SCHOLASTIC
Professional
Paper

Literacy Instruction For Older Struggling Readers: What Is The Role Of Technology?

Ted S. Hasselbring
University of Kentucky,
Lexington, Kentucky

Laura I. Goin
Designs for Learning,
Franklin, Tennessee

READ180®

What is the role of technology in literacy instruction? Dr. Ted Hasselbring, Laura Goin and members of the Cognition and Technology Group at Vanderbilt proposed an answer to this question with the development of a technology-based intervention program. In this article, Hasselbring and Goin describe the development the Peabody Learning Lab, which is based on the theoretical understanding of reading acquisition and sound pedagogical principles, enhanced through the use of integrated media.

In 1993, with the support of Drs. Hasselbring and Janet Allen, a reading specialist from University of Central Florida at the time, the Orange County Schools used the Peabody Learning Lab to create a reading intervention program combined with the Literacy Workshop, a teaching method designed to improve students' reading, writing, speaking and listening skills through selected reading, books on tape, and reading alternate forms of text such as newspapers and rulebooks for games.

Four years later, Scholastic entered into collaboration with Vanderbilt University and Orange County Schools. Scholastic staff sought to combine the Peabody Learning Lab and Orange County's instructional model with Scholastic's expertise in the development of materials that are easily managed by teachers and motivating for students. The outcome of this collaboration was Scholastic's *READ 180* program.

Reading & Writing Quarterly, 20: 1237144, 2004

ISSN: 1057-3569 print
DOI: 10.1080/10573560490262073

Taylor & Francis
Taylor & Francis Group

LITERACY INSTRUCTION FOR OLDER STRUGGLING READERS: WHAT IS THE ROLE OF TECHNOLOGY?

Ted S. Hasselbring
University of Kentucky,
Lexington, Kentucky

Laura I. Goin
Designs for Learning,
Franklin, Tennessee

In this article, we describe the development of a technology-based intervention program for older struggling readers. Developed over several years, this program was based on a theoretical understanding of reading acquisition. In addition, it capitalized on pedagogical principles that can be enhanced through the use of integrated media. The end result of this R&D activity is a powerful prototypic program that has been shown to enhance the reading skills of middle and high school students who have struggled with reading during most of their school careers.

There is considerable evidence to show that reading difficulties remain a serious problem for many of our nation's students. As many as 20% of seventeen-year-olds have been estimated to be functionally illiterate (Walberg, 1983), and 44% of all high school students have been described as semi-literate (Kirsch & Guthrie, 1984). Since the National Assessment of Educational Progress (NAEP) first began testing students' reading proficiency in 1971, reading performance has hardly changed at all. As reported in the 1998 NAEP report, 68% of our nation's poorest students in the fourth grade failed to attain basic levels of literacy. Although increases were observed among middle and upper performing students in Grade 12, the score for lower performing students was not as high in 1998 as it had been in 1992 (National Center for Education Statistics, 1999). International test comparisons also show relatively low reading achievement at the secondary level. Scores from the 1992 International Reading Study revealed that nine-year-olds in the United States finished second only to Finland, but fourteen-year-olds slipped to eighth place (National

Address correspondence to Ted Hasselbring, 229 Taylor Education Building, Lexington, KY 40506-0001. E-mail: tsh@uky.edu

Center for Education Statistics, 1993). Thus, national and international assessment results confirm observations made by business and post-secondary institutions over the past several years: that many high-school graduates cannot comprehend complex written information (see Weinstein & Walberg, 1993). Despite arguments by some that all is not as bad as it seems (see Bracey, 1997), the available evidence clearly suggests that a substantial number of our middle and high school-age students do not read well.

What could account for this lackluster reading performance by many of our secondary-age students? Certainly, learner characteristics and instructional practices play important roles. Weinstein and Walberg (1993) analyzed the 1986 NAEP results for "fixed" and "alterable" factors associated with reading performance. Parents socioeconomic status (SES) explained the largest amount of variance among the fixed factors. The numbers of books read and the amount of time spent reading were the most noteworthy of the alterable factors. Of particular interest, they found that "frequent and extensive engagement in literacy-promoting activities as a young adult was associated with higher scores on literacy outcomes (independent of earlier-fixed characteristics and experiences)" (p. 17). Their study suggests that significant language experiences can help improve reading literacy despite the fixed variables mitigating against it.

If literacy-promoting activities can help overcome factors such as low SES, we would expect middle schools and high schools to offer them. But do they? How can technology applications help remedy the lack of reading skills of our middle and high school students? In this review, we will examine some of the contextual factors that contribute to the reading difficulties of older students. We will also review several theories of reading and discuss how we have incorporated these theories into a computer based literacy program called the Peabody Learning Lab. Finally, we provide findings that describe the effect of this program on the reading performance of middle and high school students.

School-Based Contextual Factors

A major instructional goal of the first four years of elementary school is to teach children how to spell and read. Teachers often use stories and narrative reading materials as the basis for early reading instruction (Irvin, 1997). By the time students reach the end of third grade, most normally achieving students can read a majority of the words in their spoken vocabulary (Spear-Swerling & Sternberg, 1996). But as students enter fourth grade, they often encounter what Chall (1983) calls "the fourth grade slump." Instruction in basic language skills that dominated instructional time in Grades K–3 takes an abrupt turn in fourth grade. Quite suddenly, students are expected to decode and comprehend expository text without the assistance they had received in earlier grades. They now confront text passages filled with specialized vocabulary dealing with issues in social studies and science. This sudden transition puts struggling readers in a perilous position: now they must not only decode more difficult text but also extract ideas from complex, expository formats.

As students move through the grades, the gap between good readers and poor readers widens even further. Referred to by Stanovich (1986) as the "Matthew Effect," good readers become better readers and poor readers become more frustrated and fall further behind. This phenomenon shows up in the NAEP tests referred to earlier. The 1994 results generally indicated that the more students read for fun and read more pages for homework, the higher their reading scores were. Somewhat alarming was the finding that twelfth graders who reported they had never or hardly ever read for fun increased from 24% in 1992 to 27% in 1994 (National Center for Education Statistics, 1996). Among these 27%, we would expect to find students who find reading laborious and unrewarding.

