# Report of the National Reading Panel

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Teaching Children to Read

## Findings and Determinations of the National Reading Panel by Topic Areas

## Alphabetics
## Phonemic Awareness Instruction

Phonemes are the smallest units composing spoken language. For example, the words "go" and "she" each consist of two sounds or phonemes. Phonemes are different from letters that represent phonemes in the spellings of words. Instruction in phonemic awareness (PA) involves teaching children to focus on and manipulate phonemes in spoken syllables and words. PA instruction is frequently confused with phonics instruction, which entails teaching students how to use letter-sound relations to read or spell words. PA instruction qualifies as phonics instruction when it involves teaching children to blend or segment the sounds in words using letters. However, children may be taught to manipulate sounds in speech without any letters as well; this does not qualify as phonics instruction. PA is also frequently confused with auditory discrimination, which refers to the ability to recognize whether two spoken words are the same or different. These distinctions are explained in detail in the section devoted to phonemic awareness instruction in the Report of the <u>National Reading Panel: Reports of the Subgroups</u>.

There are several reasons why the NRP selected PA instruction for review and analysis. First, correlational studies have identified PA and letter knowledge as the two best school-entry predictors of how well children will learn to read during the first 2 years of instruction. Such evidence suggests the potential importance of PA training in the development of reading skills. Second, many experimental studies have been carried out to evaluate the effectiveness of PA training in facilitating reading acquisition. Third, there is currently much interest in PA training programs among teachers, principals, parents, and publishers because of claims about their value in improving children's ability to learn to read.

The initial literature search for studies relevant to PA instruction and training identified 1,962 citations. Following initial review, the Panel identified and further reviewed 78 studies that met the general NRP research methodology criteria. However, on detailed examination, only 52 studies satisfied the more specific NRP research methodology criteria. From these 52 studies, 96 comparisons of treatment and control groups were derived. Data from these comparisons were then entered into a meta-analysis to determine treatment effect sizes.

## Findings and Determinations

The results of the meta-analysis were impressive. Overall, the findings showed that teaching children to manipulate phonemes in words was highly effective under a variety of teaching conditions with a variety of learners across a range of grade and age levels and that teaching phonemic awareness to children significantly improves their reading more than instruction that lacks any attention to PA.

Specifically, the results of the experimental studies led the Panel to conclude that PA training was the cause of improvement in students' phonemic awareness, reading, and spelling following training. The findings were replicated repeatedly across multiple experiments and thus provide converging evidence for causal claims. While PA training exerted strong and significant effects on reading and spelling development, it did not have an impact on children's performance on math tests. This indicates that halo/Hawthorne (novelty) effects did not explain the findings and that indeed the training effects were directly connected with and limited to the targeted domain under study. Importantly, the effects of PA instruction on reading lasted well beyond the end of training. Children of varying abilities improved their PA and their reading skills as a function of PA training.

PA instruction also helped normally achieving children learn to spell, and the effects lasted well beyond the end of training. However, the instruction was not effective for improving spelling in disabled readers. This is consistent with other research showing that disabled readers have difficulty learning how to spell.

Programs in all of the studies provided explicit instruction in phonemic awareness. Specifically, the characteristics of PA training found to be most effective in enhancing PA, reading, and spelling skills included explicitly and systematically teaching children to manipulate phonemes with letters, focusing the instruction on one or two types of phoneme manipulations rather than multiple types, and teaching children in small groups.

PA instruction is ready for implementation in the classroom, but teachers should keep in mind several cautions. First, PA training does not constitute a complete reading program. Rather, it provides children with essential foundational knowledge in the alphabetic system. It is one necessary instructional component within a complete and integrated reading program. Several additional competencies must be acquired as well to ensure that children will learn to read and write. Second, there are many ways to teach PA effectively. In

implementing PA instruction, teachers need to evaluate the methods they use against measured success in their own students. Third, the motivation of both students and their teachers is a critical ingredient of success. Research has not specifically focused on this.

