reading Programs and the Development of the AutoSkill Academy of READING

AutoSkill ®
A helping hand for literacy ◄

Table of Contents

Introduction

As a developer and provider of software-based learning programs, AutoSkill® International Inc. stands apart in the industry for its focus on research. Not only are AutoSkill products built on a platform of extensive investigation into the learning process, they are also evaluated after the fact, in ongoing studies to ensure continual improvement and refinement.

This document examines the findings of key research into the process of reading and summarizes many of the educational conclusions that have been drawn from them. It proceeds to illustrate how this constantly growing body of knowledge has informed the development of the AutoSkill Academy of READING®—and how a basis in research has led the Academy of READING to become one of the most effective tools available for teaching learners how to read. The document also offers clear-cut evidence of the program's effectiveness, in the form of research study summaries, case studies and site evaluations.

Ultimately, the goal of this document is to provide educators with the necessary information to make confident, well-informed instructional decisions.

The original precursor to the Academy of READING was the AutoSkill Component Reading Subskills (CRS) program. Between 1985 and 1995, the CRS was expanded upon to create a DOS application known as the AutoSkill Reading Program. This, in turn, became the Academy of READING when the solution migrated to the Windows platform. The Academy of READING v5 embodies the research and capabilities described in this document, and attributed to Academy of READING.

A Balanced Approach to Reading Instruction

"The heart of a powerful reading program is the relationship between explicit, systematic skills instruction and literature, language and comprehension. While skills alone are insufficient to develop good readers, no reader can become proficient without those foundational skills."

California Department of Education, 1995

In recent years, science has shown persuasively that learning to read is a complex, unnatural process. As such, it requires a systematic, balanced approach—-one that involves the development of fundamental, core skills as well as exposure to a variety of higher-order literacy experiences in a dynamic, literacy-rich environment. In the words of Dr. Reid-Lyon (1998):

"Substantial evidence shows that many children in the first and second grades and beyond will require explicit instruction to develop the necessary phoneme awareness, phonics, spelling, and reading comprehension skills. But for these children, this will not be sufficient. For youngsters having difficulty learning to read, each of these foundational skills should be taught and integrated into textual reading formats to ensure sufficient levels of fluency, automaticity, and understanding."

What makes adopting a balanced approach to reading instruction all the more challenging is the fact that no single instructional formula can be used to teach every student how to read. Every child is different, requiring a different combination of instructional components.

The authors of the National Research Council Report, Preventing Reading Difficulties in Young Children (Snow, Burns, & Griffin, 1998) concluded that the most effective teachers construct a unique blend of instructional ingredients for every child with whom they work. The authors were also quick to point out, however, that these teachers did so by drawing on a "common menu of materials, strategies, and environments…."

Looking Inside: Brain Research

Research has determined that reading is a whole-brain process involving a careful orchestration of several areas in the organ at once. This finding has provided significant insight into the nature of reading disabilities and has illuminated the way toward effective approaches for remediation. Understanding and developing approaches for solving some of the most difficult reading-acquisition challenges is extremely helpful in solving those that are more common, as well.

Most profound reading disabilities are designated by the label: dyslexia. While numerous studies have examined this multi-faceted impediment to reading, there has not—until recently—been a clear understanding of its neurological underpinnings.

With the advent of functional Magnetic Resonance Imaging (fMRI) technology in the late 1980s, neuropsychologists and other researchers gained the ability to look inside the human brain while it performs cognitive tasks. Using the same technology that significantly enhanced the field of medicine, fMRI measures changes in the metabolic activity of the brain. Because it is

non-invasive and does not use radioisotopes (as was the case with previous imaging technology), it is particularly well suited for working with children.

Several imaging labs across the United States are currently performing studies into dyslexia using fMRI (Demb, Boynton & Heeger, 1998; Eden, et al., 1996; Pugh, et al., 2000; Wood, et al.; 1996). Their results are remarkable.

Case Study: Yale University

Dr. Sally Shaywitz and her colleagues at the Yale University School of Medicine recently presented 29 dyslexic readers with a range of reading tasks to be performed while inside an fMRI scanner. The reading tasks were generally phonological in nature and required the readers to consciously manipulate the letter sounds in words.

As expected, the dyslexic readers—in comparison with the other test subjects—had difficulty performing such tasks as reading nonsense rhyming words (e.g. "lete" and "jeat"). What excited the Yale research team was that through fMRI technology they could see clear differences in brain activity between the dyslexic and normal readers.

Yale University Test Group
- 29 dyslexic readers: 14 men and 15 women, aged 16-24
- 32 normal readers: 16 men and 16 women, aged 18-63

(Shaywitz, et al., 1998)

Dyslexic readers showed relative under-activation in the brain region that links print skills to the brain's language areas. There was, as well, less activity in the angular gyrus—a large brain region linking the visual cortex and visual-association areas—to language regions in the superior temporal gyrus, or Wernicke's area (Shaywitz, et al. 1998).

Dyslexic readers also showed a relative over-activation in the brain region known as Broca's area, which is associated with spoken language (Bock, 1998). Normal readers, by comparison, showed no increase of activity in Broca's area. Dr. Shaywitz has suggested that dyslexic readers may use this area of the brain in an effort to compensate for a deficiency in the brain regions used by normal readers for phonologically oriented reading tasks (Bock, 1998).

This study, along with previous work by Dr. Shaywitz and her colleagues (Shaywitz, et al, 1996), clearly establishes reading to be a whole-brain activity. Dr. Shaywitz explains that these studies:

> *"… suggest a tentative neural architecture for reading the printed word. In particular, the identification of letters activates sites in the extrastriate cortex within the occipital lobe, phonological processing takes place within the inferior frontal gyrus; and accessing meaning calls on areas within the middle and superior temporal gyri of the brain."*

Cognitive Cooperation

Each of the brain regions employed in the reading process is required to function cooperatively for the activity to be successful. This concept of a careful orchestration of brain regions is often

referred to as an issue of "functional connectivity" (Friston, Frith, & Frackowiak, 1994; Horowitz, 1994; McIntosh & Gonzalez-Lima, 1994, Shaywitz, et al., 2000).

The results of the Yale studies have led some researchers to conclude that functional connectivity in the brains of dyslexic readers is insufficient for the regions to act as a system for decoding print into phonological structures (Shaywitz, et al, 1998; Shaywitz, et al., 2000). This has prompted research to determine what types of instruction will benefit dyslexic readers—and how the brain might change in response to such instruction.

Case Study: University of Washington

Researchers at the University of Washington believe they have found effective instructional strategies for dyslexic readers— and have the brain scans to prove it.

Todd Richards and his colleagues carried out a study involving six dyslexic and seven non-dyslexic boys ranging in age from 10 to 13. These subjects were matched on a variety of controls including IQ. The non-dyslexics were above-average readers for their age, while the dyslexics were significantly below.

Prior to treatment, all of the boys were imaged using a new non-invasive technique called "proton echo-planar spectroscopic imaging, or PEPSI (Posse, et al. 1997). Like fMRI, PEPSI measures metabolic activity in brain regions, but it takes a more direct approach by measuring "tissue-based lactate changes caused by a temporary mismatch of oxygen delivery and consumption in response to neuronal activation." (Richards, et al., 1999)

The dyslexic readers were given a three-week, phonologically-driven instructional treatment consisting of 15 two-hour group sessions. These included activities that taught the boys to analyze the sound structure of spoken words, as well as automatic sound symbol correspondence training and decoding strategies using high-frequency English spelling patterns.

Approximately one year after the first imaging session, both test groups were re-imaged performing the same tasks to determine the long-term effect of the treatment they had undergone. As well, the dyslexic boys had their reading skills tested.

Richards and his colleagues found that not only had the dyslexic boys maintained their gains in reading skills—the imaging scans also revealed they were now expending just 1.8 times the energy to perform the phonological processing tasks as the controls. Prior to treatment, their energy expenditure was roughly 4.0 times that of the controls.

Moreover, according to Richards, the dyslexics and the controls were not statistically different when re-imaged after treatment.

While the dyslexic boys had not been cured, they had clearly demonstrated a response to treatment.

This research provides compelling evidence that a well-structured instructional intervention program—one that focuses on phonological processing, sound symbol correspondence training and the development of decoding skills—can significantly improve the skills of dyslexic readers. One of the researchers on the University of Washington team, Virginia Berninger commented: "This research offers a message of hope. We can see improvements in children's reading

levels with this intervention even if there are preexisting brain differences that make learning difficult." (UniSci, 2000)

The AutoSkill Academy of READING constitutes a deliberate and thoroughly researched response to these observations. A dynamic software program, the Academy of READING incorporates the theories of a balanced approach to reading into its instructional fabric. Its contents include:

> ▶ Explicit instruction in phonemic awareness;
> ▶ Structured development of sound symbol association knowledge;
> ▶ Development of accurate and fluent decoding of text to a level of automaticity; and
> ▶ Comprehension practice to apply skills and strategies, and develop reading fluency.

