1982

The effect of CAI and PT as supplements to the basal reading program

Sandra Hollingsworth

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THE EFFECT OF CAI AND PT
AS SUPPLEMENTS TO
THE BASAL READING PROGRAM

prepared by

Sandra Hollingsworth
B. A., Michigan Technological University, 1976

in partial fulfillment
of the requirements for
the degree of
Master of Education
UNIVERSITY OF MONTANA
1982

Approved by:

Chairman, Board of Examiners

Dean, Graduate School

Date
The purpose of this study was to investigate the differential effects of a Computer-Assisted Instruction format and a Precision Teaching approach to reading instruction, when used in conjunction with a meaning-based basal program operating on the primary level in a public school setting. 80 cases were examined. Using a pretest/posttest control group design, and applying a regression analysis for treatment effects, it was found that: (1) both CAI and PT, when used with the Basal are more effective for sight word and reading process acquisition in primary grade students than the Basal alone. (2) PT, as a Basal supplement, produced the strongest gain of any treatment for low ability primary grade students in the acquisition of reading process. (3) The Basal treatment had a more facilitative effect on spelling ability for primary grade males than for either sex in other treatment groups.
Acknowledgements

Effective research is never the result of a single individual’s efforts. The more that educators share their talents, skills and theories, the finer the studies and the better we are able to inspire and instruct children.

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The purpose of this study was to determine if Computer-Assisted Instruction (CAI) aids in the teaching of specific aspects of reading. Evidence from past studies in CAI (see "Background" section of this chapter) suggests that the potential for the efficient use of computers in reading instruction merits as careful an evaluation as their application in other instructional settings. Researchers are no longer asking whether or not computers can teach, but when and how they can be effectively incorporated into the instructional process (Mason and Blanchard, 1979). To examine some data in the vital but neglected area of reading, then, was the primary purpose of the project.

An auxiliary concern was to test some of the positive features of CAI, such as drill and practice in a tutorial setting. If comparable results (to CAI) were obtained, perhaps schools which can not yet afford computers would be able to use some of the effective techniques of CAI with alternative procedures. For that reason, Precision Teaching (PT) was also examined to teach sight words, as it incorporates the features of drill and practice.

Since most classroom reading instruction is based on a basal approach (Harris and Sipay, 1975), and since basal
programs are most effective when accompanied by a supplemental teaching method (Bond and Dykstra, 1967), both experimental procedures were used in conjunction with a basal program. The Basal also served as a control.

BACKGROUND

Computer-Assisted Instruction

Computers have been used in the classroom for over two decades. Initial instruction was delivered by large "mainframe" computers to terminals found a few blocks to many miles away. The cost of the system was exorbitant and the access fair to poor (Noyce, 1977; Baker, J.C., 1975; Beard, 1976), as the users had to wait for their scheduled time to gain access to the central machine. Software programs of the period initiated "programmed learning" designs -- innovative, but not necessarily reliable, since each student had to tediously complete every frame, whether he or she knew the material or not (Fry, 1967; Splittgerber, 1979; Baker, F.B., 1978).

Within the past few years, though, computer technology has advanced dramatically. The advent of "microcomputers" -- self contained, semi-portable units which use printed circuits instead of transistors or vacuum tubes--made the project more reliable, and brought the cost within the range of most school districts. The new systems are capable of
everything from answering the telephone in the school office, to printing paychecks, to grading papers. The management aspects of the microcomputer have been widely tested and proved (Baker, F.B., 1971; Clemson, 1980). The current need is for systematic evaluation of instructional designs and educational software for classroom use (Hickey, 1974; Watkins and Webb, 1981).

The first CAI programs, and still the most widespread, are programs in mathematics (Suppes, 1968). Computer math programs are now being written for advanced students. The prototype is known as CAL -- Computerized Accelerated Learning (Shanahan, 1981). Additionally, work in CAI is being produced in many fields, such as theater, foreign language, music and English composition (see Pipeline, Volume 6, Number 2, Fall, 1981).

