Waterford Early Reading Program™

RESEARCH SUMMARY

This document is intended as a review of research relevant to the development of the *Waterford Early Reading Program*™, created by the Waterford Institute and published by Pearson.

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Waterford Early Reading Program – Preface

PRODUCT OVERVIEW

The Waterford Early Reading Program™ *is a comprehensive, research-based curriculum that teaches children how to read, write, and keyboard. It is one of the nation's first research-based, technology-driven reform models in early reading instruction.*

Using a balanced approach to reading instruction—one that builds from rich literature and provides direct and systematic instruction—the Waterford Early Reading Program:

- Gives teachers the resources they need to have more frequent and meaningful interactions with students
- Gives students a rich environment in which to gain the skills necessary for a lifetime of learning

PRODUCT GOAL

All children can become successful readers if given appropriate instruction in the primary grades.

The use of a research-based computer program supplemented by teacher and parent materials can help children attain reading achievement. Training must include the following key reading components.

1. Phonemic awareness
   - — Blend and segment words with 80% mastery.
2. Phonics and Word Recognition
   - — Apply letter sound knowledge to decode single syllable and multi-syllabic words with 80% mastery
   - — Build sight word recognition skills to 1000 basic high-frequency words
   - — Read decodable and natural text in different genre to a 3.0 readability level
3. Vocabulary
   - — Identify words students must know to communicate effectively and recognize or use to understand what is read in print with 80% accuracy
4. Fluency
   - — Read text fluently with an accuracy of 60 words per minute in first grade and 90 to 100 words per minute by second grade.
5. Text Comprehension
   - — Use key comprehension strategies to understand the meaning of text read with 80% accuracy.

COURSE OVERVIEW

Multiple yearlong courses in the program provide an innovative continuum of instruction tailored to each student's reading level.

- *Reading Level One* (emergent reading) prepares students for beginning reading instruction by teaching print concepts, phonological awareness, and letter recognition. *Level One* is typically used in kindergarten.
    - Phonological Awareness helps young students recognize that words are made up of phonemes or sounds in words. The Phonological Awareness strand is automatically assigned concurrent with *Level One* and/or *Level Two and Three*.
- *Reading Level Two* (beginning reading) teaches letter sounds, word recognition, and beginning reading comprehension. *Level Two* is typically used in first grade.
- *Reading Level Three* (fluent reading) takes students from beginning to fluent reading and comprehension. *Level Three* is typically used in second grade.
- *Keyboarding to Read and Write* teaches students how to keyboard by touch. Students also develop reading and writing skills by keyboarding high priority words and literature from *Level Two*. *Keyboarding* is usually assigned by teachers to run concurrent with *Level Two* or *Level Three*.
- *Writing* is a menu of writing activities, paint programs, and word processors that allows teachers to devote more classroom time to developing students' writing skills.

DEVELOPMENT HISTORY

The Waterford Early Reading Program *is developed by Waterford Institute, a non-profit research center whose mission is to provide the finest possible education through high-quality models and software.*

During his time as a teacher, Waterford Institute founder and CEO, Dustin Heuston, Ph.D., discovered that the problems ailing education are not the typically blamed funding, skill, efficiency, or time. Education, he believes, suffers from a work shortfall. Waterford aims to eliminate education’s work shortfall—and support teachers—with technology.

At the completion of a $10 million research project in New York inner-city schools in 1989, one of the most important findings was that computer-based interventions should come at a much earlier age than previously anticipated. Because the software necessary to accomplish this task had not yet been developed, Waterford Institute began designing and developing the *Waterford Early Reading Program (WERP)*. The first level of the program was released in 1995, and subsequent levels and versions have been used successfully in over 10,000 sites across the United States.

Waterford Early Reading Program began its development in 1990—the year that Marilyn Jager Adams published *Beginning to Read*. Adams’ book identifies key research concepts regarding reading instruction. It was used extensively in developing *WERP*.

At first, Waterford began developing a beginning reading program—what would later become *Reading Level Two*—but further research indicated that not all students come to school prepared for reading instruction. In her book, Adams estimates that successful readers come to school with 3,000 hours of pre-literacy training. Ideally, parents provide this training for their children. Unfortunately, research shows that this training often does not take place at home and teachers can’t make up the deficit. *Reading Level One* was designed to fill this need. It provides the pre-

literacy skills necessary for students to begin formal reading instruction. Moreover, by sending student books, DVDs, and CDs home, *Reading Level One* endeavors to make up the deficit not only in students but also in younger siblings.

Reading Level Two is a beginning reading course. It builds on the pre-literacy training students receive in *Reading Level One*. *Reading Level Three* was designed based on the need for continuous practice of skills learned in preceding levels, and on the need for additional reading and writing practice.

The Institute's design and research team is comprised of experienced elementary teachers and professionals in the field of education and computer development. They have spent over two decades researching theories in child development to determine the best content and sequence of instruction for technology-based early reading curriculum. They have consulted with top reading scientists and learning experts including Marilyn Jager Adams and Joseph Torgesen. They also studied national and state standards and reviewed current reading texts.

This document is an introduction to the research background of this innovative new instructional model and the guiding principles behind it.

Reading—Essential but Elusive

All children must learn to read in order to grow into successful, contributing members of society. Reading is the foundation for every other part of a child's education. Children who learn to read at an early age are able to master other vital skills and concepts, including math and science. Unfortunately, too many elementary school children read far below their grade level, which puts them at a serious disadvantage in today's increasingly complex, fast-paced world. The challenge to teach every child to read deserves the attention of the best minds in education.

The Importance of Learning to Read

"Reading is the most important skill for success in school and society. Children who fail to learn to read will surely fail to reach their full potential" (Hall & Moats, 1999, pp. 6–7).