The combination of these elements into a single program has proved highly effective and efficient for addressing the needs of both emergent readers and students experiencing delays or disabilities in the reading-acquisition process.

Meeting the Requirements

By providing training in all the requisite areas as determined by scientific research—phonemic awareness, sound symbol association, decoding fluency and accuracy—and by providing comprehension practice activities, the Academy of READING literacy intervention software program has been extremely successful at improving students' reading abilities. It meets all the requirements of an effective reading strategy, and is designed to achieve permanent gains in mastering core reading skills, including: phonemic awareness, sound symbol association, decoding accuracy and fluency, automaticity, and comprehension. Each of these skills is examined in more detail in the sections that follow.

Phonemic Awareness

Much of today's reading research touches on the significance of phonemic awareness in reading acquisition. Phonemes are the smallest sound units that make up spoken language. In English, various combinations of some 44 different phonemes are used to form the words we speak. For example, the phonemes /k/, /a/ and /t/ blend together to form the word "cat". When we speak, the phonemes blend together so tightly that the word "cat" is produced as a single pulse of sound.

> Phonemic awareness refers to the ability to pull this sound pulse apart into its components. It is the ability to recognize, focus on and manipulate the individual sound units of spoken language.

Phonemic awareness is a sophisticated form of knowledge. It is part of—but distinct from—phonological awareness, which includes larger sound units such as syllables, onsets and rimes (Ehri, et al., 2001).

A National Research Council report on preventing reading difficulties in young children describes the difference between phonological awareness and phonemic awareness in this way:

> *"The term phonological awareness refers to a general appreciation of the sounds of speech as distinct from their meaning. When that insight includes an understanding that words can be divided into a sequence of phonemes, this finer-grained sensitivity is termed phonemic awareness."*
>
> Snow, Burns, & Griffin, 1998

Numerous studies have established the critical role of phonological processes in reading acquisition: Adams, 1990; Ball & Blachman, 1991; Blachman, 1994, 1997; Brady & Shankweiler, 1991; Goswami & Bryant, 1990; Rieben & Perfetti, 1991; Shankweiler & Liberman, 1989; Share, 1995; Shaywitz, 1996; Stanovich, 1992; Wagner & Torgesen, 1987.

Much of this research explains that an awareness of phonemes is necessary to grasp the alphabetic principle and to benefit from formal reading instruction (Adams, 1990; Chard & Dickson, 1999).

What is more, evidence suggests that phonemic awareness is highly predictive of later reading success (Ball & Blachman, 1991; Juel, 1988; Stanovich, 1986; Wagner, Torgesen, & Rashotte, 1994). In fact, it has been repeatedly shown that children who do not possess intact phonological processing skills are highly likely to become, and remain, poor readers (Blachman, 1984, 2000; Bradley & Bryant, 1983; Byrne & Fielding-Barnsley, 1993, Iverson & Turmer, 1993; Jule, 1988; Snowling, Goulandris, & Defty, 1996; Torgensen & Burgess, 1998; Vellutino & Scanlon, 1987; Wagner, Torgesen, & Rashotte, 1994).

Unfortunately for many children, the development of phonemic awareness does not come easily and requires explicit, systematic instruction. And research indicates that weak phonological processing skills persist for poor readers through their teenage years (Fawcett & Nicholson, 1995) and into adulthood (Pennington, et al., 1990).

According to results from the Connecticut longitudinal study (Shaywitz, et al., 1992), deficits in phonological processing are at the core of the difficulties experienced by the majority of reading-delayed young adults.

> *"In short, success in early reading depends on achieving a certain level of phonological awareness. Moreover, instruction in phonological awareness is beneficial for most children and seems critical for others."*
>
> Chard & Dickson, 1999

Fortunately, research indicates that phonemic awareness instruction can significantly benefit children's reading abilities and remediate those who have fallen behind.

In its meta-analysis of research related to the importance of phonemic awareness on reading acquisition, a National Reading Panel directed by the United States Congress, found consistently positive results. Analyzing 52 studies that met its rigorous research methodology criteria, the panel concluded that the benefits of phonemic awareness instruction were replicated many times across the experiments and therefore solidified claims of the beneficial impact of phonemic awareness instruction (Ehri, et al. 2001). Specifically, the panel determined

that phonemic awareness instruction assists reading and spelling acquisition and reading comprehension, despite recent claims to the contrary (Coles, 2000; Krashen, 2000).

Given the wealth of research pointing to the essential role that phonemic awareness plays in reading acquisition, it seems reasonable to suggest that an effective reading program must train students to become phonemically aware. For this reason, the Academy of READING includes a comprehensive phonemic awareness training module.

Academy of READING - Phonemic Awareness Training

Responding to research confirming the hierarchical or developmental nature of phonemic awareness (Bruce, 1964; Fox & Routh, 1975; Griffith & Olson, 1992 Liberman, et al., 1974), the phonemic awareness training module within the Academy of READING covers the essential skills in a developmental sequence.

Students begin with rhyming word-matching activities, then progress to matching words that begin with the same sound. Once this skill has been acquired, students learn to match words that have the same ending sound.

These activities are introductory in nature and can be characterized; they constitute training in the more global concept of phonological awareness. Students move into more specifically phonemic-oriented training once they have shown mastery of these early skills. Later exercises require them to match the initial sound of a target word to one of three aurally presented phonemes or sounds. Students repeat this exercise while listening for and isolating the final phoneme, then the middle phoneme.

Academy of READING - Phonemic Awareness - Skills Training

Core Skill	Skill Type	Subskills
Sound Match	Word Matching	Rhyming words
		Beginning sounds in words
		Ending sounds in words
	Sound Matching	Beginning sounds
		Ending sounds
		Middle sounds
	Blending	Blending 3 sounds
		Blending 4 sounds
	Segmentation	3 sound word building
		4 sound word building

Once students have demonstrated an ability to analyze the phonemic structure of words, they progress to phoneme-synthesis activities, working on blending three- and four-phoneme words. Finally, students are trained in rebuilding segmented three- and four-phoneme words.

All 10 skills are developed without any text present; combined, they represent the phonemic awareness training module of the Academy of READING program.

Sound Symbol Association

Learning to read the English language is an extremely difficult process. There are, after all, more than 1,100 different ways the alphabet can be used to represent the 44 different phonemes of spoken English. Many words share the same letter combinations but are pronounced quite differently when spoken: "clove", "love"; "pint", mint".

English also has many words that use different letters to represent the same sound. Consider "cook" and "technique" (the phoneme /k/ is represented by "ch", "k", and "q").

Given this complexity, it is essential for students to develop an understanding of how letters map onto sounds (phonemes) to create sound-symbol correspondences and spelling patterns. The knowledge of the relationship between letters and sounds, that is, the alphabetic principle, is the hallmark of successful readers (Adams, 1990).

Comprehensive literature reviews consistently arrive at the same conclusion: knowledge of the alphabetic principle contributes significantly to children's ability to read words in isolation or connected text.

Academy of READING - Sound Symbol Association Training

The activities designed to develop a robust knowledge of sound symbol association are found in the Letter-Sound Match training section of the Academy of READING program. The development of sound symbol association knowledge or the Alphabetic Principle, is a major component of the Academy of READING software program. The Academy of READING offers a structured opportunity to develop sound symbol association knowledge through the exercises found in Letter-Sound Match training. Having focused on isolated phonemes in Sound Match training, Letter-Sound Match training works through a series of activities in which students hear the word pronounced by the computer and must match it to one of three text options. Students work with letters, letter combinations and words. Activities include blending and word building. Students who work through these exercises not only reinforce their phonological awareness but also develop their grapho-phonemic knowledge.

Once students have completed these Letter-Sound Match training activities, they have developed an implicit understanding of the alphabetic principle. What is more, the Sound Symbol Association training is designed to get students familiar with letter-sound correspondences prior to the intense, rapid, and consistent training of visual match and auditory-visual match activities. As a "warm-up" activity, students will be better equipped to progress through these activities designed to solidify phonics and decoding skills.