## Phonics Instructional Approaches

**Analogy Phonics**—Teaching students unfamiliar words by analogy to known words (e.g., recognizing that the rime segment of an unfamiliar word is identical to that of a familiar word, and then blending the known rime with the new word onset, such as reading brick by recognizing that -ick is contained in the known word kick, or reading stump by analogy to jump).

**Analytic Phonics**—Teaching students to analyze lettersound relations in previously learned words to avoid pronouncing sounds in isolation.

**Embedded Phonics**—Teaching students phonics skills by embedding phonics instruction in text reading, a more implicit approach that relies to some extent on incidental learning.

**Phonics through Spelling**—Teaching students to segment words into phonemes and to select letters for those phonemes (i.e., teaching students to spell words phonemically).

**Synthetic Phonics**—Teaching students explicitly to convert letters into sounds (phonemes) and then blend the sounds to form recognizable words.

# Phonics Instruction

Phonics instruction is a way of teaching reading that stresses the acquisition of letter-sound correspondences and their use in reading and spelling. The primary focus of phonics instruction is to help beginning readers understand how letters are linked to sounds (phonemes) to form letter-sound correspondences and spelling patterns and to help them learn how to apply this knowledge in their reading. Phonics instruction may be provided systematically or incidentally. The hallmark of a systematic phonics approach or program is that a sequential set of phonics elements is delineated and these elements are taught along a dimension of explicitness depending on the type of phonics method employed. Conversely, with incidental phonics instruction, the teacher does not follow a planned sequence of phonics elements to guide instruction but highlights particular elements opportunistically when they appear in text.

## Types of Phonics Instructional Methods and Approaches

The sidebar depicts several different types of phonics instructional approaches that vary according to the unit of analysis or how letter-sound combinations are represented to the student. For example, in synthetic phonics approaches, students are taught to link an individual letter or letter combination with its appropriate sound and then blend the sounds

to form words. In analytic phonics, students are first taught whole word units followed by systematic instruction linking the specific letters in the word with their respective sounds. Phonics instruction can also vary with respect to the explicitness by which the phonic elements are taught and practiced in the reading of text. For example, many synthetic phonics approaches use direct instruction in teaching phonics components and provide opportunities for applying these skills in decodable text formats characterized by a controlled vocabulary. On the other hand, embedded phonics approaches are typically less explicit and use decodable text for practice less frequently, although the phonics concepts to be learned can still be presented systematically. These distinctions are addressed in detail in the Phonics subgroup report.

## Questions Guiding the NRP Analysis of Phonics Instruction

The NRP examined the research literature concerning phonics instruction to answer the following questions: Does phonics instruction enhance children's success in learning to read? Is phonics instruction more effective at some grade levels than others? Is it beneficial for children who are having difficulties learning to read? Does phonics instruction improve all aspects of reading or just decoding and word-level reading skills? Are some types of phonics instruction more effective than others and for which children? Does phonics instruction have an impact on children's spelling?

To address these questions the NRP performed a literature search to identify studies published since 1970 that compared phonics instruction to other forms of instruction for their impact on reading ability. The initial electronic and manual searches identified 1,373 studies that appeared relevant to phonics instruction. Evaluation of these studies to determine adherence to the general and specific NRP research methodology criteria identified 38 studies from which 66 treatment-control group comparisons were derived. Data from these studies were used in a meta-analysis, including the calculation of effect sizes.

The meta-analysis indicated that systematic phonics instruction enhances children's success in learning to read and that systematic phonics instruction is significantly more effective than instruction that teaches little or no phonics.

## Findings and Determinations

The meta-analysis revealed that systematic phonics instruction produces significant benefits for students in kindergarten through 6th grade and for children having difficulty learning to read. The ability to read and spell words was enhanced in kindergartners who received systematic beginning phonics instruction. First graders who were taught phonics systematically were better able to decode and spell, and they showed significant improvement in their ability to comprehend text. Older children receiving phonics instruction were better able to decode and spell words and to read text orally, but their comprehension of text was not significantly improved.