"Reading is important for the society as well as the individual. Economics research has established that schooling is an investment that forms human capital—that is, knowledge, skill, and problem solving ability that have enduring value. While a country receives a good return on investment in education at all levels from nursery school and kindergarten through college, the research reveals that the returns are highest from the early years of schooling when children are first learning to read.…The early years set the stage for later learning. Without the ability to read, excellence in high school and beyond is unattainable" (Anderson et al, 1985, p. 1).

Obstacles to Literacy

Despite the importance of reading, national studies show that children are growing up without mastering core reading skills.

The 2007 National Assessment of Educational Progress (NAEP) reported that 34 percent of fourth-grade students are reading at a "below basic" level of achievement, and it is evident that the racial/ethnic and gender gaps are not closing (National Center for Education Statistics [NCES], 2007).

Society's Increasing Demands

"It is essential and urgent to teach children to read and write competently, enabling them to achieve today's high standards of literacy. Although the United States enjoys the highest literacy rate in its history, society now expects virtually everyone in the population to function beyond the minimum standards of literacy. Today the definition of *basic proficiency* in literacy calls for a fairly high standard of reading comprehension and analysis. The main reason is that literacy requirements of most jobs have increased significantly and are expected to increase in the future. Communications that in the past were verbal (by phone or in person) now demand reading and writing—messages sent by electronic mail, Internet, or facsimile as well as print documents" (National Association for the Education of Young Children [NAEYC], and International Reading Association [IRA], 1998, part 1, p. 1).

Diverse Needs among Students in One Classroom

"With the increasing diversity among young children in our programs and schools, teaching today has become more challenging. Experienced teachers throughout the United States report that the children they teach today are more diverse in their backgrounds, experiences, and abilities than were those they taught in the past….What this means is that some kindergartners may have skills characteristic of the typical three-year-old, while others might be functioning at the level of the typical eight-year-old. Diversity is to be expected and embraced, but it can be overwhelming when teachers are expected to produce uniform outcomes for all, with no account taken of the initial range in abilities, experiences, interests, and personalities of individual children" (NAEYC & IRA, 1998, part 1, p. 1).

Students with Special Challenges

Non-English Speakers

In the United States between 1995 and 2006, the number of children with limited English ability rose 57.17% (NCELA, 2006).
Many of these second-language speakers of English will also come from backgrounds of poverty, have parents with low levels of education, and attend schools in urban and rural areas that are plagued by limited resources, insufficient numbers of certified teachers, and poor physical structures" (International Reading Association [IRA], 2001).

"Linguistic and socioeconomic factors play key roles in the literacy achievement of second-language learners" (IRA, 2001).

"Most important, teachers must understand how children learn a second language and how this process applies to young children's literacy development. Teachers need to respect the child's home language and culture and use it as a base on which to build and extend children's language and literacy experiences" (NAEYC & IRA, 1998, part 2, p. 2).

Children with Specific Learning Disabilities

"The number of students identified with learning disabilities has grown more rapidly than any other disability." (U.S. Department of Education, 2000)

To address this need, Congress revised the Individuals with Disabilities Education Act (IDEA 2004) shifting resources from ineffective models for serving children with learning problems and using resources for "Response to Intervention" (RtI). The premise of RtI is that if scientifically researched based instruction is provided and children's performance is regularly monitored in the classroom, all students will achieve high standards.

IDEA defines a 'specific learning disability' (SLD) as a disorder "in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations." (Hale, 2008, p. 1)

The basic idea of RtI is for a teacher to modify instruction (intervention) to help a struggling student, and consistently check the child's progress (progress monitoring) to see if intervention is successful. RtI includes three tiers of instruction with more time and intensive help provided if a child does not respond to learning at each tier.

Although measures have been taken to address the needs of children with learning disabilities, there are limitations and concerns with (Hale, 2008, p. 5):

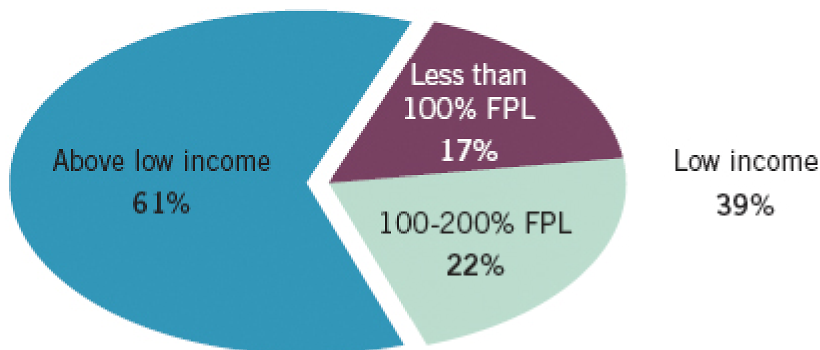
1. Difficulty establishing the criteria for "scientific research-based intervention."
2. Differences with instructional methods and strategies for different subjects.
3. Inadequate teacher training resulting in insufficient knowledge and skills to use researched-based instruction.
4. Using measures that may not have adequate reliability and validity.
5. Determining whether a child's response pattern is strong enough to be considered a "responder" or poor enough to be considered a "non-responder."

Low Socio-Economic Status

In the January 2008 Annual Report form the National Center for Children in Poverty, it stated that, "despite dramatic economic growth for our nation as a whole over the last generation, 39 percent of U.S. children live in low-income families, a percentage that continues to grow. The raw number is staggering: more than 28 million children have parents who are unable to meet their family's basic needs (*Knitzer , Jane*. (2008). National Center for Children of Poverty Annual Report. (2008).

There are over 73 million children in the United States living in federal poverty levels (FPL).

- 39%—28.6 million children live in low-income families.
- 17%—12.7 million children live in poor families. (NCCP, 2008).