CAI in Reading

CAI in reading began at Stanford University in 1964 under the direction of R.C. Atkinson and his associates. After establishing terminals in local schools, they trained first-graders to use the computer for an initial reading instructional sequence, which included syntactic and semantic practice as well as letter identification (Atkinson and Hanson, 1966). Atkinson noted that the children who used CAI for 12 minutes a day during a five-month period made significant gains in achievement. Further, he suggested
the effect of computer instruction was comparable to services of a private tutor, but at a lower cost per pupil. Atkinson also predicted that using a computer for skill reinforcement would free the teacher for more creative forms of instruction (Atkinson and Fletcher, 1972).

The impact of the Stanford project came from the knowledge acquired concerning: 1) reading curriculum and program development in CAI format (Blanchard, 1980), 2) the relationship between CAI and child behavior, and 3) scheduling terminal use in the classroom. This "pioneer study" led to the development and evaluation of many other college-based programs (Mason, 1980).

George E. Mason and Jay S. Blanchard have prepared a comprehensive review of the early literature (Computer Applications in Reading, 1979), including the college-based programs, public school applications, pupil attitude and achievement, and the research process using computers.

Since the introduction of microcomputers, many programs have been developed which involve traditional reading instruction in a CAI format. Some programs use a cassette recording of a short story and multiple choice comprehension questions to be typed onto the computer screen (Heuer, 1980). This type of CAI is known as "drill and practice," where the child reviews skills previously learned. An alternate type of CAI format is "tutorial." This is an advanced form of drill and practice which allows the learner
to progress through new concepts in a programmed instruction technique (Mason, 1980). Another example of traditional instruction modified for CAI includes exhibiting a text on the screen for a specific amount of time. The text then disappears and multiple choice questions follow (Nicasto, 1979).

CAI has been shown to be particularly effective when used in non-traditional situations. The All Indian Pueblo Project (Wells and Bell, 1980) introduced culturally relevant reading and the cloze technique via computer to help elementary children increase their reading abilities. The Basic Skills Learning System (BSLS) uses tutorials, drills, tests, printed materials (off-line materials), and videotaped presentations in an extended CAI format to teach reading to nonliterate adults. Results of two BSLS studies in Minnesota showed an average grade gain of 1.12 years after 13 hours of instruction (Rizza, Walker and Hunter, 1978).

CAI has also been useful in training reading teachers. One program models children with reading difficulties. Teacher trainees identify the weaknesses by administering an "Informal Reading Inventory" or IRI. A study of the program did not show increased ability to administer the IRI, but it did prove useful in training teachers to diagnose reading weaknesses (Henney and Boyson, 1979; Boyson, 1979).

CAI programs focusing on specific problem areas in
reading, such as rate, directionality, word identification and sight word acquisition are currently available. Students can increase their reading rates by observing words or phrases flashed on the screen for a fraction of a second, then repeating what was shown by re-entering the material via the keyboard (Russ and Feldman, 1979).

Problems with directionality in reading can also be corrected through CAI using arrows or a sequential word appearance technique (Pollard, 1979). Scott, Foresman and Company, in conjunction with Texas Instruments, Inc., has developed a series of 12 programs to be used as supplemental reading programs. One module of "Early Reading," as the series is called, teaches word identification through activities based on context clues (Roblyer, 1981).

Voice synthesizers attached to microcomputers have shown dramatic results. In an Australian study, mentally retarded children learning sight words increased 128% in five hours of computer instruction, while the comparison group only increased 34% (Lally, 1980). Other programs have been developed to incorporate a voice synthesizer in the teaching of sight words (Rogers, 1980), but have not been formally evaluated.

Evaluation of new reading programs is usually either conducted informally, while they are in use in the classroom, or analyzed informally in the software review sections of educational journals. Few empirical studies are available.
in the field. The only one which dealt directly with sight word acquisition was cited. The need for more experimental evaluation of reading programs is evident.