What help is available for students who leave elementary school and still find reading difficult? How much reading instruction is available in middle schools? Irvin (1997) reviewed the research on instructional practices at the middle school level and found only one recent national survey that describes how middle schools approach reading instruction (Irvin and Connors, 1989). Not surprisingly, almost half of the schools offered no explicit reading instruction beyond fourth grade, except for the most disabled readers or unless it were labeled as an elective. Approximately one-third of the schools offered a semester-long remedial reading course at each grade level, but instruction was usually independent of regular curricular material. About 60% of the schools surveyed required students to take a developmental reading course (usually in sixth grade) for one semester or a full year. Developmental courses are not remedial in nature and

usually emphasize sophisticated strategies for better comprehension. Some schools that did not offer special reading courses reported that their content area teachers taught reading. In other instances, the responsibility for reading instruction fell solely on the language arts teachers.

These findings suggest that reading instruction is not a priority in middle and high schools, especially the kind that would help struggling readers. It does not appear that reading help is available to students other than for those who are the most disabled. How do students with reading problems, especially those with identified learning disabilities, fare at the secondary school level? Not very well, according to the National Joint Committee on Learning Disabilities (1991).

It appears that even when programs are available for older students, they involve mostly curriculum adaptation and little in the way of explicit reading instruction (Lerner, 1997). Often, the curricular expectations are so high that students who have been identified as learning disabled drop out of school when they reach high school. Even if students stay in school, they often cannot meet the requirements for postsecondary programs, which severely limits occupational opportunities. Often this is due to their difficulty in reading.

Student-Based Factors

Special characteristics of middle and high school learners have been well documented. Adolescence is a period of transition from dependence to independence. Anyone who has spent time in a middle or high school knows what a painful process this can be, both for students and for the adults who are responsible for their education. In general, adolescents struggle with intense feelings about independence, physical changes, sexuality, peer pressure, and self consciousness (Lerner, 1997). For adolescents who are unable to keep up with their classmates on coursework, these feelings often become accentuated and distorted. Their frustration with school is reflected in dropout rates and behavior-related problems.

For adolescents with reading problems, school can be particularly challenging. Typically, these students tend to develop behaviors that impede their learning. For example, they have been characterized as lacking motivation, possessing little self-confidence, experiencing difficulty making and keeping friends, and displaying a host of maladaptive behaviors (Deshler, Ellis & Lenz, 1996; Lerner, 1997; Schumaker, Deshler & Ellis, 1986; Zigmond, 1990). Certainly, these students pose a formidable challenge for teachers. For many of the students with reading problems, the increased academic challenges and inability to develop minimum skill

competencies result in more than half (50.3%) leaving school before obtaining a high school diploma (U.S. Department of Education, 1994).

Several reasons have been given to explain learners' inability to read well as they approach middle school years. For example, one popular notion asserts that these students have not developed sufficient word recognition skills to decode text, such as through recognizing letter-sound associations, relevant contextual clues, and prefixes and suffixes (Snow, Burns, & Griffin, 1998). Furthermore, students' lack of skill in applying word recognition strategies may result from inefficient or weak short-term memory (Ashbaker & Swanson, 1996). Thus, reading instruction should allow for plenty of practice to help students recognize and use sound reading strategies while focusing on meaningful contextual experiences (Guthrie, Alao, & Rinehart, 1997). Too much emphasis on isolated skills can result in word calling, reduced motivation, and a lack of comprehension (Dymock, 1993; Educational Research Service, 1995; Schifini, 1997).

This array of student-based factors suggests that procedures for teaching reading at the middle and high school levels must center on meaningful and practical activities. We take the liberty here to distill these factors into a few important principles. First, the reading program must be relevant and intrinsically motivating because adolescents need to see the value in what they do. Second, it must assure that students' lack of skills is mostly hidden from view because students with reading difficulties are often self-conscious. Third, students should have some control over their own learning, because adolescents do not always like to be told what to do. Finally, the program should build on student strengths rather than on weaknesses, on success rather than failure, because adolescents are not apt to spend more time on tasks on which they have already tried and failed.

We have now come full circle to the Weinstein and Walberg (1993) study, which found that the parents' SES is the main fixed factor to their children's adult success. We discussed how instruction shifts from explicit reading instruction in the early elementary grades to limited, if any, reading instruction at the middle school and high school levels. And finally, we suggested that student characteristics combined with the relative absence of direct reading instruction accentuate the Matthew Effect among our reading delayed adolescents.

Literacy Acquisition In Older Students

Unfortunately, there is little empirical research about how middle and high school students best learn to read. As we mentioned earlier, reading programs at this level are adjuncts to, rather than an integral part of, the school program. Of the middle and high schools that do have reading programs, most are procedural in nature, meaning that they focus more on strategies of reading rather than on development of reading skills.

What should constitute a reading program for older students, especially those who find reading exceedingly difficult? We may be able to uncover clues from the rich research on reading acquisition. Although most of the studies were conducted with young children, we may learn how the reading process is first learned, thus giving us criteria for designing a more useful program. Of course, we realize that there are qualitative differences between children in early elementary grades and adolescents, and we have already described the differences in curricular expectations between primary and upper grades. But by identifying critical stages in learning to read, we may uncover clues that will help us design more appropriate and effective reading approaches for older students.

Early Reading Acquisition

There is strong agreement among reading experts that phonological processing ability plays an important role in the reading acquisition of young learners (Blachman, 1994; Goswami & Bryant, 1990; Snow, et al., 1998; Stanovich, 1992). Torgesen, Wagner, and Rashotte (1994) have defined phonological processing as "an individual's mental operations that make use of the phonological or sound structure of oral language when he or she is learning how to decode written language" (p. 276). Wagner and Torgesen (1987) have identified three kinds of phonological processing thought to be positively correlated with future reading success: phonological awareness, phonological memory, and rate of access for phonological information.

Phonological awareness is defined as conscious knowledge of the phonological structure of one's language. Typically, phonological awareness is measured by asking children to identify or manipulate phonemes. For example, students may be asked to identify which beginning or ending sound is the same as that found in another word. Even very young children show sensitivity to rhyme and alliteration. As students get better at identifying sounds, they can even begin to segment and blend sounds.