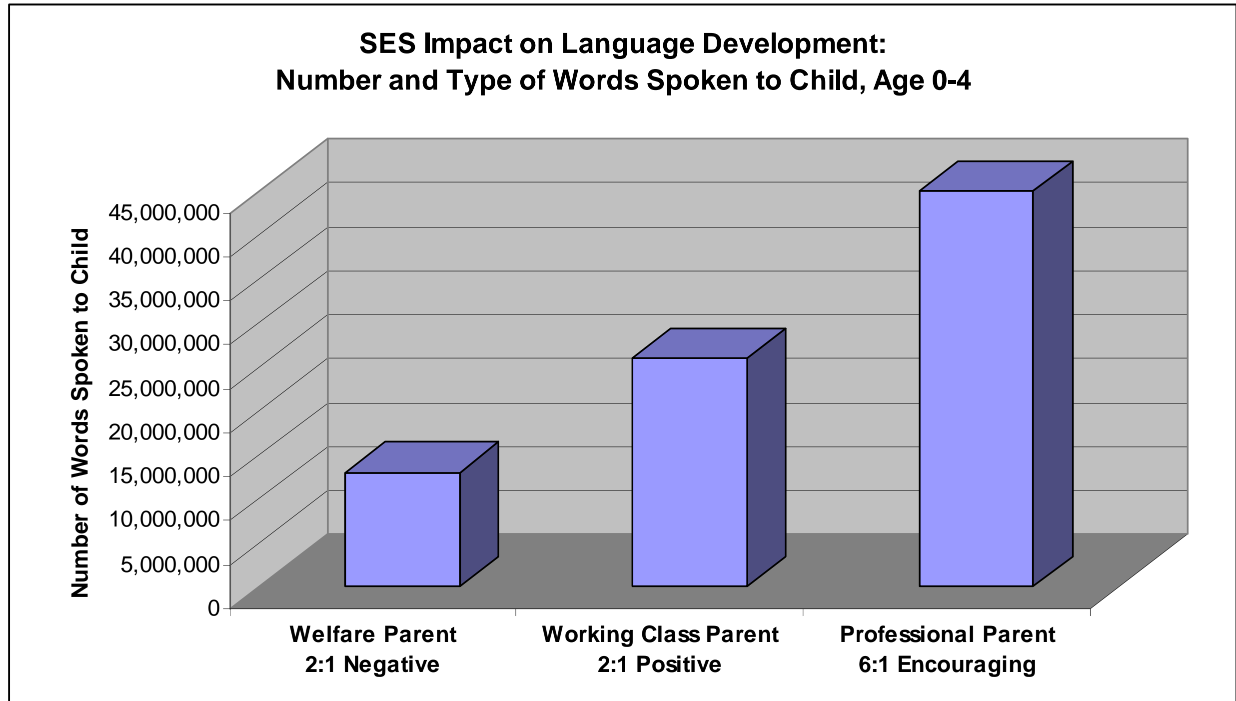
- 51% of children under age 6 in low-income families—5.3 million—live with a single parent (NCCP, 2008).

“Families rated low in SES [socioeconomic status] are not only less affluent and less educated than other families but also tend to live in communities in which the average family SES is low and tend to receive less adequate nutrition and health services, including prenatal and pediatric care. In other ways, too, low SES often encompasses a broad array of conditions that may be detrimental to the health, safety, and development of young children, which on their own may serve as risk factors for reading difficulties…. [The risk effects of SES] are strongest when it is used to indicate the status of a school or a community or a district, not the status of individuals. A low-status child in a generally moderate or upper-status school or community is far less at risk than that same child in a whole school or community of low-status children” (National Research Council, 1999, pp. 125–127).

A comprehensive research study conducted on home learning experiences of young children by Dr. Betty Hart and Dr. Todd Risley, concluded that a child’s future intellectual ability hinges upon the quality of oral language and vocabulary growth from birth to age four.

They discovered a massive difference in the amount of talking between children and their caregivers from different socio-economic levels. The study concluded that by the time children were four years of age, children of professional parents with college educations would hear 45 million words addressed to them; children of average working-class parents would hear 26 million words; and children of taciturn, welfare parents heard 13 million words addressed to them. (Hart and Risley, 1995, p. 198-199)

Extrapolated data also showed differences in children’s hourly experience with positive and negative words from parents. In professional families, the average child was accumulating a ratio of 6 encouragements to 1 discouragement. The average child in a working-class family was accumulating a ratio of 2 encouragements to 1 discouragement, and the average child in a welfare family was accumulating a ratio of 1 encouragement to 2 discouragements.



"Estimating the magnitude of the differences in children's cumulative experience before the age of 3 gives an indication of how big the problem is. We see the risk to our nation and its children that makes intervention more urgent than ever." (Hart and Risley, 1995, p. 203)

"In order to combat such problems, large investments in education must be made, particularly at the early childhood level" (Day & Yarbrough, 2001, p. 5).