Academy of READING - Sound Symbol Association - Skills Training

Core Skill	Skill Type	Subskills
Letter-Sound Match	Letters	Group 1
	Letters	Group 2
	Beginning position	Beginning sounds
	Ending position	Ending sounds
	Middle position	Middle sounds

	Letter patterns	Group 1 CV/VC letter patterns
		Group 2 CV/VC letter patterns
		Group 3 CV/VC letter patterns
	Blending	Blending 3 sounds
		Blending 4 sounds
	Segmentation	3 sound word building
		4 sound word building
		3 letter word building
		4 letter word building

Phonics and Decoding

"Instructors should recognize the ample evidence that youngsters who are directly taught phonics become better at reading, spelling and comprehension than those who must pick up all the confusing rules of English on their own. Educators who deny this reality are neglecting decades of research. They are also neglecting the needs of their students."

Reyner et al., 2002

In their meta-analysis of phonics instruction research, the National Reading Panel determined that explicit, systematic phonics instruction was a crucial component in an effective reading program (National Reading Panel, 2000). This conclusion echoed the findings of at least two other major reviews of classroom studies that compared phonics instruction to more holistic approaches to reading instruction. Both Marilyn Adams' 1990 review and Jeanne Chall's 1996 review determined that systematic phonics instruction produced significantly higher achievement among emergent readers, particularly those considered to be "at risk" of reading failure.

This conclusion does not suggest, however, that phonics instruction is a complete reading curriculum. It does suggest that explicitly and systematically teaching beginning readers to link letters to sounds is an essential part of a balanced reading program.

The evidence is so abundant that Keith Stanovich wrote:

"That direct instruction in alphabetic coding facilitates early reading acquisition is one of the most well-established conclusions in all of behavioral science (1994)."

The Academy of READING offers a unique opportunity to develop and strengthen the appreciation for the alphabetic principle and an understanding of phonics. Having first become familiar with the mapping of sounds to symbols in the Letter-Sound Match activities, the Auditory-Visual Match activities of the Academy of READING entrench this knowledge through repeated exposure to a series of high-frequency words and syllables along a development continuum. As students practice making the visual match and auditory-visual match with these words and syllables, they become highly skilled at the rapid and automatic recognition of the

---

Grapho-phonemic Awareness (Phonics)

To deal with the complexity of the sound-symbol relationships of the English language, many teachers incorporate phonics rules into their instruction. This can be problematic, however, due to the inconsistency of the rules themselves – the rationale behind much of the criticism of phonics instruction.

The pronunciation of phonemes is dependent upon the phonemes around them. Phonics rules should not be considered "rule" but rather as weak generalization. Reading vowels in words cannot be held to a consciously applied set of rules. Instead, it must be guided by a more general, implicit knowledge of letter-sound relationships and English orthography.

AutoSkill suggests that teachers make students aware of how phoneme pronunciation is dependent upon the phonemes around them and not tied to a specific phonic's rule.

---

myriad of ways in which the alphabet can be used to represent the sounds of the English language.

Decoding Accuracy and Fluency

Skilled reading can be characterized as accurate and fluent decoding of text that allows for the extraction of meaning. If a reader reads in a laborious, inefficient manner, it is extremely difficult for him or her to comprehend or remember what has been read, or to relate the ideas to background knowledge (Reid-Lyon, 1998).

The decoding and word-recognition abilities of skilled readers are "so rapid, automatic, and efficient that skilled readers need not rely on contextual information. It is the poor readers who must guess from context out of necessity because of weak decoding skills. " (Stanovich & Stanovich, 1995)

Research studies have consistently found that efficient decoding and word-recognition skills are closely connected to improved reading comprehension (Calfee & Piontkowski, 1981; Herman, 1985; Stanovich, 1986). The National Reading Panel Report (2000) explains the connection this way:

"Both decoding and comprehension require cognitive resources. At any given moment, the amount of cognitive resources available for these two tasks is restricted by the limits of memory. If the word recognition task is difficult, all available resources may be

consumed by the decoding task, leaving little or nothing for use in interpretation. Consequently, for the nonfluent reader, difficulty with word recognition slows down the process and takes up valuable resources that are necessary for comprehension. Reading becomes a slow, labor-intensive process that only fitfully results in understanding."

The importance of accuracy while reading is well understood. Without accurate letter and word recognition, text has no possibility of being comprehensible. As a result, reading programs and remediation efforts often emphasize decoding accuracy at the expense of fluency (Torgesen, in press).

A recent National Assessment of Educational Progress (NAEP) report highlighted the lack of fluency achievement in American education (Pinnell et al., 1995). The NAEP study of a nationally representative sample of fourth graders found that 44 percent of students were 'disfluent' when reading appropriate grade-level stories. Although decoding and word recognition accuracy are essential to skilled reading, they are not enough—without fluency, comprehension is inevitably impeded (National Reading Panel Report, 2000).

Automaticity

A major breakthrough in the understanding of reading fluency and its impact on comprehension was the development of the theory of automatic information processes as articulated by LaBerge and Samuels in 1974.

These researchers theorized that the reading of letters, syllables and words must be learned to a point of automatic responding so that readers can attend to higher-level comprehension and reasoning (Fiedorowicz, 1986). Obviously, then, this concept of reading fluency incorporates automaticity—"fluent processing of information that requires little effort or attention," as defined in The Literacy Dictionary (Harris & Hodges, 1995).

According to the National Reading Panel Report (2000), automaticity "involves processing complex information that ordinarily requires long periods of training before the behavior can be executed with little effort or attention."

Ackerman (1987) emphasizes that automatic processes "may develop only through extensive practice under consistent conditions, which are typical of many skill acquisition situations." Without a doubt, learning to read can be described as a complex undertaking that requires extensive practice. The AutoSkill Academy of READING software program was designed with this in mind.

Academy of READING - Phonics and Decoding Training

The Academy of READING program incorporates and applies the theory of automaticity alongside a task-analytic methodology. A unique training procedure, it includes both visual matching-to-sample and auditory-visual matching-to-sample activities, and is designed to improve rapid automatic responding through practice (Fiedorowicz, 1985).

The Academy of READING breaks down the complex task of learning to decode into a developmental sequence. Learners focus on individual letters as well as common and

orthographically accurate vowel-consonant combinations that form words and pseudo-words, and on high-frequency words of varying complexities.

Academy of READING - Phonics and Decoding

Component Skill	Visual Match	Auditory-Visual Match
Letters	✓	
Letter names		✓
Letter sounds		✓
CV/VC letter patterns	✓	✓
CVC letter patterns	✓	✓
Words with CVC letter patterns	✓	✓
CVCV letter patterns	✓	✓
Words with CVCV letter patterns	✓	✓
CCVC letter patterns	✓	✓
Words with CCVC letter patterns	✓	✓
CVCC letter patterns	✓	✓
Words with CVCC letter patterns	✓	✓
Group 1 CVVC letter patterns	✓	✓
Group 1 words with CVVC letter patterns	✓	✓
Group 2 CVVC letter patterns	✓	✓
Group 2 words with CVVC letter patterns	✓	✓
Words grouped into 10 levels	✓	✓

Practice with pseudo-words is essential for an effective training program in decoding. According to Shaywitz (2000), the reading of pseudo-words is "perhaps the clearest indication of decoding ability because familiarity with letter patterns cannot influence the individual's response."

In order to achieve automaticity of letter and word recognition, learners must demonstrate an ability to respond at a high level of accuracy and at a consistent rate of speed. As students progress through this hierarchy of skills, decoding accuracy and fluency is achieved.

Comprehension

AutoSkill recognizes that to become successful readers, students must not only receive instruction in component skills, but must also practice the use of those skills in comprehension exercises.

Stanovich (1986) explains that there is a powerful "bootstrapping" effect caused by increased reading practice. A reader who is able to employ effective reading strategies in a confident manner tends to read more often, enabling accelerated vocabulary development, orthographic awareness and word recognition skills.

The paragraph content for the Academy of READING was designed to appeal to specific groups of readers. For children in K-12 grades, the paragraphs deal with engaging topics related to

common childhood experiences. For adults, paragraphs were selected from a variety of real-world sources. All paragraphs were graded using several criteria including the Fry Readability Formula, sentence structure and syntax analysis, as well as an alignment to the Dolch leveled word list.

Academy of READING Comprehension - Skills Training

Core Skill	Subskills
Independent Reading 10 groups of reading passages covering junior and senior topics. Includes exercises to develop student's understanding of essential comprehension skills.	Main idea/theme
	Author's purpose
	Detail
	Sequence
	Inference
	Vocabulary
	Relationship
	Text structures
The Academy of READING includes a set of reading paragraphs to help students strengthen their comprehension abilities. These include the development of a reading vocabulary; the ability to identify a main idea; the ability to understand relationships, make inferences, and note specific facts and details; and the capacity for retaining information.	