Research over the past twenty years has shown a consistent and strong relationship between children's ability to recognize and manipulate sounds and their reading progress (Byrne, Freebody, & Gates, 1992; McBride-Chang & Chang, 1996; Ingram, 1976; O'Connor, Jenkins, Leicester, & Slocum, 1993; Snow et al., 1998; Stanovich, Cunningham, & Cramer, 1984). Torgesen, et al. (1994) reported empirical findings of correlation between beginning kindergartners' performance on awareness tasks and word reading skills within a range of .4 to .6. There also is support for the notion that direct training of children in phonological awareness facilitates reading acquisition (Bradley & Bryant, 1983; Fox & Routh, 1984; Mann, 1991).

Memory for sounds and the rate at which children are able to retrieve them from short-term memory also contribute to individual differences in children's reading performance (Mann & Lieberman, 1984; Torgesen, 1985). Children who are unable to hold a sound in memory long enough to apply it to reading certainly would find it a plodding, laborious exercise. In addition, the difference in the rate at which children can accurately name letters, numbers, or pictures is predictive of the difference in the rate at which they acquire word-reading skills in first grade (Torgesen, Wagner, & Rashotte 1994; Wagner & Torgesen, 1987).

Torgesen, Wagner, and Rashotte (1994) summarized what is known about phonological processing into four statements:

(a) individual differences in phonological process were predictive of later differences in development of reading skills;

(b) training in phonological awareness, coupled with instruction in specific letter-sound relationships, significantly enhanced growth in early word-reading skills;

(c) older good and poor readers consistently differed in phonological processing skills; and,

(d) phonological skills were related to one another in development.

The link between phonological processing and reading performance is indisputable. To be able to read, children must show sensitivity to sounds, develop a correspondence between these sounds and letters of the alphabet, and then quickly retrieve and blend these sounds into a sequence called reading.

If students can segment and blend sounds and know which letters together make which sounds, children should be able to read and spell many words such as sit and kite. But how do children learn to read words that do not have regular letter-sound correspondence? Do children develop strategies that do not depend solely on phonological awareness?

There is mounting evidence that children use a host of strategies to help them read in addition to strict sound-symbol relationships. For example, Goswami and Bryant (1990) suggest that children make inferences about spelling categories and sequences when they begin to read. As they become better readers, they learn how to make better inferences. Two of the tools children use to construct these inferences are onset and rime. Most children can associate onsets and rimes with sequences of letters without much (if any) instruction. The more they hear and produce rhymes, the better they become at formulating strategies to categorize them into appropriate reading and spelling sequences.

According to Goswami and Bryant (1990), children also learn sound symbol by learning the alphabetic script. Teaching children the script leads to rapid associations of script to phonemes that children use more for spelling than for reading. Children eventually break rimes into phonemes to produce written language, but they are quite unwilling to do this when they first begin to read.

The third factor in Goswami's and Bryant's theory of reading acquisition establishes the important link between spelling and reading. Goswami and Bryant (1992) assert that knowledge of spelling helps children read, which in turn aids in their ability to spell. In the beginning stages of reading, children do not make solid associations between reading and spelling. However, as they gain more practice in manipulating onsets, rimes, and phonemes, they use more sophisticated strategies to help them recognize and spell unfamiliar words.

Several models of reading acquisition have been forwarded to help us understand how these theories may translate into actual progression of skill. We have chosen to summarize two such models because we think they give a balanced perspective of the role phonological processing and visual recognition play in how children learn to read. First, we define two terms that appear in the descriptions of both models: recoding, which refers to the process of transforming the spellings of words into sounds by application of letter-sound rules, and sight-word reading, which involves the recognition of words by retrieving them from memory as a result of repeated practice reading the words.

Ehri (1992) presents an interesting theory about how children use recoding and sight-word memory to read words with fluency. Ehri contends that the dual route theory, where children learn to read either by recoding or by sight-word memorization, is too narrow and simplistic to describe the complexity involved in learning to read. Instead, children form formal and systematic ways to apply visual and phonological connections to spellings and pronunciations of words as they proceed through three phases. In phase 1, visual cue reading, children form quite arbitrary relationships between how a word appears and its meaning and pronunciation. At this stage, the link is strictly visual, not phonological. Because the learning is arbitrary, words that are

not practiced frequently are easily forgotten or are confused with other words. Sometimes, children call synonyms of words in place of the targeted word because they hold meanings in memory rather than pronunciations.

Ehri calls the second phase of reading phonetic cue reading. In this phase, children begin to put letters and sounds with systematic visual phonological associations. These associations are incomplete because the learner has not yet learned to represent every spelling with a sound. Usually, children in this phase can associate only beginning and ending letters with sounds. Although rudimentary, children's ability to systematically link sounds to letters enables them to more easily read words they had not previously memorized.

During the final phase, children move to more mature alphabetic sight-word learning called cipher reading. As children become more sophisticated in segmenting and phonological recoding, they form "complete visual-phonological connections" to read a large number of sight words. They not only learn connections between letters and pronunciations of phonemes, but they also have processed and coded all possible spellings. To reach this stage, learners have acquired substantial phonological recoding skill, and they use it to analyze spellings fully as visual representations. According to Ehri, readers in this stage do not make errors that make sense phonetically but are phonemically wrong because they have figured out how the phonemic system works.

Ehri suggests that this theory helps to explain why poor readers are not skilled at reading words. When in phase 2, learners who do not become fluent readers never learn to recode words accurately and rapidly, which precludes establishing lasting associations between a sequence of letters in spellings and the phonemic parts of a word's pronunciation. Only when learners have built a solid repertoire of visual-phonological connections in lexical memory are they able to read fluently and reliably.

Spear-Swerling and Sternberg (1996) describe normally achieving reading acquisition in six phases. The first two phases, visual-cue word recognition and phonetic-cue recognition, generally follow the descriptions of the first two phases in Ehri's model. During the first phase, children are unaware of the principle that letters in words represent sounds in a systematic way but can make use of distinctive shapes of words or logos. In the second phase, children use partial phonetic clues to help recognize words. To reach this phase, children must have some knowledge of sound symbol relationships and be able to accomplish simple tasks such as rhyming and alliteration.