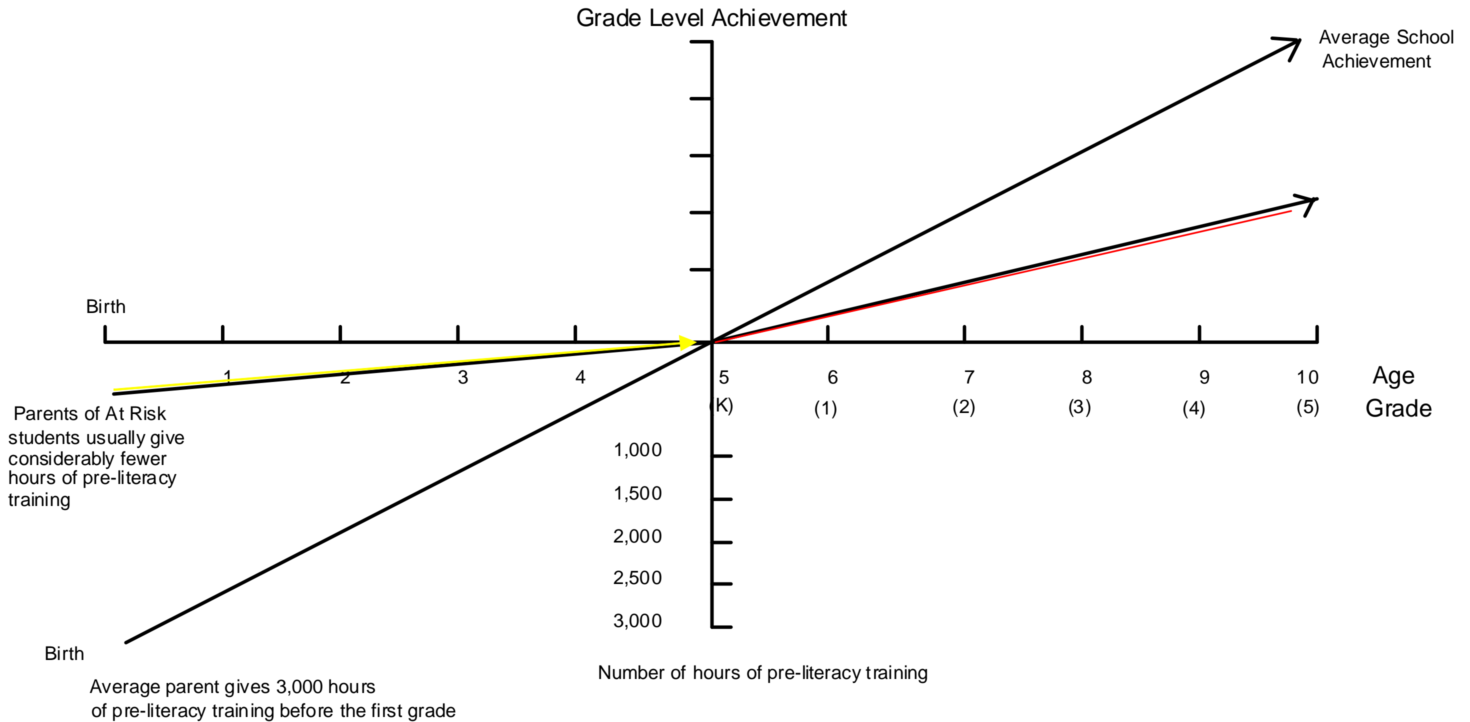
The Achievement Gap: Too Little Too Late

Students who struggle in the early grades tend to continue to do poorly into the upper grades. Children who have difficulty reading at the end of first grade often display similar difficulties in fourth grade.

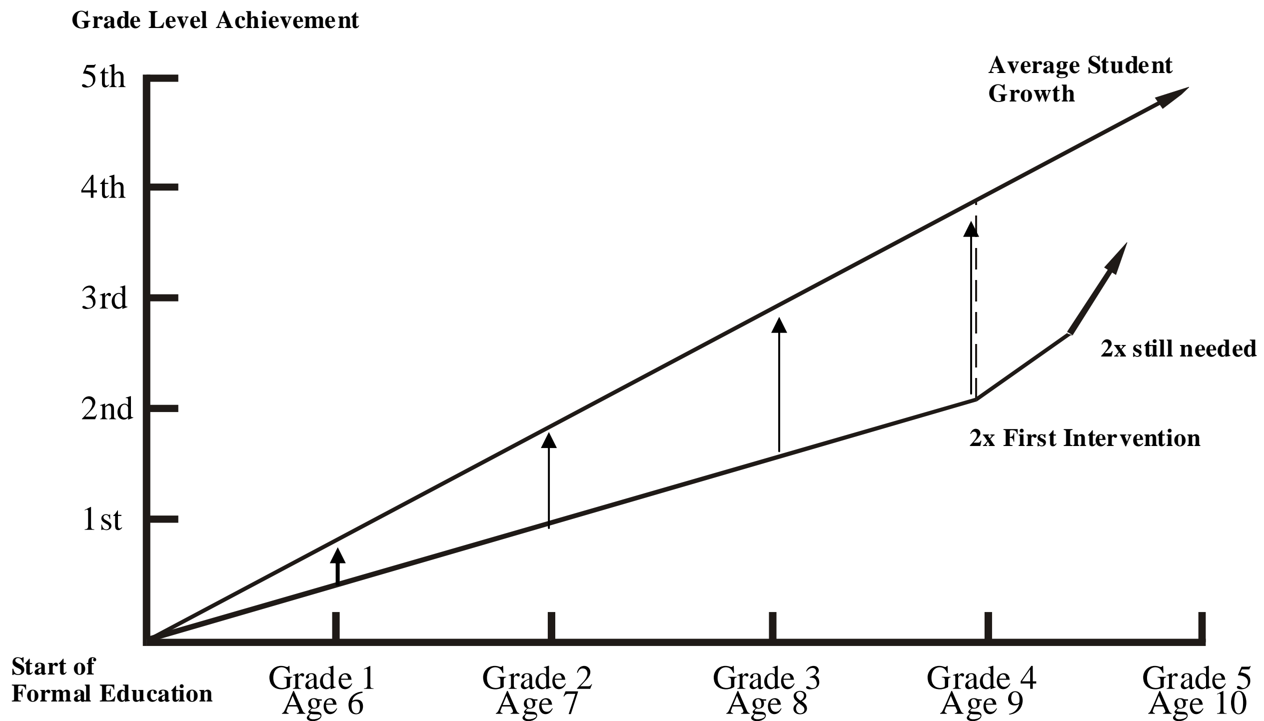
Research shows that "without early intervention, the poor first-grade reader almost invariably becomes a poor middle school reader, high school reader, and adult reader. In short, children who get off to a poor start in reading rarely catch up. We wait—they fail. But it does not have to be this way. It is a tragedy that both general and special education practices and policies continue unchanged even as extensive converging evidence makes clear that one major solution to the problem of school failure in general, and reading failure in particular, is early identification and prevention" (Finn et al, 2001, p. 270).