Systematic synthetic phonics instruction (see sidebar for definition) had a positive and significant effect on disabled readers' reading skills. These children improved substantially in their ability to read words and showed significant, albeit small, gains in their ability to process text as a result of systematic synthetic phonics instruction. This type of phonics instruction benefits both students with learning disabilities and low-achieving students who are not disabled. Moreover, systematic synthetic phonics instruction was significantly more effective in improving low socioeconomic status (SES) children's alphabetic knowledge and word reading skills than instructional approaches that were less focused on these initial reading skills.

Across all grade levels, systematic phonics instruction improved the ability of good readers to spell. The impact was strongest for kindergartners and decreased in later grades. For poor readers, the impact of phonics instruction on spelling was small, perhaps reflecting the consistent finding that disabled readers have trouble learning to spell.

Although conventional wisdom has suggested that kindergarten students might not be ready for phonics instruction, this assumption was not supported by the data. The effects of systematic early phonics instruction were significant and substantial in kindergarten and the 1st grade, indicating that systematic phonics programs should be implemented at those age and grade levels.

The NRP analysis indicated that systematic phonics instruction is ready for implementation in the classroom. Findings of the Panel regarding the effectiveness of explicit, systematic phonics instruction were derived from studies conducted in many classrooms with typical classroom teachers and typical American or English-speaking students from a variety of backgrounds and socioeconomic levels. Thus, the results of the analysis are indicative of what can be accomplished when explicit, systematic phonics programs are implemented in today's classrooms. Systematic phonics instruction has been used widely over a long period of time with positive results, and a variety of systematic phonics programs have proven effective with children of different ages, abilities, and socioeconomic backgrounds.

These facts and findings provide converging evidence that explicit, systematic phonics instruction is a valuable and essential part of a successful classroom reading program. However, there is a need to be cautious in giving a blanket endorsement of all kinds of phonics instruction.

It is important to recognize that the goals of phonics instruction are to provide children with key knowledge and skills and to ensure that they know how to apply that knowledge in their reading and writing. In other words, phonics teaching is a means to an end. To be able to make use of letter-sound information, children need phonemic awareness. That is, they need to be able to blend sounds together to decode words, and they need to break spoken words into their constituent sounds to write words. Programs that focus too much on the teaching of letter-sound relations and not enough on putting them to use are unlikely to be

very effective. In implementing systematic phonics instruction, educators must keep the end in mind and ensure that children understand the purpose of learning letter sounds and that they are able to apply these skills accurately and fluently in their daily reading and writing activities.

Of additional concern is the often-heard call for "intensive, systematic" phonics instruction. Usually the term "intensive" is not defined. How much is required to be considered intensive? In addition, it is not clear how many months or years a phonics program should continue. If phonics has been systematically taught in kindergarten and 1st grade, should it continue to be emphasized in 2nd grade and beyond? How long should single instruction sessions last? How much ground should be covered in a program? Specifically, how many letter-sound relations should be taught, and how many different ways of using these relations to read and write words should be practiced for the benefits of phonics to be maximized? These questions remain for future research.

Another important area is the role of the teacher. Some phonics programs showing large effect sizes require teachers to follow a set of specific instructions provided by the publisher; while this may standardize the instructional sequence, it also may reduce teacher interest and motivation. Thus, one concern is how to maintain consistency of instruction while still encouraging the unique contributions of teachers. Other programs require a sophisticated knowledge of spelling, structural linguistics, or word etymology. In view of the evidence showing the effectiveness of systematic phonics instruction, it is important to ensure that the issue of how best to prepare teachers to carry out this teaching effectively and creatively is given high priority.

Knowing that all phonics programs are not the same brings with it the implication that teachers must themselves be educated about how to evaluate different programs to determine which ones are based on strong evidence and how they can most effectively use these programs in their own classrooms. It is therefore important that teachers be provided with evidence-based preservice training and ongoing inservice training to select (or develop) and implement the most appropriate phonics instruction effectively.