In the controlled word recognition phase, children are able to make use of all the letter formations in a word. However, they must use considerable effort to do so, and word recognition

is not automatic. Orthographic knowledge, the knowledge of spelling patterns, plays a vital role in attaining full capacity to word recognition. Phonological processing skills and exposure to text has been found to contribute to the development of orthographic knowledge.

As children become more adept at using their newfound knowledge, they enter the phase called automatic word recognition. As the name implies, children expend very little mental effort to quickly and accurately recognize words, which theoretically frees up mental resources for comprehension. By the time they are eight years old, most normally achieving readers will be able to recognize automatically most words in their spoken vocabularies. A factor that promotes automaticity is practice and repeated readings, especially when the level of reading is such that students make few mistakes (LaBerge & Samuels, 1974; Samuels, 1997). Thus, classroom routines that afford students the opportunity to practice reading fluently foster automaticity.

Comprehension is the central focus of the fifth and sixth stages of reading development. In the strategic reading stage, students use a variety of strategies, such as prereading, rereading, and looking up unfamiliar words in the dictionary, to help them get a better understanding of what they are reading. In the proficient adult reading stage, readers develop comprehension abilities and make higher order connections.

Thus, the importance of phonological awareness and orthographic knowledge to reading acquisition cannot be overstated. Abundant and convincing research points to phonological sophistication as an important ingredient in the ability to become a skilled reader. Children who receive direct and systematic training receive higher reading scores than children who do not receive this training (O'Connor, Notari-Syverson, & Vadasy, 1996; Stanovich, 1986).

As many of us know, theory and research findings do not always find their way into the classroom. Treatment of this topic has ranged from philosophical discussions (see Kessels & Korthagen, 1996) to reviews of critical factors that influence teachers' willingness to adopt new instructional strategies (Gersten & Brengelman, 1996). In the case of reading, given the large amount of evidence pointing to the importance of phonological awareness and orthographic knowledge, our instructional design should align very closely with both areas.

Development Of Media-Enhanced Learning Environments

For more than two decades, considerable research has examined the use of computers for facilitating learning. Much of the early research focused on the potential of drill-and-practice programs for providing better and faster learning (Kulik, Bangert, & Williams, 1983). Enthusiasm for computer-assisted instruction grew as researchers found effect sizes on the average of 0.5 standard deviations in favor of computer-assisted instruction over conventional instruction (Kulik, Kulik, & Cohen, 1980; Kulik, Bangert and Williams, 1983). But enthusiasm waned when Clark (1983) found substantial confounds in the reviewed research related to uncontrolled differences in content, novelty, and teaching method. For example, the 0.5 effective size in favor of computer-assisted instruction was reduced to 0.13 when the same teacher planned and presented both treatments. Clark and Saloman (1986) concluded that future media-related research should describe how the presentation of the media application contributes to student processing capabilities.

Heeding this advice, investigators planned subsequent research around the advantages of computer-matched and student-centered applications. For example, we discussed in an earlier section the importance of word recognition fluency on comprehension. In general, students who can quickly and accurately recognize words are more likely to comprehend what they read (Lesgold & Resnick, 1982; Naslund & Samuels, 1992). Computers have the unique capacity to deliver individualized practice to students who need to increase their reading fluency and have proven beneficial in developing decoding fluency (Jones, Torgeson, & Sexton, 1987; Roth & Beck, 1987).

In addition to providing practice in developing decoding speed, computers can help students make the important transition from word calling to understanding. Although the ability to recognize sound-symbol relationships is important, it is certainly not sufficient for comprehension. Students must also call upon their prior knowledge and use context clues to extract meaning from what they read. There is growing evidence that computer-based effects such as animation and sound enable students to make these connections (Matthew, 1996).

For more than a decade, researchers have conducted studies on how the design of media-enhanced environments influences the learning of K–12 students (see Cognition and Technology Group at Vanderbilt University, 1994). The main purpose for creating these environments was to

make it possible for at-risk students to develop their literacy skills, ie: language, mathematics, and thinking skills, in an engaging, supportive environment.

One adaptation to these media-enhanced environments that we have worked on over the past several years is a computer-based, multimedia instructional program called the Peabody Literacy Lab, which is designed to improve the literacy skills of middle and high school students. We believe that this work addresses the contextual issues discussed above and succeeds in providing the instructional opportunities found in the early literacy studies.

Description Of The Peabody Literacy Lab

The Peabody Literacy Lab (PLL) is based on a unique combination of learning theory and pedagogical principles that capitalizes on the power of integrated media technology. Based upon several years of empirical research conducted at Peabody College of Vanderbilt University, this program mediates instruction in word recognition, decoding, and spelling, as well as the comprehension of text passages. Instruction is centered on contemporary topics that are presented as a video anchor. Using the concept of "anchored instruction," an animated tutor guides the student and provides feedback via a digitized human voice. The program tracks individual student progress and adjusts the instruction accordingly. The three components to the program are represented by a lab metaphor where the student can visit the Reading Lab, Word Lab, or Spelling Lab. Following is a description of each of these components.

Reading Lab

The Peabody Literacy Lab (PLL) is based on a unique combination of learning theory and pedagogical principles that capitalizes on the power of integrated media technology. Based upon several years of empirical research conducted at Peabody College of Vanderbilt University, this program mediates instruction in word recognition, decoding, and spelling, as well as the comprehension of text passages. Instruction is centered on contemporary topics that are presented as a video anchor. Using the concept of "anchored instruction," an animated tutor guides the student and provides feedback via a digitized human voice. The program tracks individual student progress and adjusts the instruction accordingly. The three components to the program are represented by a lab metaphor where the student can visit the Reading Lab, Word Lab, or Spelling Lab. Following is a description of each of these components. The theoretical and instructional underpinning of the Reading Lab involves the use of video as a context for instruction. Research has shown that effective readers and listeners construct mental models that

contain information about the situations and scenes that a story describes. Further, mental models in many ways are similar to images, pictures, or movies (McNamara, Miller, & Bransford, 1991). For example, when people read about objects arranged in a scene, they seem to use cognitive processes similar to those used for thinking about pictures of objects in scenes. In addition, readers seem to mentally "switch scenes" in their mental models when a main character moves from one building, room, or outdoor setting to another. According to this view of mental models, pictures that help learners imagine what scenes in a story might look like and how they change during the story should help the learners construct good mental models.