In the following figure, the grade-level achievement of students is represented graphically on the vertical and horizontal axes extending up and to the right. Average achievement is represented by the solid black line, while the "at risk" student is the red line below. As grade level/age increases, so does the level of expected achievement. A struggling student may not stand out in kindergarten or first grade. But left on that trajectory, the student will be tragically below expectations for high school.

The number of pre-literacy hours is also graphed. In *Beginning to Read*, Marilyn Jager Adams estimates that the parent gives 3,000 hours of pre-literacy training (singing, reading together, pointing out print, educational TV, etc.) to their children. By comparison, she estimates that parents of at risk students give 200 hours during this same time period (Adams, 1990, pp. 89-90).



As years go by, the gap that was not immediately apparent in the early grades begins to widen, and the need for intervention grows exponentially. If tutors or technology is introduced too late, the struggling student may have to gain two to four times his peers in order to match their rate of growth. This is, by definition, extremely difficult for the struggling learner.



If we look specifically at the top right quadrant, we see the problem of delayed intervention. Consider the length of the vertical arrows representing the amount of work needed to bring this student to expected achievement. An intervention at grade three or four may take four to six times the amount of resources needed to accomplish the same goal in earlier grades.

What's more, for intervention to be successful, it must not only double the student's rate of learning, but multiply it by four times. Because these students are the weakest learners, they face a tremendous obstacle to achieving success in this manner.

THE SOLUTION: EARLY INTERVENTION WITH THE RIGHT TOOLS

Children need early prevention and intervention in their curriculum.

"...the most valid and efficient way to deliver this early intervention in reading is through regular education….it is critical to provide this instruction as early as possible in a child's school career to avoid the reading failure that will other wise occur" (Finn et al, 2001, p. 271).

"The ability to read and write does not develop naturally, without careful planning and instruction….Experiences in these early years begin to define the assumptions and expectations about becoming literate and give children the motivation to work toward learning to read and write. From these experiences children learn that reading and writing are valuable tools that will help them do many things in life" (NAEYC & IRA, 1998, part 1, p. 3).

"An extensive knowledge base now exists to show us the skills children must learn in order to read well. These skills provide the basis for sound curriculum decisions and instructional approaches that can help prevent the predictable consequences of early reading failure" (Center

for the Improvement of Early Reading Achievement [CIERA] & National Institute for Literacy [NIFL], 2001, p. *ii*).

How the Waterford Early Reading Program Meets the Needs of Today's Children

The *Waterford Early Reading Program* was designed to give teachers and parents the tools they need to intervene early and narrow the achievement gap. The pages that follow review the following instructional elements—elements that make it a unique and powerful instructional program.

- A balanced reading continuum grounded in research
- Technology integrated into the curriculum
- A dynamic sequencer that responds to student performance
- Engaging learning approach
- Parental involvement

A Balanced Reading Continuum Grounded in Research

The Waterford Early Reading Program *is a complete continuum of instruction. It assumes children have no knowledge of reading and writing, and it takes them through all necessary steps to help them become fluent readers.*

In order to implement the most effective methods for teaching beginning reading, the designers of the *Waterford Early Reading Program*, all former teachers, researched data, consulted experts, and observed students. The program is largely based on the 11 research-based findings summarized below.

1. Emergent Readers Need to Understand How Print Works

"After their first contacts with print, children face three big challenges in the task of learning to read: The first is that all spoken languages have to be written down in some serial order which is arbitrary…The second is that the information in print is organized in a hierarchy of levels—discourse or text, sentence, phrase, word, letter cluster, letter and sub-letter levels—and the reader has to know which level to attend to at any one moment to be effective…The third problem combines the other two—during acquisition children have to learn how to attend to print in serial order while at the same time deciding which level of the language hierarchy to attend to…Learning what information in print to attend to in what order to get the greatest payoff can only be done on whole texts and this learning underlies successful reading" (Clay, 1991, p. 113).

2. Recognizing Individual Letters Is a Critical Determinant of Reading Proficiency

"With explicit instruction directing their attention to letters and sounds, and with practice using appropriately graded and engaging materials, students who seem to be low in reading ability can in time function within the normal range" (Carnegie Task Force, 1996, p. 105).

"Based on her review of the literature, Chall reported that prereaders' knowledge of letter names was a strong predictor of success in early reading achievement—even stronger than mental age

(Chall, 1967). Based on analyses of the USOE first-grade studies, Bond and Dykstra reinforced and extended Chall's report: Prereaders' letter knowledge was found to be the single best predictor of first-year reading achievement, with the ability to discriminate phonemes auditorily ranking a close second. Furthermore, these two predictors were the winners regardless of the instructional approach administered (Bond and Dykstra 1967)." (Adams, 1990. p. 55.)

"…If children do not know letter names and shapes, they need to be taught them along with phonemic awareness" (CIERA & NIFL, 2001, p. 7).

The easiest place for students to start is with the alphabet song. Once the letter names become familiar, students can benefit from activities that teach the letter shapes (Adams, 1990, p. 363).

3. Phonological Awareness Plays a Critical Role in Learning to Read

"Phonemic awareness, a component of phonological awareness, is the ability to notice, think about, and work with the individual sounds in spoken words. Before children learn to read print, they need to become aware of how the sounds in words work. They must understand that words are made up of speech sounds, or phonemes" (CIERA & NIFL, 2001, p. 2).