A common question with any instructional program is whether "one size fits all." Teachers may be able to use a particular program in the classroom but may find that it suits some students better than others. At all grade levels, but particularly in kindergarten and the early grades, children are known to vary greatly in the skills they bring to school. Some children will already know letter-sound correspondences, and some will even be able to decode words, while others will have little or no letter knowledge. Teachers should be able to assess the needs of the individual students and tailor instruction to meet specific needs. However, it is more common for phonics programs to present a fixed sequence of lessons scheduled from the beginning to the end of the school year. In light of this, teachers need to be flexible in their phonics instruction in order to adapt it to individual student needs.

Children who have already developed phonics skills and can apply them appropriately in the reading process do not require the same level and intensity of phonics instruction provided to children at the initial phases of reading acquisition. Thus, it will also be critical to determine objectively the ways in which systematic phonics instruction can be optimally incorporated and integrated in complete and balanced programs of reading instruction. Part of this effort should be directed at preservice and inservice education to provide teachers with decisionmaking frameworks to guide their selection, integration, and implementation of phonics instruction within a complete reading program.

Teachers must understand that systematic phonics instruction is only one component—albeit a necessary component—of a total reading program; systematic phonics instruction should be integrated with other reading instruction in phonemic awareness, fluency, and comprehension strategies to create a complete reading program. While most teachers and educational decisionmakers recognize this, there may be a tendency in some classrooms, particularly in 1st grade, to allow phonics to become the dominant component, not only in the time devoted to it, but also in the significance attached. It is important not to judge children's reading competence solely on the basis of their phonics skills and not to devalue their interest in books because they cannot decode with complete accuracy. It is also critical for teachers to understand that systematic phonics instruction can be provided in an entertaining, vibrant, and creative manner.

Systematic phonics instruction is designed to increase accuracy in decoding and word recognition skills, which in turn facilitate comprehension. However, it is again important to note that fluent and automatic application of phonics skills to text is another critical skill that must be taught and learned to maximize oral reading and reading comprehension. This issue again underscores the need for teachers to understand that while phonics skills are necessary in order to learn to read, they are not sufficient in their own right. Phonics skills must be integrated with the development of phonemic awareness, fluency, and text reading comprehension skills.

## Fluency

Fluent readers are able to read orally with speed, accuracy, and proper expression. Fluency is one of several critical factors necessary for reading comprehension. Despite its importance as a component of skilled reading, fluency is often neglected in the classroom. This is unfortunate. If text is read in a laborious and inefficient manner, it will be difficult for the child to remember what has been read and to relate the ideas expressed in the text to his or her background knowledge. Recent research on the efficacy of certain approaches to teaching fluency has led to increased recognition of its importance in the classroom and to changes in instructional practices.

Reading practice is generally recognized as an important contributor to fluency. Two instructional approaches, each of which has several variations, have typically been used to teach reading fluency. One, guided repeated oral reading, encourages students to read passages orally with systematic and explicit guidance and feedback from the teacher. The other, independent silent reading, encourages students to read silently on their own, inside and outside the classroom, with minimal guidance or feedback.

## Guided Oral Reading

The NRP conducted an initial series of electronic literature searches and identified 364 studies potentially relevant to the effects of guided oral reading instructional practices. Of these, 16 studies met the NRP research methodology criteria and were included in a meta-analysis, and 21 additional studies met the criteria but could not be included in the meta-analysis—although they were used in the qualitative interpretation of the efficacy of these instructional methods.

### Findings and Determinations

On the basis of a detailed analysis of the available research that met NRP methodological criteria, the Panel concluded that guided repeated oral reading procedures that included guidance from teachers, peers, or parents had a significant and positive impact on word recognition, fluency, and comprehension across a range of grade levels. These studies were conducted in a variety of classrooms in both regular and special education settings with teachers using widely available instructional materials. This suggests the classroom readiness of guided oral reading and repeated reading procedures. These results also apply to all students—good readers as well as those experiencing reading difficulties. Nevertheless, there were important gaps in the research. In particular, the Panel could find no multiyear studies providing information on the relationship between guided oral reading and the emergence of fluency.