In the Reading Lab, video is used to help students build mental models from text. Video of interesting and motivating topics is used for this purpose. The video is broken into four or five short clips, and a set of lessons is built around each clip. Each time the student enters the Reading Lab, the instructional sequence begins by having the student view a video clip. This is followed by having the student read a text passage that describes the video just viewed. If the student cannot read the passage, which is likely, the tutor offers support: the student can have the passage read to them in either a slow (word by word) mode or a fast (sentence by sentence) mode; the student can get help with pronunciation of individual words by clicking on a word; and the student can access a dictionary by clicking on a word and then clicking on the "define" button.

A unique aspect of this program is that student progress is monitored continuously to determine if he has mastered a set of target words included in the text passage. If the student has not mastered all of the target words, he keeps going back to the Word Lab until all targeted words are mastered. However, when the student has demonstrated mastery of all targeted words, the student begins a new set of activities in the Reading Lab.

Comprehension activities occur in two different ways. The first involves the use of what we have termed "discrepancy passages." In this activity, the student again views a video clip and is given three text passages that describe the video clip which are very similar. One of the passages, however, more accurately describes the video clip than do the other two passages. The purpose of discrepancy passages is to have the student construct a mental model while reading the text passages and then match the mental model to the video clip. Thus the student must determine which of the three passages is the best description of the video clip.

A second activity involves the use of modified cloze passages. In this activity, the student reads a passage where words have been removed and replaced with a blank. The tutor instructs the student to predict what word might go in the blank. By clicking on the blank, the student is

shown a list of possible words and he then selects one that logically fits in that blank. Thus, he must use the context of the sentence to select an appropriate word.

After completing these activities for a video clip, the student receives a new video to view, and the activities are repeated.

Word Lab

The purpose of the Word Lab is to develop automatic word recognition and introduce the use of phonological processing skills. The pedagogy of the Word Lab is built around an explicit instructional model that includes the following steps:

1. **Assessment of current level of functioning**
2. **Presentation of new content skills**
3. **Guided student practice**
4. **Feedback and correctives**
5. **Independent student practice**
6. **Ongoing review**

When entering the Word Lab for the first time, the student is met by the tutor, who would like to find out which words the student can read already. This is done by presenting the student a set of six words and having the tutor pronounce one of the six. The student's task is to click on the word the tutor has pronounced as quickly as possible. The computer records the correctness of the response as well as the response latency. These data are then entered into the database. The assessment continues until the tutor has a set of ten words that the student has difficulty reading. At this point, the tutor begins instruction on reading these words.

The instructional sequence consists of three activities: study, practice, and speed. The study component begins with the tutor presenting five of the words from the assessment that the student is having difficulty reading. The tutor begins the instruction by presenting the five target words and telling the student to say and record the words by clicking on the microphone button. Prior to recording, the student can hear the words by clicking on the words. If the student clicks on a word, the tutor says the word and breaks it into its component parts (eg, onset and rime).

Following the study segment, the next part of the program involves practicing reading the five target words using a timed recording task. Words are presented one at a time on the screen, and the recording begins automatically. Students have only a few seconds to read and record the word. When the time is up, the tutor says the word and plays back the student's recording. The

student decides if his or her recording is correct. If correct, he or she clicks the "+", and if incorrect, he or she clicks the "–" button. If he was unable to record the word in the allotted time, he or she clicks the "–" button. (The tutor is unable to distinguish a correct response from an incorrect response so students are asked to be on their honor.)

The third Word Lab activity, the Speed Challenge, is a timed activity to provide practice in the fluent recognition of the study words. It is similar to the initial assessment task. Words are listed on the screen and the tutor reads one of the words. The student clicks on the correct word. Students have only a few seconds to respond to each word.

The data collected during the Speed Challenge are analyzed to determine which words can be read fluently. These words are placed on a review list and are reviewed at intervals during subsequent Speed Challenges.

Spelling Lab

The purpose of the Spelling Lab is to develop and enhance orthographic knowledge and phonological processing skills by learning to spell. The words selected from the Spelling Lab are taken from the anchor Reading Lab passages and are the same words presented in the Word Lab. Thus, as students are learning to read, they are also learning about the phonology of the words.

The first spelling activity for each set of words is an assessment. During this pretest students are asked to spell the words on the list. Words that are spelled correctly and within a fluency time limit are put on a review list, while incorrect and non-fluent words are targeted for more instruction. At any time during the assessment activity, the student can ask the tutor to repeat a word or use the word in a sentence by clicking on the appropriate button. Following the assessment, words that were not spelled correctly or fluently are presented for fluency training. Sets of up to three words are pulled from the spelling word bank. Each word is pronounced, used in a sentence, broken into word parts, and then pronounced again. The student is then asked to type the word. Once the student types the first letter, the word on the screen disappears. When the word has been completed, the student would press return to enter the word. Once the student has demonstrated that he or she can spell the three target words correctly, the student is given additional practice at spelling these words to develop fluency. The study words are presented in an order that intersperses previously learned words with the current target words. During the introduction and practice of words, the tutor provides the student with detailed feedback any time an error is made. When possible, the tutor analyzes the error and provides the student with specific information on how to fix the spelling error.

Theoretical Considerations Of The Peabody Literacy Lab

One primary consideration as we were developing the PLL was to ensure that its components addressed the available research on reading acquisition. Earlier, we summarized the empirical evidence regarding what is known about reading. In our search, we found one non-controversial factor that distinguished good and poor readers—phonological awareness. The research has consistently shown that children who are more adept at recognizing, discriminating, and blending sounds become better readers than children who do not have these skills. Furthermore, direct teaching to enhance children's awareness of sounds and letter-sound relationships has been demonstrated to significantly improve students' ability to read words (see Torgesen et al., 1994).

A primary objective of the PLL is to help students develop phonological awareness and orthographic reliability. Each PLL module (connected text, words, subword) monitors students' facility with sounds and spelling patterns. When students have difficulty recognizing sound in parts of words, in whole words, and in connected text, the tutor models a way to segment the unknown word, how each part is pronounced, and the pronunciation of the whole word as the sounds are blended. Thus, sound and graphics are combined in a powerful representation of word sounds and structures.