"Recent longitudinal studies of reading acquisition have demonstrated that the acquisition of phonemic awareness is highly predictive of success in learning to read—in particular in predicting success in learning to decode. In fact, phonemic awareness abilities in kindergarten (or in that age range) appear to be the best single predictor of successful reading acquisition" (International Reading Association, 1998, p. 2).

The importance of phonological (or phonemic) awareness in learning to read is supported by Griffith & Olsen (March 1992, 516–523), Bradley & Bryant (1991), Juel (1991), Juel (1998, p. 778), and Torgesen & Mathes (2000).

4. Beginning Readers Need to Understand the Relationships Between Written Language and Its Component Sounds

The relationship between written language and its component sounds is called *phonics*, and although there has been much debate over its importance, the fact is that all students learn about letter-sound relationships regardless of the type of instruction they receive. Then they use this knowledge to decode new words (Snow, Burns, & Griffin, 1998, pp. 173–174).

Marilyn Jager Adams, who has reviewed much of the research on phonics instruction, concludes that phonics instruction should be a prominent part of any beginning reading program, but that it should by no means be a program's only concern (1990, p. 411).

"Phonics instruction is most effective when it begins in kindergarten or first grade. To be effective with young learners, systematic instruction must be designed appropriately and taught carefully. It should include teaching letter shapes and names, phonemic awareness, and all major letter-sound relationships. It should ensure that all children learn these skills. As instruction proceeds, children should be taught to use this knowledge to read and write words" (CIERA & NIFL, 2001, p. 15).

"A program of systematic phonics instruction clearly identifies a carefully selected and useful set of letter-sound relationships and then organizes the introduction of these relationships into a logical instructional sequence… a systematic program of instruction provides children with ample opportunities to practice the relationships they are learning" (CIERA & NIFL, 2001, p. 16).

5. Beginning Readers Need Practice Reading and Listening to a Variety of Texts

Reading to and listening to wonderful stories reminds the students that the effort involved in word recognition is worthwhile. As S. A. Stahl explains, "Letter-sound instruction makes no sense to a child who does not have an over-all conception of what reading is about, how print functions, what stories are, and so on" (1994, p. 620).

"Problems arise when the relationship between what children learn in phonics and the stories they read is either too low or too high. When too few of the words are decodable, it is questionable whether what is taught in phonics is of any use. On the other hand, when all but one or two of the words in a selection are constrained by the letter sounds introduced, it is virtually impossible to write interesting selections in natural sounding language (Beck & Juel, 1992, p. 115).

"Studies have found that a minimum of five books per child is necessary to provide even the most basic print-rich environment (Morrow & Weinstein, 1986; Neuman & Roskos, 1997). Computers and developmentally appropriate software should also be available to provide alternative, engaging, enriching literacy experiences" (NAEYC 1996, as cited in NAEYC & IRA, 1998, part 2, p. 5).

6. Beginning Readers Need to Develop Automatic Word Recognition Skills so That They Can Pay Attention to Meaning

Automaticity is based on the principle that tasks become easier and require less attention through practice. When decoding becomes automatic, readers are able to focus on comprehension. Adams states that skillful readers "process the letters of text…quickly and easily" because they have an "overlearned knowledge about the sequences of letters comprising frequent words and spelling patterns" (1990, p. 410).

7. Readers Should Practice Spelling and Writing New Words

Spelling out words forces readers to attend to each letter of a word in left to right order (Adams, 1990, p. 131). A study by B. W. A. Whittlesea has shown that "the act of writing newly learned words results in a significant strengthening of their perceptual integrity in recognition" (Adams, 1990, pp. 129–130).

8. Readers Need Practice Reading Orally with Expression and Automaticity

"Although some readers may recognize words automatically in isolation or on a list, they may not read the same words fluently when the words appear in sentences in connected text…It is important to provide students with instruction and practice in fluency as they read connected text" (CIERA & NIFL, 2001, p. 23).

"Model fluent reading, then have students reread the text on their own. By listening to good models of fluent reading, students learn how a reader's voice can help written text make sense…It is the actual time that students are actively engaged in reading that produces reading gains" (CIERA & NIFL, 2001, p. 26).

One group of researchers found "in their analysis of oral reading lessons…that maintaining a focus on comprehension during reading lessons not only improves comprehension, but also improves children's word recognition skills beyond that of an emphasis on accuracy (Stahl, Huebach, & Cramond, 1994, p. 8).

9. Readers Can Develop Comprehension Strategies That Help Them Better Understand What They Read

"Text comprehension can be improved by instruction that helps readers use specific comprehension strategies" (CIERA & NIFL, 2001, p. 49). Presenting comprehension strategies to students as "the procedures that readers ought to use all of the time when reading and thus teaching them in the context of regular assignments is not only possible but desirable" (Pressley et al., 1989, p. 325).

10. Readers Can Develop Vocabulary To Increase Comprehension of What They Read

"Vocabulary knowledge has long been known to be a major correlate of comprehension ability, as measured by standardized tests." (Snow, et al., 1998, p. 63).

The National Research Council's conclusion is that the majority of reading problems could be prevented by, among other things, increasing children's oral language skills. (Snow, Burns, & Griffin, 1998)

National Reading Panel concluded that vocabulary is critically important in oral reading instruction (NICHD, 2000b)

11. Readers Should Practice Writing Connected Text to Express Ideas and Learn Basic Grammar and Usage Skills to Improve Their Writing

For many beginning readers, the ability to read is a by-product of the ability to print and spell (Durkin, 1989, p. 137). Stotsky points out that better readers are often better writers and vice versa, as measures by quantifiable factors (as quoted in Heller, 1995, p. 5).