Educational Principles at Work

"…One easily realizes that the most impressive findings have been registered in intervention studies where children received a combined training program that emphasized the integration of phonological skills with letter knowledge."

E. Roth and W. Schneider, "Training of Phonological Awareness and Letter Knowledge in Children-at-risk.," 1998

Integrated Instruction – Balanced Skills Training

The reciprocal relationship between phonological awareness and the acquisition of literacy skills—for example, understanding the correspondence between sounds and symbols—has been well documented. Studies indicate a relationship in which one ability assists the development of another, and vice versa.

According to Byrne and Fielding-Barnsley (1989): "…neither phonemic awareness nor letter-sound knowledge was sufficient for acquisition of the alphabetic principle. They were needed in combination." Similarly, Ball and Blachman (1991) determined that when phonemic segmentation skills are taught in conjunction with letter-name and letter-sound instruction, there could be an immediate and beneficial impact on reading and spelling skills.

Given the wealth of support for integrated instruction, it seems reasonable to expect an effective reading program to offer this type of approach. The Academy of READING offers an implementation option that supports just such an approach.

The program sets in motion a sequence of training exercises that integrates phonemic awareness and sound symbol association training activities with visual matching or auditory-visual matching activities. With appropriate support from the instructor, students practice essential sound-symbol correspondence and decoding training while developing phonemic awareness during each instructional session.

Motivation

"As in every domain of learning, motivation is crucial. Although most children begin school with positive attitudes and expectations for success, at the end of the primary grades and increasingly thereafter, some children become disaffected."

Snow, Burns, & Griffin, 1998

There is significant evidence to suggest that students who experience early reading difficulty run a serious risk of falling further and further behind. Reading becomes more awkward as students spend more time with increasingly difficult texts (Stanovich, 1986).

One method of breaking this downward spiral is by motivating these underachieving students to read and succeed. Effective strategies for motivating struggling readers include focusing on individualized instruction built upon students' current interests (Brophy, 1998; McIntyre, 1989).

Another strategy is known as Mastery Learning. Brophy (1998) describes this as a system in which students, once certified as mastering a unit of study, are not required to do further work on it. Students who do not meet mastery criteria receive corrective feedback and continue in

their practice until mastery is achieved. This method is believed to be effective in building the confidence of struggling students, increasing their willingness to take necessary risks and achieve challenging goals (Grabe, 1985).

The AutoSkill Mastery Learning Approach

Taking a Mastery Learning Approach, the Academy of READING acknowledges students who successfully complete a component of training with an award and printable certificate of success. Once a skill has been mastered, the student moves on to the next: his or her progress is abundantly clear, represented graphically for the student to provide an image of how his or her efforts are yielding results.

This positive reinforcement has a tremendous impact on building self-esteem and motivation. What is more, the short but intense training periods allow the student to stay focused without placing a heavy burden on his or her attention span.

Feedback, of course, is an important part of the learning process. Without it, learners cannot know whether they have performed a task adequately or inadequately. Certain kinds of feedback, however, can be counterproductive. For struggling students with a history of poor academic performance, negative feedback can be detrimental to perceptions of self-worth and self-efficacy.

Positive and corrective feedback can motivate struggling readers as they receive confirmation on their abilities or acquire the information necessary to complete a task successfully in the next trial. Corrective feedback of this sort supports a student's learning needs without being negative or discouraging.

The Academy of READING has therefore been designed to employ only corrective and positive feedback. For example, when a student makes an error in the visual match or auditory visual match training activities, the correct answer is simply underlined in blue. A green check mark appears when the student is correct. Congratulatory messages let students know when they have mastered each skill. This type of feedback cultivates a positive atmosphere of learning and achievement.

Evaluation

State and federal education officials are holding educators increasingly accountable for student success. Several states currently regard teachers as responsible for student performance on standardized tests; they may reward or penalize the teachers according to the results.

Consequently, there is a powerful imperative for teachers to track and assess student progress. Typically, progress is tracked through testing, with teachers adjusting their instruction according to the results. Teachers also recommend that parents periodically request some concrete indication of their children's progress in school.

Without a detailed reporting and management system, it is unlikely that a teacher can accurately assess students' progress or anticipate test performance. In fact, research indicates that a characteristic of a successful school is the "means to monitor pupil progress through diagnostic data collection and use of data for instructional improvement (Fullan, 1991)."

Reporting and Management

The Academy of READING provides a complete reporting and management system that constantly and consistently tracks student testing and training results, and interventions by skill to show progress and pinpoint areas of concern. Examples include:

Skill area	Details skill level and skill type
Status of skill	Not Attempted, Mastered or Currently Being Worked on
Started and completed dates	Dates that training was started and completed on a specific skill
Time on task	Amount of time student has spent in practice and training for each skill
Trials	Number of attempts to master a skill
Interventions	Number of interventions that occurred while student attempted to master a skill. Interventions include accelerating through skills, review of tutorials, breaks to relieve fatigue
Teacher Time	Number of Teacher Time interventions student received while attempting to master a skill

Summary progress data is also available to summarize progress and skills mastered. For example, it shows the overall date range that a student trained in a specific skill, percentage of skills mastered by the student compared to total skills in individual training program, total time on task and total skills mastered.

More specifically, the system records each individual error made by students during their training. This provides a powerful diagnostic tool, allowing teachers to identify precisely the strengths and weaknesses of each student. These results are available at any time and fully printable, allowing teachers to demonstrate progress to concerned parents and principals. What is more, students can be supplied with concrete, quantifiable evidence of their own progress.

In addition to student reports, the Academy of READING program also tracks overall progress by class and school, enabling educators and administrators to keep abreast of progress and easily pinpoint issues for quick corrective action. This includes reports, which show gains, snapshot of progress, and status of tests, as examples. A wealth of information is presented which can help drive key decisions on literacy proficiency programs, and demonstrate ongoing progress to meet accountability requirements.

Assessment

Teachers need to know the reading levels of their students for individualized instruction to be appropriate and possible. Otherwise, instruction tends to occupy a middle ground in which advanced students are not sufficiently challenged and struggling students are left behind.

Armed with the detailed knowledge provided by the Academy of READING, teachers can accurately adjust their approach to classroom instruction.

The Academy of READING Assessment Test is an integral component of the Academy of READING v5.   This assessment provides a profile of student reading comprehension proficiency for students in Grades 2-10, both before and after training. The initial assessment scores drive student placement into individualized training programs, while post-test scores enable educators to track progress and reading improvements resulting from the training.

Consistent with standardized test formats, grades 3 to 10 assessments use passages taken from children's literature and can be completed within a typical class period. The grade 2 assessment uses proprietary, unpublished text that follows the same format and design of the other assessments. The grade 2 assessment can also be completed within a typical class period.

The Academy of READING Assessment has been designed so that the Grade Equivalent reading level scores reported are consistent with scores on other major standardized tests.

Test results are reported in multiple formats, to enable interpretation of student skills from multiple perspectives. Student proficiency is reported in the following score levels:

Developmental Level	Based on 9 key comprehension levels
Performance Level	Below Basic, Basic, Proficient, or Advanced
Grade Equivalent	According to grade level, and within grade level based on month of instruction – for example Grade 6.3 reflects Grade 6, month 3

Performance Level and Grade Equivalent scores provide measures of a student's ability relative to a population. Developmental Level scores are unique to the AutoSkill test and provide absolute measures to enable teachers to interpret which skills and strategies are used by the student to complete comprehension tasks.

A comparison of students' assessment test scores before and after training on the Academy of READING are used to determine absolute gains in developmental levels, and demonstrate the effectiveness of training in moving between performance levels. The pre- and post-tests are designed to be maximally sensitive to partial year development gains in moving between grade levels and within grade levels.

The Academy of READING Assessment Test was developed on behalf of AutoSkill International Inc., by Dr. Peter B. Mosenthal and Michael Hardt of Performance by Design of Syracuse, New York. Following extensive research, Dr. Mosenthal and Mr. Hardt designed the assessment using constructs to provide a consistent means of measuring underlying reading comprehension skills.

Implementation

Expecting teachers to significantly change their teaching practices is counterproductive to the intended change. Experts advise taking gradual, incremental steps to ensure that those carrying out the change are equipped with the required skills.

It is complex and difficult to implement programs that require educators to change their schedules or daily routines in the classroom. Underestimating this challenge—or approaching it with unrealistic expectations—will inevitably end in disappointment (Fullan, 1991, 1993).