Word naming speed has also been associated with reading performance, especially comprehension (Mann & Lieberman, 1984; Torgesen, 1985). Students who can recognize text quickly do so quite effortlessly; conversely, students who must stop at almost every word to "sound it out" expend large amounts of energy. Most of the time, students who can recognize words quickly and easily are able to comprehend more readily what they have read. The PLL monitors reading speed, both in connected text and word level formats. As learners become more fluent readers, the PLL gradually increases the rate at which words are displayed.

We also emphasized earlier the reciprocal nature of reading and spelling (Goswami & Bryant, 1990); that is, reading improves spelling and spelling improves reading. The PLL affords students many opportunities to build both kinds of skills. Students practice reading in all three modules, but it is in the subword module that students practice manipulating patterns of words, such as through onsets and rimes, and syllables.

Finally, we paid close attention to the sequence of skill development. Although the Peabody Literacy Lab does not require that the student go through the activities in a linear format, we wanted to make sure that we could identify stages of reading competence in each module. For example, Ehri and also Spear-Swerling and Sternberg stress the importance of building strong and fluent visual-phonemic connections. We included a scaffolded progression of practice, beginning with isolated sound-symbol relationships and eventually moving to whole-word and connected text.

Student Factors

How does the Peabody Learning Lab accommodate the needs of middle and high school learners? Earlier, we stated the four criteria that guided the design of the PLL. Of primary importance was student motivation and relevance. We were reasonably sure that the multimedia format of the PLL satisfied part of the criteria in this area. However, we knew the concern that many educators share about software: glitz can easily be mistaken for educational value. For this reason, we created the media presentations in the PLL according to what we have learned about the concept of anchored instruction. Anchors are motivating, authentic situations, usually presented in video formats, that enable students to practice noticing and resolving problem situations (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, 1990). Anchors have shown to have positive effects on learning in math (Bottge & Hasselbring, 1993; Bransford et al., 1988) and science (Sherwood et al., 1987). Thus, the power of the video anchor provides a context for the reading the student will encounter in the connected text and whole word modules of the Lab.

The assessment function of the PLL maintains secure records, monitors student actions, and regulates the difficulty of practice exercise. Although the Lab suggests activities for students based on their previous performance, students have the option to override the tutor in favor of another activity.

Effects Of The Peabody Literacy Lab

During the development process, the Peabody Literacy Lab was used by the Orange County Public Schools (OCPS) in Florida as an intervention program for their most disabled readers. In one school year, the PLL was used with 63 students from three different schools in Grades six through eight. Approximately twenty students in each school were pulled out for PLL instruction. Students used the PLL thirty minutes a day for the entire school year. In addition, students were given books-on-tape and high interest, low-level books that they used daily for periods of sustained reading. The goal of the intervention was to break the "Matthew Effect" and to stop the growing discrepancy between the successful and struggling readers.

Sixty-two students who did not receive the PLL were selected as a contrast group. These students were also below grade-level readers and received instruction in regular education arts classes.

The Stanford Diagnostic Reading Test (SDRT) was administered in the fall to both the experimental (PLL) and contrast students. The SDRT was again administered in the spring. Mean, standard deviations, and gains of pretest and posttest scores of the PLL group and the contrast group are provided in Table 1. Separate 2x2 analysis of variance for repeated measures were used to analyze the data for each SDRT subtest. The between-subjects factor was the type of instruction, and the within subjects (repeated) factor was the time of test. Significant interactions between type of instruction and time of test were found in Auditory Vocabulary ($F[1,89]1/414.70$, $p<.0001$), Literal Comprehension ($F[1,92]1/4$ 7.83, $p<.01$), Inferential Comprehension ($F[1,92]1/44.52$, $p<.05$), and Total Reading Comprehension ($F[1,92]1/411.37$, $p<.001$). No significant interactions were found for Phonetic Analysis or Structural Analysis.

On three out of the four subtests, the trendline of the PLL group ascends from pre test to post test and intersects the trend line of the contrast group. T-tests for paired samples on gain scores of the literacy group for each subtest were significant for Auditory Vocabulary ($t[52]1/4$ 3.67, $p<.001$), Literal Comprehension ($t[56]1/4$ 3.63, $p<.001$), Inferential Comprehension ($t[56]1/4$ 2.13, $p<.05$), and Total Reading Comprehension ($F[56]1/4$ 4.53, $p<.001$).

The three experimental teachers remarked that these gains were remarkable for these students since most had lost ground each year on standardized reading tests. The students themselves recognized that they had improved in reading and spoke openly to the evaluators about their successes. One student described his year as follows:

> "Before we did Peabody I got embarrassed when the teacher asked me to read. I'd say things like my head's hurting or I would just lay my head down. Once I faked like I was sick—I hated reading. But now, I like reading because the computer doesn't embarrass me."

TABLE 1
Stanford Diagnostic Reading Test Pretest and Posttest NCE Scores

	Pretest		Posttest		
Subtest Group	**M**	**(SD)**	**M**	**(SD)**	**Gain**
Auditory Vocabulary					
PLL group	21.5	(14.0)	29.4	(16.0)	7.9
Contrast group	32.3	(17.9)	29	(20.0)	-3.3
Literal Comprehension					
PLL group	11.2	(10.2)	18.9	(13.8)	7.7
Contrast group	19.5	(17.2)	18.6	(17.7)	-0.9
Inferential Comprehension					
PLL group	15.1	(11.4)	20	(13.2)	4.9
Contrast group	25.2	(19.4)	23.3	(24.3)	-1.9
Total Reading Comprehension					
PLL group	11	(9.5)	20.3	(12.4)	9.3
Contrast group	21.3	(17.8)	20.9	(21.1)	-0.4
Phonetic Analysis					
PLL group	18.2	(12.4)	24.7	(13.0)	4.5
Contrast group	25.1	(15.1)	29.6	(18.5)	4.5
Structural Analysis					
PLL group	14.3	(14.5)	24.6	(15.7)	10.3
Contrast group	20	(19.9)	25.3	(22.4)	5.3

Summary

Students leaving the elementary school grades unable to read face years of frustration in school and in adult roles. Their inability to derive meaning from text incapacitates them in just about every endeavor, from homework to driver's license exams. The serious consequences of this handicap can never adequately be measured, but there is little doubt that illiteracy is a major factor behind poverty and crime.