"…the potential contribution of writing to reading runs much deeper than any concern of form or style. In particular, as children become authors, as they struggle to express, refine, and reach audiences through their own writing, they actively come to grips with the most important reading insights of all (Graves 1983)." (Adams, 1990, p. 405)

Technology Integrated into the Curriculum

The Waterford Early Reading Program *maximizes the benefits of computer instruction (adaptive, interactive software) in combination with solid classroom materials (easy-to-use teacher guides, take-home student books, classroom posters and handouts).*

Technology Is Required by New National Standards

National Association for the Education of Young Children (NAEYC) guidelines require that "appropriate technology is integrated into the regular learning environment and used as one of many options to support children's learning" (NAEYC, 1996).

Good Technology Should Be Integrated with Classroom Activities

"Very young children have shown comfort and confidence in using software. They can follow pictorial directions and use situational and visual cues to understand and think about their activity (Clements and Nastasi 1993). Typing on the keyboard does not seem to cause them any trouble; if anything, it is a source of pride" (Clements, 2001, p. 1).

"Research shows that computer activities yield the best results when coupled with suitable off-computer activities. For example, children who are exposed to developmental software alone—the on-computer group—show gains in intelligence, non-verbal skills, long-term memory, and manual dexterity. Those who also worked with supplemental activities, in comparison—the off-computer group—… improved their scores in verbal, problem-solving, and conceptual skills (Haugland 1992)" (Clements, 2001, p. 4).

A Dynamic Sequencer that Responds to Student Performance

In order to harness technology's potential to individualize instruction, Waterford Institute created a "sequencer" that constantly monitors student performance and dynamically determines which instruction to deliver next. This piece of software works behind the *Waterford Early Reading Program* to automatically adjust the order of instruction based on each student's performance.

Literacy is Improved by Individualized Instruction

Students' reading ability is assessed at the beginning of the program in order for the sequencer to determine the appropriate starting point within the curriculum. Once the student is placed, the sequencer responds to student performance. For struggling learners, the sequencer presents more instruction, more practice, and intense review. Drawing from the complete curriculum, the sequencer will present a wealth of the material needed to master the skill and give the added support that struggling learners need. When students show early mastery of skills, the sequencer allows them to skip the explicit instruction and spend more time in practice and application of the skill.

The sequencer tracks the progress of each student, adapts to individual abilities, and keeps recordings of oral reading, so teachers are more able to prepare directed classroom lessons and activities.

In a research article by Benjamin S. Bloom, it stated "studies find that typically teachers give students in the top third of the class the greatest attention and students in the bottom third of the class receive the least attention and support. These differences in the interaction between teachers and students provide some students with much greater opportunity and encouragement for learning than is provided for other students in the same classroom (Bloom, 1984, p. 11)

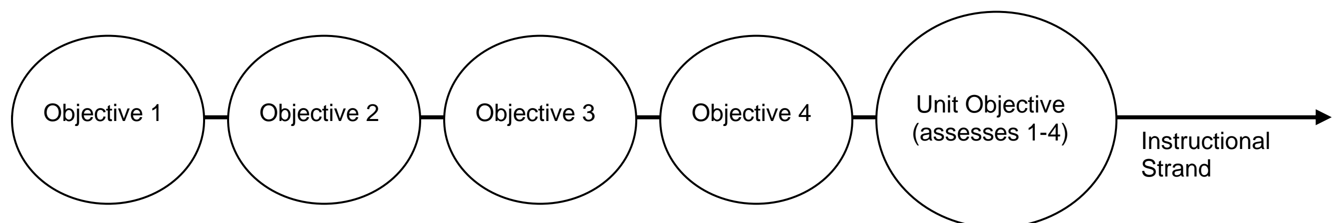
In fact, Eaton H. Conant concluded that the average classroom provides about two hours of instruction each day. Of that two hours, each student receives one minute of individual instruction each day—that's only 180 minutes per year (Conant, 1973)

"Instructional strategies adapted to individual students and small groups raise achievement." (Paik, 2003, p. 84)

Waterford Early Reading Program provides 15 to 30 minutes of daily individualized instruction based on the time recommendations in the product.

Effective Sequence of Instruction

The Waterford sequencer has a hierarchical structure. Activities are bundled into "Objectives," each with a discrete learning goal and a target mastery score. Objectives, in turn, are organized in order of difficulty into units and Instructional Strands. (See illustration that follows)



Each Objective produces a mastery score based on student performance. The sequencer determines which Objective within the unit or Instructional Strand to present next based on the student's mastery score. Each student works at his own pace.

The presentation of instruction within Objectives and activities is organized based on the work of Robert Gagne, an American educational psychologist who pioneered the science of sound instruction. A major contribution to the theory of instruction was the model "Nine Events of Instruction". The Waterford sequencer provides a way to organize a more effective sequence of instruction following **Gagne's Nine Events of Instruction** that activates processes needed for effective learning (Gagne, et al., 2005, p. 205). Gagne believes all lessons should include this sequence of events:

1. Gaining attention: Communicate the importance and relevance of the lesson content to the learners.

2. Informing learner of lesson objective: Simply state what the students will learn and what they will be expected to accomplish.

3. Stimulating recall of prior learning: Relate the content of the lesson to learners' prior knowledge.

4. Present stimuli with distinctive features: Present a definition of the concept and utilize instructional strategies that are unique to the content area..

5. Guiding learning: As instructional strategies are presented or utilized, ensure that an appropriate environment for learning is defined and established.

6. Eliciting performance: Present three to five examples for learners to practice the desired performance.

7. Providing informative feedback: Provide learners with feedback on how well they have learned the desired capability or skill.

8. Assessing performance: Ask questions requiring a response and inform the learner if mastery is achieved.

9. Enhancing retention and learning transfer: Present three to five additional concept examples with a different approach

Each Objective within the Waterford sequencer is made up of a combination of activities from the following categories. These activities provide the needed context and content outlined in Gagne's Nine Events of Instruction. (Retention is addressed in the next section.)