According to educational change expert Michael Fullan (1993), expecting teachers to significantly change their teaching practices is counterproductive to the intended change. He suggests that educators and administrators should expect change to occur over a two- to three-year period if the nature of the change is large in scope.

Other researchers are not even as optimistic and suggest that change can be realistically achieved in three to five years (Samuels, 1981; Samuels & Pearson, 1988).

Whatever the timeframe, experts advise gradual, incremental steps toward change. It is also essential to ensure that those carrying out an educational change are equipped with the required technical skills.

If the goal of a school district is to raise standardized test scores of reading ability, then experts like Fullan (1991) suggest "to work at fewer innovations, but do them better – the reason being that it is probably not desirable, certainly not humanly possible, to implement all the changes expected, given what we know about the meaning, time, and energy required for effective implementation."

AutoSkill designed the Academy of READING with this understanding in mind. By giving considerable thought and study to some of the key factors to successful program implementation, the Academy of READING can be incorporated into a school's reading curriculum without placing a heavy burden on daily scheduling or professional development resources. Furthermore, AutoSkill provides teachers with the support necessary for successful program implementation.

Daily Schedule

In the case of the Academy of READING, students will ideally train for 15 to 40 minutes per day, three to five times per week, depending on the age of the student. This schedule enables teachers to incorporate other activities into their language-arts programs or computer lab time slots. Furthermore, a commitment of 15 to 40 minutes does not require a major realignment of schedules, nor does it demand a significant change in teacher or student routines.

Introductory Level Staff Development

During the software implementation process, AutoSkill gives hands-on computer-based training to all literacy educators and other users of AutoSkill literacy software programs. The focus is on educational software product training, including coverage of implementation issues, and an overview of the program's pedagogical merits. Adaptable to your education environment, an introductory development session is usually given in a one-day class.

Best Practices Workshops

Experienced users of AutoSkill educational software programs benefit from this workshop, which focuses on higher-level methods for monitoring and tracking students' progress, as well as literacy intervention and coaching strategies. Educators who participate have normally worked with the reading software program for a full year.

AutoSkill Advantage Customer Support Program

The AutoSkill Advantage customer support program provides expert AutoSkill instructional and technical support to assist customers in leveraging their investment in AutoSkill educational software products. The program is designed to assist literacy educators operating in the most hectic and challenging of learning environments. The program also provides complete support to technical administrators to assist them in installing and using AutoSkill products.

The Advantage program is designed to meet a range of instructional and technical needs – from email and telephone support system administrators and educators, to providing educator tools for the classroom.

The Science of Selection

"…the fundamental purpose of science is to test our beliefs and intuitions and to tell us where the truth lies…indeed, the education of our children is too important to be determined by anything but the strongest of objective scientific evidence."

Dr. Reid-Lyon, Chief, Child Development and Behavior Branch,
National Institute of Child Health and Human Development (NICHD), 1998

It is by no means a simple decision for educators today to adopt a reading program. Many factors enter into the equation—but first among them is proof of effectiveness. No teacher or administrator is likely to commit financial or professional resources to a reading initiative without scientific validation of its methodology and its results.

The value of scientific research is called out clearly in a published document of the United States Department of Education. The piece, which offers guidance for applicants to the competitive grant program of the Reading Excellence Act, stresses the importance of scientifically based reading research that:

- ▶ employs rigorous, systematic and empirical methods;
- ▶ is able to justify the conclusions drawn;
- ▶ indicates replicability by multiple investigators in various locations; and
- ▶ has been objectively peer-reviewed.

According to the Education Commission of the States, the newly reformed Elementary and Secondary Education Act – No Child Left Behind – aims to have all children achieve reading proficiency by the end of the 3rd grade, with significant funding allocated for Reading First and Early Reading First programs. As detailed in the No Child Left Behind Policy Brief (Education Commission of the States), the National Reading Panel, outlines five scientifically based essential components of effective reading instruction:

- ▶ phonemic awareness
- ▶ phonics
- ▶ vocabulary development
- ▶ reading fluency, including oral reading skills
- ▶ reading comprehension strategies

AutoSkill understands these requirements and incorporates this knowledge into the Academy of READING, a research-based literacy intervention solution designed to help struggling students achieve permanent gains in mastering core reading skills.

The AutoSkill Story

A Revolution in Reading-skills Development

Working from an understanding that reading is a whole-brain activity and that reading instruction demands a balanced approach, neuropsychologists Christina Fiedorowicz and Ronald Trites developed the concept of *subtypes.*

The concept of subtypes is actually quite simple. It suggests that even though individuals with reading difficulties have many similar characteristics, they have differential strengths and weaknesses in component reading skills.

Traditional methods of remediation tend to use one single method for teaching disabled readers. In the subtype/subskill approach, the strategy is to apply teaching methods that correspond to each individual's own pattern of strengths and weaknesses, in order to develop decoding and word-attack skills. Three specific subtypes of reading disabilities have been identified and validated: Type O, Type A and Type S (see Fiedorowicz & Trites, 1987, for a review of this literature).

The Three Subtypes of Reading Disabilities
Type O: Oral
Type A: Auditory/Visual
Type S: Sequencing

Through research, Drs. Fiedorowicz and Trites demonstrated the effectiveness of using subtype classifications to develop reading programs that directly answer the unique needs of individual learners. Their findings led to the development of the original AutoSkill Component Reading Subskills (CRS) program—forerunner to today's Academy of READING.

In the Beginning

The origins of AutoSkill and its Academy of READING software lie with Dr. Christina Fiedorowicz and Dr. Ronald Trites.

Dr. Fiedorowicz's study of training component reading skills for students with reading disabilities ultimately led to the development of the AutoSkill Component Reading Subskills Program, one of the central programs within Academy of READING.

As Dr. Fiedorowicz's development partner, Dr. Ronald Trites was instrumental in turning the vision of AutoSkill and its Academy of READING program into reality.

Confronting Complexity

Reading is a highly complex process, but through task analysis it can be broken down into component parts. Once the simpler component skills are learned well, a reader is better prepared to focus on the more difficult aspects of the process.

It is for these reasons that, in the Academy of READING, letters, letter combinations, syllables progressing to words of different phonetic patterns, sentences and finally paragraphs are learned to ensure that the student has mastered the key component skills required to be an effective reader. This allows students to comprehend the greater meaning of the text they are reading, rather than concentrating on decoding individual words.

Another important aspect of the process of learning to read is *automaticity*, which suggests that the basic component skills of reading must not only be learned, but learned to such a degree that processing them becomes automatic (Fiedorowicz, 1986; LaBerge & Samuels, 1974). This automaticity of response then facilitates the attainment of higher-level reading skills such as comprehension.

Behavior is a further consideration. It has long been recognized that learning is enhanced through the immediate positive reinforcement of correct responses and through the presentation of correct answers when errors have been made. Part of the reinforcement process is progressive learning: training exercises are presented in sequence from simple to complex, building a strong foundation step by step in a hierarchy of skills.

The Academy of READING was therefore built on a combination of these elements: each was integrated into a unique instructional approach. Once developed, the efficacy of the program had to be proven. Could it actually help improve the skills of children with dyslexia? Drs. Fiedorowicz and Trites conducted three clinical research studies to find the answer to this essential question.

Put to the Test

Research Study I

The first study to examine the effectiveness of the AutoSkill Reading Program with reading disabled children was conducted by Dr. Fiedorowicz in 1986. It included 15 boys, all of who had serious reading disabilities. Each had failed to acquire normal reading proficiency despite average intelligence, socio-cultural opportunity, conventional instruction, and freedom from gross sensory, emotional or neurological handicaps.

Research Study 1: Test Group
- 15 boys
- Average age: 11 years (range of 8.1 to 13.8 years)
- Average projected reading grade delay per Wide Range Achievement Test: 2.3 grades (range of 1.5 to 4.3 grades)

- 5 Type O
- 5 Type A
- 5 Type S

Each student in the test group was given 30-minute sessions on the AutoSkill Reading Program four to five times per week over an 11-week period. This amounted to an average of 21.5 hours of training.

Training was tailored to each subtype classification. Type O participants were trained on the oral reading procedure; Type A participants on the auditory-visual matching procedure; and Type S participants on the visual matching procedure. Eight of the boys were trained during the first half of the academic year and seven during the second half of the academic year.