A wealth of empirical research has identified factors that limit young children's reading progress. They include weaknesses in phonological awareness, phonological memory, and rate of access for phonological information. Studies have also shown how reading and spelling are iterative processes, each making important contributions in ways that strengthen the other. Fortunately, because the curriculum in early elementary grade focus on basic skills such as reading and spelling, many students have opportunities to practice and improve their skills.

Beyond elementary school, however, the change in emphasis from skill work to coursework severely limits how much time and instruction is devoted to teaching reading and spelling. Our review has revealed few consistent approaches to remediating reading and spelling skills in older students unless the student qualifies for special education services. But even in those special cases, professionals seem confused about how best to teach adolescents to read and spell, especially after years of instruction that has yielded very little in the way of improvement. One reason for the lack of success rests in how students are asked to learn the decoding process. Very often, students have learned skills in isolation that are of little use because they cannot apply them quickly and accurately. We noted how the lack of fluency in word recognition seriously hampers comprehension and of course reduces the likelihood that any pleasure will come from reading. It seems unlikely that these students would benefit much from more of the same instruction about phonics rules. In fact, in continuing this approach, teachers may run the risk of forever conveying to students the message that reading and rules are somehow synonymous. In both theories of reading acquisition outlined above, the authors state that learners cannot read until they can derive meaning from connected text. Students cannot reach that stage until they develop fluency in applying what they have learned about letter-sound combinations in interesting, meaningful contexts.

In our discussions about media research, we acknowledged how early attempts to design computer software to remediate students' learning problems proved inadequate. But we are guardedly optimistic about the future of multimedia applications, such as the Peabody Literacy Lab. For more than five years, we have witnessed how the PLL motivates and challenges even the most resistant learners. We believe in the capacity of technology to afford students the instruction and practice they need to become fluent, understanding readers.

References

Ashbaker, M. H., & Swanson, H. L. (1996). Short-term memory and working memory operations and their contribution to reading in adolescents with and without learning disabilities. *Learning Disabilities Research & Practice, 11*, 206-213.

Blachman, A. (1994). What we have learned from longitudinal studies of phonological processing and reading, and some unanswered questions: A response to Torgeson, Wagner, and Rashotte. *Journal of Learning Disabilities, 27*, 287-291.

Bottge, B. A., & Hasselbring, T. S. (1993). A comparison of two approaches for teaching complex, authentic mathematics problems to adolescents with learning difficulties. *Exceptional Children, 59*, 556-566.

Bracey, G. W. (1997). *Setting the record straight: Responses to misconceptions about public education in the United States*. Alexandria, VA: Association for Supervision and Curriculum Development.

Bradley, L., & Bryant, P. E. (1983). Categorizing sounds and learning to read: A causal connection. *Nature, 310*, 419-421.

Bransford, J. D., Goin, L. I., Hasselbring, T. S., Kinzer, C. K., Sherwood, R. D., & Williams, S. M. (1988). Learning with technology: Theoretical and empirical perspectives. Peabody *Journal of Education, 64*, 5-26.

Bransford, J. D., Sherwood, R. D., Hasselbring, T. S., Kinzer, C. K., & Williams, S. M. (1990). Anchored instruction: Why we need it and how technology can help. In D. Nix & R. Spiro (Eds.), *Cognition, education, multimedia: Exploring ideas in high technology* (pp. 115-141). Hillsdale, NJ: Erlbaum.

Byrne, B., Freebody, P., & Gates, A. (1992). Longitudinal data on the relations of word-reading strategies to comprehension, reading time, and phonemic awareness. *Reading Research Quarterly, 27*, 141-151.

Chall, J. S. (1983). Literacy: Trends and explanations. *Educational Researcher, 12*, 3-8.

Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research, 53*, 445-459.

Clark, R. E., & Saloman, G. (1986). Media in teaching. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (pp. 464-478). New York: Macmillan.

Cognition and Technology Group at Vanderbilt University. (1994). Multimedia environments for developing literacy in at-risk students. In B. Means (Ed.), *Technology and education reform* (pp. 23-56). San Francisco, CA: Jossey-Bass.

Deshler, D. D., Ellis, E. S., & Lenz, B. K. (1996). *Teaching adolescents with learning disabilities: Strategies and methods*. Denver: Love Publishing.

Dymock, S. (1993). Reading but not understanding. *Journal of Reading, 37*, 86-91.

Educational Research Service. (1995). *Reading at the middle and high school levels*. Arlington, VA: ERS.

References

Ehri, L. C. (1992). Reconceptualizing the development of sight word reading and its relationship to recoding. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 107-143). Hillsdale, NJ: Erlbaum.

Fox, B., & Routh, D. K. (1984). Phonemic analysis and synthesis as word attack skills: Revisited. *Journal of Educational Psychology, 76*, 1059-1064.

Gersten, R., & Brengelman, S. U. (1996). The quest to translate research into classroom practice. *Remedial and Special Education, 17*, 67-74.

Goswami, U., & Bryant, P. (1990). *Phonological skills and learning to read*. East Sussex, UK: Erlbaum.

Goswami, U., & Bryant, P. (1992). Rhyme, analogy, and children's reading. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 49-63). Hillsdale, NJ: Erlbaum.

Guthrie, J. T., Alao, S., & Rinehart, J. M. (1997). Engagement in reading for young adolescents. *Journal of Adolescent & Adult Literacy, 40*, 438-446.

Ingram, D. (1976). *Phonological disability in children*. New York: Elsevier.

Irvin, J. L. (1997). Building sound literacy learning programs for young adolescents. *Middle School Journal, 28*, 4-9.

Irvin, J. L., & Connors, N. A. (1989). Reading instruction in middle level schools: Results of a U.S. Survey. *Journal of Reading, 32*, 306-311.

Jones, K., Torgesen, J. K., & Sexton, M. A. (1987). Using computer-guided practice to increase decoding fluency in learning disabled children: A study using the Hint & Hunt I program. *Journal of Learning Disabilities, 20*, 122-128.