## Independent Silent Reading

There has been widespread agreement in the literature that encouraging students to engage in wide, independent, silent reading increases reading achievement. Literally hundreds of correlational studies find that the best readers read the most and that poor readers read the least. These correlational studies suggest that the more that children read, the better their fluency, vocabulary, and comprehension. However, these findings are correlational in nature, and correlation does not imply causation. No doubt, it could be that the more that children read, the more their reading skills improve, but it is also possible that better readers simply choose to read more.

In order to address this issue of causation, the panel examined the specific impact that encouraging students to read more has on fluency, vocabulary development, and reading comprehension. The studies that were identified that address this issue were characterized by three major features. First, the studies emphasized silent reading procedures with students reading on their own with little or no specific feedback. Second, the studies did not directly assess fluency or the actual increase in the amount of reading due to the instructional procedures. Rather, only changes in vocabulary and/or comprehension were typically measured as outcomes rather than increases in fluency that could be expected from the increased reading practice. Third, very few studies that examined the effect of independent silent reading on reading achievement could meet the NRP research review methodology criteria (n = 14), and these studies varied widely in their methodological quality and the reading outcome variables measured. Thus, a meta-analysis could not be conducted. Rather, the 14 studies were examined individually and in detail to identify converging trends and findings in the data.

## Findings and Determinations

With regard to the efficacy of having students engage in independent silent reading with minimal guidance or feedback, the Panel was unable to find a positive relationship between programs and instruction that encourage large amounts of independent reading and improvements in reading achievement, including fluency. In other words, even though encouraging students to read more is intuitively appealing, there is still not sufficient research evidence obtained from studies of high methodological quality to support the idea that such efforts reliably increase how much students read or that such programs result in improved reading skills. Given the extensive use of these techniques, it is important that such research be conducted.

It should be made clear that these findings do not negate the positive influence that independent silent reading may have on reading fluency, nor do the findings negate the possibility that wide independent reading significantly influences vocabulary development and reading comprehension. Rather, there are simply not sufficient data from well-designed studies capable of testing questions of causation to substantiate causal claims. The available data do suggest that independent silent reading is not an effective practice when used as the only type of reading instruction to develop fluency and other reading skills, particularly with students who have not yet developed critical alphabetic and word reading skills. In sum, methodologically rigorous research designed to assess the specific influences that independent silent reading practices have on reading fluency and other reading skills and the motivation to read has not yet been conducted.

## Comprehension

Comprehension is critically important to the development of children's reading skills and therefore to the ability to obtain an education. Indeed, reading comprehension has come to be the "essence of reading" (Durkin, 1993), essential not only to academic learning in all

subject areas but to lifelong learning as well. In carrying out its analysis of the extant research in reading comprehension, the NRP noted three predominant themes in the research on the development of reading comprehension skills. First, reading comprehension is a complex cognitive process that cannot be understood without a clear description of the role that vocabulary development and vocabulary instruction play in the understanding of what has been read. Second, comprehension is an active process that requires an intentional and thoughtful interaction between the reader and the text. Third, the preparation of teachers to better equip students to develop and apply reading comprehension strategies to enhance understanding is intimately linked to students' achievement in this area. Because these three themes serve as the foundation for understanding how best to help teachers develop students' comprehension abilities, the extant research relevant to vocabulary instruction, to text comprehension instruction, and to the preparation of teachers to teach reading comprehension strategies was examined in detail by the NRP. The major findings and determinations of the Panel for each of these three subareas are provided next.

## Vocabulary Instruction

The importance of vocabulary knowledge has long been recognized in the development of reading skills. As early as 1924, researchers noted that growth in reading power means continuous growth in word knowledge (Whipple, 1925). Vocabulary is critically important in oral reading instruction. There are two types of vocabulary—oral and print. A reader who encounters a strange word in print can decode the word to speech. If it is in the reader's oral vocabulary, the reader will be able to understand it. If the word is not in the reader's oral vocabulary, the reader will have to determine the meaning by other means, if possible. Consequently, the larger the reader's vocabulary (either oral or print), the easier it is to make sense of the text.