Pre-training and post-training assessments measured accuracy and latency of response (i.e. speed) for the component reading subskills. The Gallistel-Ellis Test of Coding Skills was used to assess phonetic knowledge, the Qualitative Analysis of Silent and Oral Reading was used to assess the reading of cloze paragraphs, and the Student Problem Individual Reading Evaluation was used to assess reading word recognition and paragraph-reading fluency, retention and comprehension.

Outcomes

By training part of the test group in one half of the school year and part in the other, researchers were able to compare the two groups mid-way through the year, when one had received instruction and one had not. The boys who received the training improved more than the untrained participants in their phonetic knowledge of words and reading word recognition (1.1 grade-level gain versus a 0.1 grade-level gain).

It was also found that the trained participants improved more than the untrained participants in oral reading accuracy, oral reading speed, auditory-visual matching accuracy and visual matching speed.

Once both groups had been trained, the results of the total sample indicated the same significant effects. Improvements were registered in auditory-visual matching speed, phonetic knowledge of syllables and instructional level of paragraph reading fluency and comprehension.

The results demonstrated that the AutoSkill program was an effective tool for improving the specific component reading skills and the general reading skills of reading-disabled children. An additional comparison revealed that those reading gains were maintained over a four-month follow-up period.

Research Study II

The results of the first study were promising, but before the AutoSkill program was made available to teachers, a second, more comprehensive study was conducted (Fiedorowicz & Trites, 1987).

The participants in this study included 115 students who met the same rigorous criteria for reading disability that were employed in the first study.

Research Study II: Test Group
- 115 students (82 males, 33 females)
- Average age: 11.2 years (range of 7.9 to 14.6 years)
- Average projected reading-grade delay per Wide Range Achievement
- Test: 2.9 grades (range of 1.2 to 6.2 grades)

- 26 Type O
- 22 Type A
- 26 Type S
- 17 Untrained Control Participants
- 24 Alternate Computer-Trained Control Participants

The AutoSkill-trained participants (Types O, A and S) were given 30-minute session on the AutoSkill software three times per week, over a 38-week period. This totaled an average of 56.4 hours of training. As before, each participant was trained according to his or her subtype classification.

The untrained control participants were pre- and post-tested at the same time of the academic year as the AutoSkill-trained participants, but in the interim period, the untrained control participants proceeded normally within the school system. The purpose of this control group was to define a sample of reading-disabled participants and follow their progress in whatever programming the school districts typically provided for them.

The alternate computer-trained control participants were provided with computer-assisted programs concerned with some aspect of language arts development. They engaged in three half-hour sessions per week for a total of 30 hours. They were compared with a matched sub-sample of AutoSkill-trained participants who were trained for 30 hours. The purpose of this group was to control for the effect of working on computer-assisted programs related to language-arts development. The programs were selected following consultation with specialists within each school district; teachers were permitted to use their choice of programs.

The pre- and post-test assessment battery included:

- ▶ the AutoSkill Reading Program Test Battery to evaluate Test - Revised to assess reading word recognition;
- ▶ the Gallistel-Ellis Test of Coding Skills to assess phonetic knowledge;
- ▶ the Qualitative Analysis of Silent and Oral component reading subskills;
- ▶ the Wide Range Achievement Reading to assess the reading of cloze paragraphs; and
- ▶ the Student Problem Individual Reading Evaluation to assess paragraph reading fluency, retention and comprehension.

Outcomes

The AutoSkill-trained participants improved more than the untrained control participants in reading word recognition, phonetic knowledge of letters, phonetic knowledge of syllables, paragraph reading accuracy, paragraph reading speed, paragraph reading retention and paragraph reading comprehension. As well, they exhibited better results for graphic representation and meaning of inserted words in cloze passages.

The comparison of the AutoSkill-trained participants and the alternate computer-trained control participants revealed that the AutoSkill-trained participants showed greater improvement in reading word recognition, paragraph reading accuracy and paragraph reading speed.

Overall, the results of this investigation indicated significant gains for the AutoSkill-trained reading-disabled students. Not only were the findings of the first study replicated, but also further benefits of training were exposed —most importantly, the transfer of training to paragraph reading fluency and comprehension.

Research Study III

The results of the first two studies provided evidence of the effectiveness of the AutoSkill program with reading-disabled children. The participants in both made significant gains completing component reading tasks and standardized reading tests that measured different aspects of the reading process. These gains were due to the needs-specific training administered by AutoSkill, and were assessed upon immediate completion of the intervention phase. In the first study (Fiedorowicz, 1986), it was demonstrated that the gains were maintained after a fairly short four-month interval.

A third study was conducted (Fiedorowicz & Trites, 1990) to determine if the gains made in the second study were maintained over a one-year period. The participants consisted of a randomly selected sub-sample of reading-disabled participants from the Type O, Type A, Type S and untrained control groups of the second study.

Research Study III: Test Group
- 59 students
- Average age: 11.1 years (range of 7.3 to 14.6 years)
- Average projected reading-grade delay per Wide Range
  Achievement Test: 3.3 grades (range of 1.2 to 6.2 grades)
- 15 Type O
- 15 Type A
- 15 Type S
- 14 Untrained Control Participants

These follow-up participants were evaluated one year after their final post-test assessment in the second study (i.e., Fiedorowicz & Trites, 1987). The assessment battery included all of the same tests applied previously.

Outcomes

The results showed that participants trained through the AutoSkill program maintained their gains not only in component reading skills but also in general reading skills. In fact, there was a continued improvement in some of the reading skills. Phonetic knowledge of letter sounds and phonetic knowledge of words improved from post-test to follow-up. In contrast, the participants who did not receive the AutoSkill training continued to show a relatively low level of performance in most of the general reading skills.

AutoSkill was honored with awards for the excellence of the original study and this follow-up, including a research award from the Ottawa Council for Exceptional Children (September 1988) and the Sam Rabinovitch Evaluation for Research Award of the Canadian Council for Exceptional Children (October 1988).

> *"The research conducted on AutoSkill was well conceived and implemented, and showed convincing results of a reading technology's ability to increase student reading achievement on a variety of measures."*

Dr. John Schacter, Reading Programs that Work, 2000

Conclusion

The Academy of READING has earned recognition for its effectiveness in building the reading skills of learners at all stages of their academic careers—learners facing the broadest spectrum of education-related challenges. As this document has attempted to demonstrate, that success is due to many factors:

- ▶ a solid foundation of scientific research into the complex process of learning to read;
- ▶ a comprehensive approach to skill-building that concentrates on the essential subskills required for reading success;
- ▶ a focus on establishing the automaticity of readers' responses to text; and
- ▶ an incremental mastery approach that bolsters students' confidence and increases their motivation to learn.

All of these have been incorporated into the program after careful assessments of their value and validity. The development of the Academy of READING and its core modules has involved extensive testing and evaluation—a process that has ultimately validated the program's pedagogical approach.

That validation is what educators increasingly require garnering support for reading programs and marshaling the necessary resources to implement them.

Research into reading and learning is, of course, far from complete. As it advances, AutoSkill will to continue to refine the Academy of READING, incorporating new discoveries to ensure that as a tool, the Academy of READING provides what teachers need to help their students succeed.

References

Ackerman, P.L. (1987). Individual differences in skilled reading: An integration of psychometric and information processing perspectives.

Psychological Bulletin, 102, 3-27.

Adams, M. J. (1990). Beginning to read: Thinking and learning about print.

Cambridge, MA: MIT Press.

Arnold, N.G. (1996/97). Learned helplessness and attribution for success and failure in LD students.

Their World, National Center for Learning Disabilities.

Ball, E. W. & Blachman, B. A. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling?

Reading Research Quarterly, 26, 49-66.

Blachman, B.A. (1984). Relationship of rapid naming ability and language analysis skills to kindergarten and first grade reading achievement.

Journal of Educational Psychology, 76, 610-622.

Blachman, B.A. (1994). Early literacy acquisition: The role of phonological awareness. In G. Wallach & K. Butler (Eds.), *Language learning disabilities in school-age children and adolescents: Some underlying principles and applications* (pp. 253-274).

Columbus, OH: Merrill/Macmillan.

Blachman, B.A. (1997). Early intervention and phonological awareness: A cautionary tale. In B.A. Blachman (Ed.), *Foundations of reading acquisition and dyslexia: Implications for early intervention* (pp. 409-430).

Mahwah, NJ: Lawrence Erlbaum Associates.

Blachman, B.A. (2000). Phonological Awareness. In. In M.L. Kamil, P.B. Mosenthal, P.D. Pearson, and R. Barr (Eds.), *Handbook of Reading Research, III.*

Mahwah, NJ: Lawrence Erlbaum Associates.

Bock, B. (1998). NICHD-funded researchers map physical basis of dyslexia.