Kessels, J. P. A. M., & Korthhagen, F. A. J. (1996). A relationship between theory and practice: Back to the classics. *Educational Researcher, 25*(3), 17-22.

Kirsch, I. S., & Guthrie, J. T. (1984). Adult reading practices for work and leisure. *Adult Education Quarterly, 34*, 213-232.

Kulik, J., Bangert, R., & Williams, G. (1983). Effects of computer-based teaching on secondary school students. *Journal of Educational Psychology, 75*, 19-26.

Kulik, C., Kulik, J., & Cohen, P. (1980). Instructional technology and college teaching. *Teaching of Psychology, 7*, 199-205.

LaBerge, D., & Samuels, S. J. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology, 6*, 293-323.

Lerner, J. W. (1997). *Learning disabilities: Theories, diagnosis, and teaching strategies*. 7th ed. New York: Houghton-Mifflin Company.

References

Lesgold, A. M., & Resnick, L. B. (1982). How reading difficulties develop: Perspectives from a longitudinal study. In J. P. Das, R. F. Mulcahy, & A. E. Wall (Eds.), *Theory and research in learning disabilitie*s (pp. 155-187). New York: Plenum Press.

Mann, V. (1991). Language problems: A key to early reading problems. In B. Wong (Ed.), *Learning about learning disabilities* (pp. 130-163). San Diego: Academic Press.

Mann, V. A., & Lieberman, I. Y. (1984). Phonological awareness and verbal short-term memory. *Journal of Learning Disabilities, 17*, 592-599.

Matthew, K. I. (1996). The impact of CD-ROM storybooks on children's reading comprehension and reading attitude. *Journal of Educational Multimedia and Hypermedia, 5*, 379-394.

McBride-Chang, C., & Chang, L. (1996). Phonological processing skills and print exposure: Correlates of word reading in children ages 9 to 16. *Reading & Writing Quarterly: Overcoming Learning Difficulties, 12*, 385-400.

McNamara, T.P., Miller, D.L., & Bransford, J.D. (1991). Mental models in reading comprehension. In R. Barr, M. Kamil, P. Mosenthal, & P. Pearson (Eds.) *Handbook of reading research*. Vol. 2. New York: Longman Publishing Group.

Naslund, J. C., & Samuels, S. J. (1992). Automatic access to word sounds and meaning in decoding written text. *Reading and Writing Quarterly: Overcoming Learning Disabilities, 8*, 135-156.

National Center for Education Statistics. (1993). *Education in States and Nations*. Washington, DC: Government Printing Office.

National Center for Education Statistics. (1996). *The Condition of Education 1996*. Washington, DC: Government Printing Office.

National Center for Education Statistics. (1999). *NAEP 1998 Reading Report Card for the Nation and the States*. Washington, DC: Government Printing Office.

National Joint Committee on Learning Disabilities. (1991). School reform: Opportunities for excellence and equity for individuals with learning disabilities-A special report. *The DLD Times, 9*(1), i7iv.

O'Connor, R. E., Jenkins, J. R., Leicester, N., & Slocum, T. A. (1993). Teaching phonological awareness to young children with learning disabilities. *Exceptional Children, 59*, 532-546.

O'Connor, R. E., & Notari-Syverson, A., & Vadasy, P. F. (1996). Ladders to literacy: The effects of teacher-led phonological activities for kindergarten children with and without disabilities. *Exceptional Children, 63*, 117-130.

Roth, S. F., & Beck, I. L. (1987). Theoretical and instructional implications of the assessment of two microcomputer word recognition programs. *Reading Research Quarterly, 22*, 197-218.

Samuels, S. J. (1997). The method of repeated readings. *The Reading Teacher, 50*, 376-381. (Reprinted from *The Reading Teacher*, 1979, 32.)

Reference

Schifini, A. (1997). Reading instruction for the pre-literate and struggling older student. Scholastic Literacy Research Paper, 3(13).

Schumaker, J. B., Deshler, D. D., & Ellis, E. S. (1986). Intervention issues related to the education of LD adolescents. In J. K. Torgesen & B. Y. L. Wong (Eds.), *Psychological and educational perspectives on learning disabilities* (pp. 329-365). Orlando, FL: Academic Press, Inc.

Sherwood, R. D., Kinzer, C. K., Hasselbring, T. S., & Bransford, J. D. (1987). Macrocontexts for learning: Initial findings and issues. *Applied Cognitive Psychology, 1*, 93-108.

Snow, C. E., Burns, M. S., & Griffin, P. (Eds.) (1998). Preventing reading difficulties in young children. Washington, DC: National Academy Press. Available online: http://books.nap.edu/html/prdyc/

Spear-Swerling, L., & Sternberg, R. J. (1996). *Off track: When poor readers become "learning disabled."* Boulder, CO: Westview Press, Inc.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly, 21*, 360-406.

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. Treman (Eds.), *Reading acquisition* (pp. 307-342). Hillsdale, NJ: Erlbaum.

Stanovich, K. E., Cunningham, A. E., & Cramer, B. B. (1984). Assessing phonological awareness in kindergarten children: Issues of task comparability. *Journal of Experimental Child Psychology, 38*, 175-190.

Torgesen, J. K. (1985). Memory processes in reading disabled children. *Journal of Learning Disabilities, 18*, 350-357.

Torgesen, K., Wagner, R.K., & Rashotte, C.A. (1994). Longitudinal studies of phonological processing and reading. *Journal of Learning Disabilities, 27*, 276-288.

U.S. Department of Education. (1994). To assure the free appropriate public education of all children with disabilities. *Sixteenth annual report to Congress on the implementation of the Individuals with Disabilities Education Act*. Washington, DC: U. S. Government Printing Office.

Walberg, H. J. (1983). Scientific literacy and economic productivity in international perspective. *Daedalus, 112*,1-28.

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.

Weinstein, T., & Walberg, H. J. (1993). Practical literacy of young adults: Educational antecedents and influences. *Journal of Research in Reading, 16*, 3-19.

Zigmond, N. (1990). Rethinking secondary school programs for students with learning disabilities. *Focus on Exceptional Children, 23*, 1-22.

SCHOLASTIC

Professional Paper

Scholastic Inc.
557 Broadway
New York, NY 10012
1-800-SCHOLASTIC

Item # 895513
25M 5/05