- **Preassessment:** measures the student's background knowledge to determine level of instruction needed for an Objective or a set of Objectives

- **Song:** engages students with music and memorable lyrics to teach and reteach concepts

- **Introduction:** provides a brief overview of the learning objective or provides quick hints on what will come next and how to be successful with that skill

- **Instruction:** explicitly teaches the target learning objective

- **Book:** provides students experience applying their developing literacy skills, particularly the target skill for the Objective, to a book

- **Practice:** applies instruction through repetition, usually in a game

- **Postassessment:** measures the students' mastery at the end of an Objective or unit; determines whether the student needs remediation

Exemplary Reading Programs Build in Review to Strengthen Learning

Mastered skills need to be retained. Waterford looked to learning decay theory to build retention into the sequencer.

Learning decay is the theory that new information can be lost if it is not moved to long-term memory through targeted practice. Some of the first research on this subject was done by the

German psychologist, Hermann von Ebbinghaus who founded two important concepts (Ebbinghaus, 1964):

1. Repetition. The process of committing something to memory involves the formation of new associations. These associations are strengthened through repetition.

2. Overlearning. Through repetition, information is overlearned (the overlearning effect), which means that it is resistant to disruption or loss, and it requires more time to forget.

In another study it was found that higher mastery means slower forgetting. Both younger and older children exhibited higher forgetting rates for items that were mastered more slowly (e.g., abstract nouns), than for items that were mastered more rapidly (e.g., concrete nouns) (Brainerd & Reyna, 1995).

"Studies with infants have found that long-term retention is enhanced when information is distributed over multiple, temporally discrete sessions instead of being presented in a single, massed session" (Rovee-Collier, 1995). Geary (1994) confirms this principle, stating "practice should occur in small doses (about 20 minutes a day) and over an extended period of time."

Learning decay algorithms in the Waterford sequencer consider the rate at which students learn an objective. If the student takes several repetitions to learn an objective, the period between reviews is different than if the student masters the objective immediately.

In the *Waterford Early Reading Program*, reviews are triggered by progress through the curriculum (automated review). Students review past material before moving into more difficult material. In *Waterford Early Math and Science*, reviews are triggered by progress of time (algorithms based on learning decay theory).

"Reviewing skills helps students retain knowledge. Exemplary beginning reading programs build in review to strengthen learning. A reading instruction program that teaches a specific curriculum element in two weeks, with a review at the beginning of the second week…bridges interruptions 'to support cumulative learning'" (Calfee, 1998, p. 329).

Engaging Learning Approach

Waterford engages students with music and rich multimedia to introduce, teach, and practice concepts.

Engaging Multi-media Elements Teach Important Concepts and Skills

"Songs and chants serve at least two purposes. First, they make rote learning tasks, such as the alphabet and vowel generalizations, easy to memorize and later transfer to real reading situations. Second, songs and chants provide a springboard into rich experiences" (Reutzel and Cooter, 1992, p. 125).

Teachers can increase their effectiveness tenfold by using visual information in class. "Learning really starts with the seeing, and then the thinking,…rather than the other way around ("Making an Impression," 2002).

Home Involvement

Waterford recognizes the importance of the home in successful learning. Students are given a variety of take-home materials to amplify the positive impact of the Waterford classroom curriculum. These materials inform parents of their students' progress and provide activity ideas for parents that continue students' learning at home. Students who own their own set of Waterford books—especially poor students with few other materials possessions—are more motivated to read and learn.

The *Waterford Early Reading Program* uses the following items to reinforce learning in the home:

- DVDs of books and songs that allow students to view and listen to stories and songs they are exposed to in the classroom and on the computer
- Books (both controlled text and natural text) that reinforce word patterns, sight words, vocabulary, and comprehension taught at school
- CDs of books and songs that allow students to listen to stories and songs they are exposed to in the classroom and on the computer
- HomeLink Newsletters that inform parents about their students' progress and foster continued learning at home, available in both English and Spanish languages.
- Worksheets and computer printouts available at the end of many lessons that provide homework, extra practice, and reinforcement of skills

Each Student Needs Books to Read at Home

"Studies indicate that the number of books in a family's home relates to the academic achievement of its children…whether parents read to their children can impact the degree of educational success" (Shaw & Blake, 1998, p. 74).

"Analyses of schools that have been successful in promoting independent reading suggest that one of the keys is ready access to books. However, fully 15 percent of the nation's schools do not have libraries. In most of the remaining schools, the collections are small, averaging just over 13 volumes per student" (Anderson et al, 1985, p. 78).

Family Involvement Is a Critical Factor in Teaching Children to Read

"Parents play roles of inestimable importance in laying the foundation for learning to read" (Anderson et al, 1985, p. 27). Henderson and Berla (1994) found that "family involvement is a critical factor in student achievement from the earliest childhood years through high school, and that efforts to improve a child's performance are much more effective when the family is actively involved." Studies show that children from low-income or minority families benefit most when their parents are involved with school (Shaw & Blake, 1998, p. 76).

Parents Help Children Develop Positive Attitudes Toward Literacy

"Studies indicate that the number of books in a family's home relates to the academic achievement of its children…whether parents read to their children can impact the degree of educational success" (Shaw & Blake, 1998, p. 74).

Conclusion

The *Waterford Early Reading Program* has a unique mission: to improve and enhance the education of all children and narrow the achievement gap for students who need help the most.

Some students enter school prepared to learn; others do not. Waterford developed programs to give students with a wide variety of backgrounds access to a carefully sequenced reading curriculum they can work through at their own pace. Their performance is assessed and skills are re-taught as necessary to ensure that they build a solid foundation before going on to more advanced concepts. As they master skills and concepts, their self-confidence grows.

Through the application of innovative technology and a quality curriculum, Waterford puts every child on the proven path to reading.

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