NIH-National Institute of Child Health and Human Development News Release, 2 March. www.eurekalert.org/releases/nichd-frmpbodla.html

Bradley, L., & Bryant, P. E. (1983). Categorizing sounds and learning to read - a causal connection.

Nature, 301, 419-421.

Bradley, L., & Bryant, P.E. (1985). Rhyme and reason in reading and spelling.

Ann Arbor, MI: University of Michigan Press.

Brady, S.A., & Shankweiler, D.P. (eds.) (1991). *Phonological processes in literacy: A tribute to Isabelle Y. Liberman*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Brophy, J. (1998). Motivating Students to Learn.

Boston, MA: McGraw Hill.

Bruce, L.J. (1964). The analysis of word sounds by young children.

British Journal of Educational Psychology, 34, 158-170.

Bruck, M. (1992). Persistence of dyslexics' phonological awareness deficits.

Developmental Psychology, 28(5), 874-886.

Byrne, B., & Fielding-Barnsley, R. (1989). Phonemic Awareness and letter knowledge in the child's acquisition of the alphabetic principle.

Journal of Educational Psychology, 81, 313-321.

Byrne, B., & Fielding-Barnsley, R. (1993). Evaluation of a program to teach phonemic awareness to young children: A 1-year follow-up.

Journal of Educational Psychology, 85, 104-111.

California Department of Education. (1995). Every child a reader: The report of the California Reading Task Force.

Sacramento: Author. (http://www.cde.ca.gov/cilbranch/eltdiv/ rdg_init.htm).

Calfee, R.C., & Piaotkowski, D.C. (1981). The reading diary: Acquisition of decoding.

Reading Research Quarterly, 16, 346-373.

Chard, D.J., & Dickson, S.V. (1999). Phonological Awareness: Instructional and Assessment Guidelines.

Intervention in School and Clinic, 34(5), 261-270.

Coles, G. (2000). *Misreading reading.*

Portsmouth, NM: Heinemann.

Cummins, P. (1991). The Learning Center: Adult basic education using computers.

Report to the Advisory Council, Ottawa, Ontario.

Demb, J., Boynton, G., & Heeger, D. (1998). Functional magnetic resonance imaging of early visual pathways in dyslexia.

Journal of Neuroscience, 18, 6939-6951.

Eden, G.F., VanMeter, J.W., Rumsey, J.M., Maisog, J.M., Woods, R.P., & Zeffiro, T.A. (1996). Abnormal processing of visual motion in dyslexia revealed by functional brain imaging.

 Nature, 382, 66-69.

Ehri, L.C. (1979). Linguistic insight: Threshold of reading acquisition. In T. Waller, & G. MacKinnon (Eds.). *Reading research: Advances in theory and practice* (pp.63-114).

New York: Academic Press.

Ehri, L.C., Nunes, S.R., Willows, D.M., Schuster, B.V., Yaghoub-Zadeh, Z., & Shanahan, T. (2001). Phonemic awareness instruction helps children learn to read: Evidence from the National Reading Panel's meta-analysis.

Reading Research Quarterly, 36(3), 250-287.

Fawcett, A.J., & Nicolson, R.I. (1995). Persistence of phonological awareness deficits in older children with dyslexia. Reading and Writing: An Interdisciplinary Journal, 7(4), 361-376.

Fiedorowicz, C. (1986). Training of component reading skills. Annals of Dyslexia, 36, 318-334.

Fiedorowicz, C., & Trites, R. (1987). An evaluation of the effectiveness of computer-assisted component reading subskills training.

Toronto: Queen's Printer for Ontario.

Fiedorowicz, C., & Trites, R. (1990). Follow-up study of the effectiveness of the AutoSkill CRS Program.

Toronto: Queen's Printer for Ontario.

Fletcher, J.M., Shaywitz, S.E., Shankweiler, D.P., Katz, L., Liberman, I.Y., Stuebing, K.K., Francis, D.J., Fowler, A.E., & Shaywitz, B.A. (1994). Cognitive profiles of reading disability: Comparisons of discrepancy and low achievement definitions.

Journal of Educational Psychology, 86(1), 6-23.

Fox, B. & Routh, D. K. (1975). Analyzing spoken language into words, syllables, and phonemes: A developmental study.

Journal of Psycholinguistic Research, 4, 331-342.

Friston, K.J., Frith, C.D., & Frackowiak, R.S.J. (1994).

Human Brain Mapping, 1, 69-79.

Fullan, M. (1991). The meaning of educational change.

Toronto, ON: OISE Press.

Fullan, M. (1993). Change forces: Probing the depths of educational reform.

New York, NY: Falmer Press.

Goswami, U., & Bryant, P. (1990). Phonological skills and learning to read.

Hillsdale, NJ: Lawrence Erlbaum Associates.

Grabe, M. (1985). Attributions in a mastery instructional system: Is an emphasis on effort harmful?

Contemporary Educational Psychology, 10, 113-126.

Griffith, P., & Olson, M. (1992). Phonemic awareness helps beginning readers break the code.

The Reading Teacher, 45, 516-523.

Harris, T.L, & Hodges, R.E. (1995). *The literacy dictionary*.

Newark, DE: International Reading Association.

Herman, P.A. (1985). The effect of repeated readings on reading rate, speech pauses, and word recognition accuracy.

Reading Research Quarterly, 20, 553-565.

Horowitz, B. (1994). Data analysis paradigms for metabolic-flow data: Combining neural modeling and functional imaging.

Human Brain Mapping, 2, 112-122.

Iverson, S., & Tunmer, W.E. (1993). Phonological processing skills and the Reading Recovery program.

Journal of Educational Psychology, 85(1), 112-126.

Juel, C. (1988). Learning to read and write: A longitudinal study of 54 children from first through fourth grades.

Journal of Educational Psychology, 80(4), 437-447.

Krashen, S. (April, 2000). Comments on the National Reading Panel. Electronic mail message posted on the National Reading Conference listserv.

Leberge, D., & Samuels, S.J. (1974). Toward a theory of automatic information processing.

Cognitive Psychology 6, 293-323.

Liberman, I.Y., Shankweiler, D., Fischer, F.W., & Carter, B. (1974). Explicit syllable and phoneme segmentation in the young child.

Journal of Experimental Child Psychology, 18, 201-212.

Lundberg, I., Frost, J., & Petersen, O. P. (1988). Effects of an extensive program for stimulating phonological awareness in preschool children.

Reading Research Quarterly, 23, 263-284.

McIntosh, A.R., & Gonzalez-Lima, F. (1992). The application of structural modeling to metabolic mapping of functional neural systems. In F. Gonzalez-Lima, T. Finkenstadt, and H. Scheich (Eds.), Advances in metabolic mapping techniques for brain imaging of behavioral and learning functions (pp. 219-255).

Dordrecht, The Netherlands: Kluwer Academic Publishers.

McIntyre, T. (1989). A resource book for remediating common behavior and learning problems.

Boston, MA: Allyn & Bacon.

Morais, J., Bertelson, P., Cary, L., & Alegria, J. (1987). Literacy training and speech segmentation. In P. Bertelson (Ed.), The onset of literacy: Cognitive processes in reading acquisition (pp. 45-64).

Cambridge, MA: MIT Press.

National Reading Panel. (2000). Report of the National Reading Panel: Reports of the subgroups.

Washington, DC: National Institute of Child Health and Human Development Clearinghouse.

Pennington, B.F., Van Orden, G.C., Smith, S.D., Green, P.A., & Haith, M.M. (1990). Phonological processing skills and deficits in adult dyslexics.

Child Development, 61, 1753-1778.

Perfetti, C.A. (1985). *Reading Ability*.

New York: Oxford University Press.

Perfetti, C.A., Beck, I., Bell, L.C., & Hughes, C. (1987). Phonemic knowledge and learning to read are reciprocal: A longitudinal study of first grade children.

Merrill-Palmer Quarterly, 33(3), 283-319.

Pinnell, G.S., Pikulski, J.J., Wixson, K.K., Campbell, J.R., Gough, P.B., & Beatty, A.S. (1995). *Listening to children read aloud*.

Washington, DC: Office of Educational Research and Improvement, U.S. Department of Education.

Posse, S., Dager, S.R., & Richards, T.L. (1997). In vivo measurement of regional brain metabolic response to hyperventilation using magnetic resonance proton echo planar spectroscopic imaging (PEPSI).

Mag. Res. Med., 37, 858-865.