To determine how vocabulary can best be taught and related to the reading comprehension process, the NRP examined more than 20,000 research citations identified through electronic and manual literature searches. From this set, citations were removed if they did not meet prespecified criteria: if they were not reports of research, if they were not reporting experimental or quasi-experimental studies, if they were not published in English, or if they dealt exclusively with learning disabled or other special populations, including second-language learners. Comprehensive review of the remaining set of studies according to the NRP review criteria identified 50 studies for further evaluation. Further analysis and coding of these studies indicated that a formal meta-analysis could not be conducted because there was a small number of research studies in vocabulary instruction dealing with a relatively large number of variables. There are recent published meta-analyses for some selected variables, and it was decided not to duplicate those efforts. Also, a substantial amount of published research on vocabulary instruction did not meet NRP research methodology criteria. Because the Panel wanted to glean as much information as possible from the studies identified in the searches, the vocabulary instruction database was

reviewed for trends across studies, even though formal meta-analyses could not be conducted. Fifty studies dating from 1979 to the present were reviewed in detail. There were 21 different methods represented in these studies.

## Findings and Determinations

The studies reviewed suggest that vocabulary instruction does lead to gains in comprehension, but that methods must be appropriate to the age and ability of the reader. The use of computers in vocabulary instruction was found to be more effective than some traditional methods in a few studies. It is clearly emerging as a potentially valuable aid to classroom teachers in the area of vocabulary instruction. Vocabulary also can be learned incidentally in the context of storybook reading or in listening to others. Learning words before reading a text also is helpful. Techniques such as task restructuring and repeated exposure (including having the student encounter words in various contexts) appear to enhance vocabulary development. In addition, substituting easy words for more difficult words can assist low-achieving students.

The findings on vocabulary yielded several specific implications for teaching reading. First, vocabulary should be taught both directly and indirectly. Repetition and multiple exposures to vocabulary items are important. Learning in rich contexts, incidental learning, and use of computer technology all enhance the acquisition of vocabulary. Direct instruction should include task restructuring as necessary and should actively engage the student. Finally, dependence on a single vocabulary instruction method will not result in optimal learning.

While much is known about the importance of vocabulary to success in reading, there is little research on the best methods or combinations of methods of vocabulary instruction and the measurement of vocabulary growth and its relation to instruction methods.

## Text Comprehension Instruction

Comprehension is defined as "intentional thinking during which meaning is constructed through interactions between text and reader" (Harris & Hodges, 1995). Thus, readers derive meaning from text when they engage in intentional, problem solving thinking processes. The data suggest that text comprehension is enhanced when readers actively relate the ideas represented in print to their own knowledge and experiences and construct mental representations in memory.

The rationale for the explicit teaching of comprehension skills is that comprehension can be improved by teaching students to use specific cognitive strategies or to reason strategically when they encounter barriers to understanding what they are reading. Readers acquire these strategies informally to some extent, but explicit or formal instruction in the application of comprehension strategies has been shown to be highly effective in enhancing understanding. The teacher generally demonstrates such strategies for students until the students are able to carry them out independently.

The literature search identified 453 studies that addressed issues and topics relevant to text comprehension since 1980. Studies published between 1970 and 1979 were added if they were of particular relevance, resulting in 481 studies that were initially reviewed. Of these, 205 studies met the general NRP methodological criteria and were then classified into instructional categories based on the kind of instruction used. Application of the more specific review criteria precluded formal meta-analyses because of the large variation in methodologies and implementations used. The Panel found few research studies that met all NRP research methodology criteria. Nevertheless, the Panel employed the NRP criteria to the maximum extent possible in its examination of this body of literature. (See the Comprehension section of the Report of the National Reading Panel: Reports of the Subgroups.)

In its review, the Panel identified 16 categories of text comprehension instruction of which 7 appear to have a solid scientific basis for concluding that these types of instruction improve comprehension in non-impaired readers. Some of these types of instruction are helpful when used alone, but many are more effective when used as part of a multiple-strategy method. The types of instruction are:

- Comprehension monitoring, where readers learn how to be aware of their understanding of the material;
- Cooperative learning, where students learn reading strategies together;
- Use of graphic and semantic organizers (including story maps), where readers make graphic representations of the material to assist comprehension;
- Question answering, where readers answer questions posed by the teacher and receive immediate feedback;
- Question generation, where readers ask themselves questions about various aspects of the story;
- Story structure, where students are taught to use the structure of the story as a means of helping them recall story content in order to answer questions about what they have read; and
- Summarization, where readers are taught to integrate ideas and generalize from the text information.

## Findings and Determinations

In general, the evidence suggests that teaching a combination of reading comprehension techniques is the most effective. When students use them appropriately, they assist in recall, question answering, question generation, and summarization of texts. When used in combination, these techniques can improve results in standardized comprehension tests.

Nevertheless, some questions remain unanswered. More information is needed on ways to teach teachers how to use such proven comprehension strategies. The literature also suggests that teaching comprehension in the context of specific academic areas—for

example, social studies—can be effective. If this is true of other subject areas, then it might be efficient to teach comprehension as a skill in content areas.

Questions remain as to which strategies are most effective for which age groups. More research is necessary to determine whether the techniques apply to all types of text genres, including narrative and expository texts, and whether the level of difficulty of the texts has an impact on the effectiveness of the strategies. Finally, it is critically important to know what teacher characteristics influence successful instruction of reading comprehension.

# Teacher Preparation and Comprehension Strategies Instruction

Teaching reading comprehension strategies to students at all grade levels is complex. Teachers not only must have a firm grasp of the content presented in text, but also must have substantial knowledge of the strategies themselves, of which strategies are most effective for different students and types of content and of how best to teach and model strategy use.

Research on comprehension strategies has evolved dramatically over the last 2 decades. Initially, investigators focused on teaching one strategy at a time; later studies examined the effectiveness of teaching several strategies in combination. However, implementation of this promising approach has been problematic. Teachers must be skillful in their instruction and be able to respond flexibly and opportunistically to students' needs for instructive feedback as they read.

The initial NRP search for studies relevant to the preparation of teachers for comprehension strategy instruction provided 635 citations. Of these, only four studies met the NRP research methodology criteria. Hence, the number of studies eligible for further analysis precluded meta-analysis of the data derived from these investigations. However, because there were only four studies, the NRP was able to review them in detail. The studies investigate two major approaches: Direct Explanation and Transactional Strategy Instruction.

The Direct Explanation approach focuses on the teacher's ability to explain explicitly the reasoning and mental processes involved in successful reading comprehension. Rather than teach specific strategies, teachers help students (1) to view reading as a problem solving task that necessitates the use of strategic thinking, and (2) to learn to think strategically about solving comprehension problems. For example, teachers are taught that they could teach students the skill of finding the main idea by casting it as a problemsolving task and reasoning about it strategically.

Transactional Strategy Instruction also emphasizes the teacher's ability to provide explicit explanations of thinking processes. Further, it emphasizes the ability of teachers to facilitate student discussions in which students collaborate to form joint interpretations of text and

acquire a deeper understanding of the mental and cognitive processes involved in comprehension.

## Findings and Determinations

The four studies (two studies for each approach) demonstrated that teachers could be instructed in these methods. Teachers required instruction in explaining what they are teaching, modeling their thinking processes, encouraging student inquiry, and keeping students engaged. Data from all four studies indicated clearly that in order for teachers to use strategies effectively, extensive formal instruction in reading comprehension is necessary, preferably beginning as early as preservice.