Pugh, K., Mencl, W., Shaywitz, B., Shaywitz, S., Fulbright, R., Skudlarski, P., Constable, R. Marchione, K., Jenner, A., Shankweiler, D., Katz, L., Fletcher, J., Lacadie, C., & Gore, J. (2000). The angular gyrus in developmental dyslexia: Task-specific differences in functional connectivity in posterior cortex.

Psychological Science, 11, 51-56.

Rayner, K., Foorman, B.R., Perfetti, C. A., Pesetsky, D., & Seidenberg, M.S. (2002). How reading should be taught?

Scientific American, 286(3), 84-92

Reid-Lyon, G. (1998). "Why reading is not a natural process." *Educational Leadership/March*, 14-18.

Richards, T.L., Dager, S.R., Corina, D., Serafini, S., Heide, A.C., Steury, K., Strauss, W., Hayes, C.E., Abbott, R.D., Craft, S., Shaw, D., Posse, S., & Berninger, V.W. (1999). Dyslexic children have abnormal brain lactate response to reading-related language tasks.

American Journal of Neuroradiology, 20, 1393-1398.

Richards, T.L., Corina, D., Serafini, S., Steury, K., Echelard, D.R., Dager, S.R., Marro, K., Abbott, R.D., Maravilla, K.R., & Berninger, V.W. (2000). The effects of a phonologically-driven treatment for dyslexia on lactate levels as measured by proton MRSI.

American Journal of Neuroradiology, 21, 916-922.

Rieben, L., & Perfetti, C.A. (1991). Learning to read: Basic research and its implications.

Hillsdale, NJ: Lawrence Erlbaum Associates.

Roth, E., & Schneider, W. (1998). Training of phonological awareness and letter knowledge in children-at-risk. In P. Reitsma, & L. Verhoeven (Eds.). *Problems and Interventions in Literacy Development* (pp.225-239).

Dordrecht, Netherlands: Kluwer Academic Press.

Samuels, S.J. (1981). Characteristics of exemplary reading programs. In J. Guthrie (Ed.), *Comprehension and teaching: Research reviews* (pp255-273).

Samuels, S.J. & Pearson, P.D. (1988). *Changing school reading programs.*

Newark, DE: International Reading Association.

Schacter, J. (2000). Reading programs that work: A review of programs for pre-kindergarten to 4th grade.

Milken Family Foundation, Santa Monica, CA.

Shankweiler, D., Crain, S., Katz, L., Fowler, A.E., Liberman, A.M., Brady, S.A., Thornton, R., Lundquist, E., Dreyer, L., Fletcher, J.M., Stuebing, K.K., Shaywitz, S.E., & Shaywitz, B.A. (1995), Cognitive profiles of reading-disabled children: Comparisonof language skills in phonology, morphology and syntax.

Psychological Science, 6(3), 149-156.

Shankweiler, D., & Liberman, I.Y. (Eds.) (1989). *Phonology and reading disability: Solving the reading puzzle.* Ann Arbor: University of Michigan Press.

Share, D.L. (1995). Phonological recoding and self-teaching: Sine qua non of reading acquisition.

Cognition, 55, 151-218.

Shaywitz, B.A., Shaywitz, S.E., Pugh, K.R., Skudlarski, P., Fulbright, R.K., Constable, R.T., Fletcher, J.M., Liberman, A.M., Shankweiler, D.P., Katz, L., Bronen, R.A., Marchione, K.E., Lacadie, C., & Gore, J.C. (1996). The functional organization of brain for reading and reading disability (dyslexia).

The Neuroscientist, 2, 245-255.

Shaywitz, B.A., Pugh, K.R., Jenner, A.R., Fulbright, R.K., Fletcher, J.M., Gore, J.C., & Shaywitz, S.E. (2000). The neurobiology of reading and reading disability (dyslexia). In M.L. Kamil, P.B. Mosenthal, P.D. Pearson, and R. Barr (Eds.), *Handbook of Reading Research, III.*

Mahwah, NJ: Lawrence Erlbaum Associates.

Shaywitz, S.E., (1996).

Dyslexia. Scientific American, 275(5), 98-104.

Shaywitz, S.E., Escobar, M., Shaywitz, B.A., Fletcher, J.M., & Makuch, R. (1992). Evidence that dyslexia may represent the lower tail of a normal distribution of reading ability.

New England Journal of Medicine, 326, 145-150.

Shaywitz, S.E., Shaywitz, B.A., Pugh, K.R., Fulbright, R.K., Constable, R.T., Mencl, W.E., Shankweiler, D.P., Liberman, A.M., Skudlarski, P., Fletcher, J.M., Katz, L., Marchione, K.E.,

Lacadie, C., Gatenby, C., & Gore, J.C. (1998). Functional disruption in the organization of the brain for reading in dyslexia.

Proc. Natl. Acad. Sci. USA, 95, 2636-2641.

Snow, C., Burns, S., and Griffin, P. (eds.) (1998). *Preventing reading difficulties in young children*.

Washington, DC: National Academy Press.

Snowling, M.J., Goulandris, N., & Defty, N. (1996). A longitudinal study of reading development in dyslexic children.

Journal of Educational Psychology, 88(4), 653-669.

Stanovich, K.E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy.

Reading Research Quarterly, 21, 360-407.

Stanovich, K.E. (1992). Speculations on the causes and consequences of individual differences in early reading acquisition. In P.B. Gough, L.C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp.307-342).

Hillsdale, NJ: Lawrence Erlbaum Associates.

Stanovich, K.E. (1994). Romance and reality.

The Reading Teacher 47, 280-291.

Stanovich, K.E., & Siegel, L.S. (1994). Phenotypic performance profile of children with reading disabilities: A regression-based test of the phonological-core variable-difference model.

Journal of Educational Psychology, 86(1), 24-53.

Stanovich, K.E., & Stanovich, P.J. (1995). How research might inform the debate about early reading acquisition.

Journal of Research in Reading, 18, 87-105.

Stuart, M. and Coltheart, M (1988) Does reading develop in a sequence of stages?

Cognition, 30, 139-181.

Torgesen, J.K., & Burgess, S.R. (1998). Consistency of reading-related phonological processes throughout early childhood: Evidence from longitudinal, correlational and instructional studies. In J. Metsala & L. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 161-188).

Mahwah, NJ: Lawrence Erlbaum Associates.

UniSci (2000). Brain shown to change as dyslexics learn. *Daily University Science News, 26, May*.

http://unisci.com/stories/20002/0525004.htm.

USED (1999). Reading Excellence Act State Competitive Grant Program: Non-regulatory guidance for state applicants.

Vandervelden, M.C., & Siegal, L.S. (1995). Reading and understanding: An introduction to the psychology of reading. Cambridge, UK: Hartnolls Ltd.

Vellutino, F.R., & Scanlon, D.M. (1987). Phonological coding, phonological awareness, and reading ability: Evidence from a longitudinal and experimental study.

Merrill-Palmer Quarterly, 33(3), 321-363.

Vladyka, P. (1994). An evaluation of the AutoSkill reading program.

Education Report, Humble I.S.D. Middle School, Humble, Texas.

Wagner, R.K., & Torgesen, J.K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills.

Psychological Bulletin, 101, 192-212.

Wagner, R.K., Torgesen, J.K., & Rashotte, C.A. (1994). The development of reading related phonological processing abilities: New evidence of bi-directional causality from a latent variable longitudinal study.

Developmental Psychology, 30, 73-87.

Wesseling, R., & Reitsma, P. (1998). Phonemically aware in a hop, skip, and a jump. In P. Reitsma, & L. Verhoeven (Eds.). *Problems and Interventions in Literacy Development* (pp.225-239).

Dordrecht, Netherlands: Kluwer Academic Press.

Wood, F.B., Garrett, A.S., Hart, L.A., Flowers, D.L., & Absher, J.R. (1996). Event related potential correlates of glucose metabolism in normal adults during a cognitive activation task. In R.W. Thatcher, G.R. Lyon, J. Rumsey, & N. Krasnegor (Eds.), Developmental neuroimaging: Mapping the development of brain and behavior (pp. 197-206).

New York: Academic Press.

About AutoSkill

AutoSkill International Inc. delivers highly effective and scalable reading and math intervention solutions to help struggling elementary, middle and high school students develop fluency in the foundation skills of reading and math. AutoSkill products use a research-based approach that is proven to generate significant and sustainable gains for at-risk students of all ages and abilities. The company's award-winning software provides an individualized and engaging experience for students, and comprehensive set of monitoring, management and reporting tools for teachers and administrators. AutoSkill deploys its reading and math intervention solutions across schools and districts in North America and Europe.

www.autoskill.com