More research is needed to address the following questions. Which components of teacher preparation are most effective? Can reading comprehension strategies be successfully incorporated into content area instruction? How can the effectiveness of strategies be measured in an optimal manner? Can strategies be taught as early as grades 1 and 2, when children also are trying to master phonics, word recognition, and fluency? How can teachers be taught to provide the most optimal instruction?

# Teacher Education and Reading Instruction

Recent developments such as class size reduction and the writing of standards suggest the growing importance of teacher education on learning outcomes. In addition, the National Reading Panel decided to focus on this area because during its regional meetings speakers expressed intense interest in the quality and importance of teacher education. In teacher education programs, preservice teachers generally acquire knowledge through supervised teaching and through coursework in theory and methods. Continuing education for practicing teachers comes from professional development, also called inservice education. The NRP analysis on this topic was guided by three primary questions: How are teachers taught to teach reading? What does research show about the effectiveness of this instruction? How can research be applied to improve teacher development? The initial literature search by the Panel identified more than 300 articles. A total of 32 studies met the methodological NRP criteria: 11 preservice and 21 inservice. No meta-analysis was conducted because the range of variables and theoretical positions was too large for the limited number of studies.

## Findings and Determinations

As indicated by the NRP's examination of the literature, only a small number of experimental studies have been published about the effectiveness of preservice and inservice teacher education. For conclusions to be drawn about the effectiveness of teacher education, information on both teacher and student outcomes must be reported. Preservice research,

however, only measured teacher outcomes, whereas ideally both short- and long-term teacher and student outcomes should be observed. With respect to research on inservice education, only about one-half measured student outcomes as well as teacher outcomes.

Generally the results indicated that inservice professional development produced significantly higher student achievement. There were few studies of the long-term maintenance of the gains. While there were only a small number of studies, almost all of them showed positive effects on teaching. However, there were too few studies on specific variables to allow the Panel to draw specific conclusions about the content of preservice education.

More information is needed in several areas. What is the optimal combination of preservice and inservice education, and what are the effects of preservice experience on inservice performance? What is the appropriate length of inservice and preservice education? What are the best ways to assess the effectiveness of teacher education and professional development? How can teachers optimally be supported over the long term to ensure sustained implementation of new methods and to ensure student achievement? The relationship between the development of standards and teacher education is also an important gap in current knowledge.

# Computer Technology and Reading Instruction

Until recently, computers were not considered capable of delivering reading instruction effectively. They could not comprehend oral reading and judge its accuracy. They also were unable to accept free-form responses to comprehension questions, so their use had to rely primarily on multiple-choice formats. Today, the situation is much improved. New computers have speech recognition capabilities as well as many multimedia presentation functions. Developments in the Internet, with possibilities of linking schools and instruction, have further increased interest in technology as a teaching device. Computer technology is different from other areas the NRP analyzed. It cannot be studied independently of instructional content and is not an instructional method in itself. Thus, computer technology must be examined for its ability to deliver instruction, for example, in vocabulary or in phonemic awareness.

Because this is a relatively new field, the number of studies published in this area is small. Only 21 studies met the NRP research methodology criteria.

## Findings and Determinations

Although it is difficult to draw conclusions from these studies, it is possible to make some general statements. First, all the studies report positive results, suggesting that it is possible to use computer technology for reading instruction. The seven studies that reviewed the addition of speech to computer-presented text indicate that this may be a promising use of technology in reading instruction.

Two other trends show promise. The use of hypertext (highlighted text that links to underlying definitions or supporting or related text, almost like an electronic footnote), while technically not reading instruction, may have an instructional advantage. Second, the use of computers as word processors may be very useful, given that reading instruction is most effective when combined with writing instruction.

Striking in its absence is research on the incorporation of Internet applications to reading instruction.

Research also is needed on the value of speech recognition as a technology and the use of multimedia presentations in reading instruction.

In sum, the Panel is encouraged by the reported successes in the use of computer technology for reading instruction, but relatively few specific instructional applications can be gleaned from the research. Many questions still need to be addressed.