This study design combined that need plus indications that CAI would be a valuable supplement to established classroom programs (Jamison, Suppes and Wells, 1974), that CAI would be particularly effective in learning situations which require drill and practice (Bunderson and Faust, 1976) and that basal programs are most effective when supplemented (Bond and Dykstra, 1967).

**Precision Teaching**

Precision Teaching (PT) is a system of continuous measurement and charting of a child's progress. Its purpose is to structure the learning environment so that no child will fail and to increase the efficiency of teaching and learning processes (Kunzelmann, 1970).

PT grew out of the behaviorist school of psychology when Ogden R. Lindsley, who was at the University of Kansas in 1965, incorporated B.F. Skinner's idea of recording behavior frequencies in the special education classroom (Lindsley, 1971). Lindsley took Skinner's frequency ideas from their animal-lab perspective and developed them in the human world. He looked at human behavior and ways to modify it. Lindsley showed that, by looking at patterns in classroom performance, both students and teachers would be able
to predict the outcome of instructional procedures. Lindsley and his students were able to quickly determine, by daily charting of performance, whether a particular curriculum was working for an individual child. If it did not, another technique could be tested in the same way. Goals set became easily measurable, mastery defined, and an up-to-date progress report was always available for the child and his parents (Brent et al, 1978).

Repeated practice is the basic methodology of PT. Research into repeated reading of passages supports the method, stating that repetition causes errors to decrease while rate increases (Carver and Hoffman, 1981). Very few empirical evaluations of PT itself have been conducted. R. D. Hoeltzel's study, which showed the effectiveness of PT in reading, is a notable exception (Hoeltzel, 1973).

Specific instructions, goals, guidelines and charting techniques can be found in the "Spokane, Seattle, Tacoma Project" or S. S. T. (State of Washington, Department of Public Instruction, Seattle, WA) and "The Sacajawea Project" (Skyline School, 3300 3rd NW, Great Falls, MT 59401).

Basal Reading Programs

The most prevalent organized program to teach beginning reading in the United States is the basal program. Although there are many such programs available which differ in philosophy, methodology and materials, they all include
specific methods for the teacher and materials which are pre-planned and sequentially organized. Most are continuous from the pre-primer level through grade 6, but a few continue through grade 8 (Harris and Sipay, 1975).

The basic differences between the basal programs occur in the way the child is initially taught to recognize words, the words introduced (type and frequency), and whether the initial emphasis is on decoding or comprehension. Programs which emphasize letter-sound regularity are known as "code-emphasis" approaches. Those which stress whole common words are "meaning-emphasis" programs (Carnine and Silbert, 1979).

No specific program has been found to be the "best" approach when used exclusively. In fact the "Coordinated First Grade Studies", sponsored by the U.S. Office of Education in 1964-65, reported that combinations of programs, such as basal and a supplemental approach, appear to be more effective (Bond and Dykstra, 1967). This premise formed a basis for the study design.

Background Summary

CAI, PT and Basal programs have all been developed to fulfill specific requirements of the educational process. All have proven to be effective in teaching reading. The current study was an attempt to demonstrate and test specific applications of all three approaches to the reading process.
QUESTIONS

Since previous research which focuses on the interaction of CAI, PT and Basals is not available, several initial questions were raised in relation to this study:

1) What differences are there in the effects of Computer-Assisted Instruction, Precision Teaching (as a direct instruction format) and the Basal on the acquisition of sight word vocabulary? It was expected that performance of the children in the treatments specifically developed to teach sight words, i.e., CAI and PT, would exceed that of children receiving Basal instruction only. No differences were anticipated between CAI and PT.

2) What differences are there in the effects of CAI, PT and the Basal on the acquisition of reading process? CAI, because it dealt specifically or indirectly with all aspects of the reading process, was expected to produce better results than either PT or Basal approaches.

3) What incidental differences are there in the effects of CAI, PT and the Basal on the acquisition of spelling ability? Because of the sequential letter component of entering words into the computer, CAI was expected to be more effective for spelling acquisition than either
DEFINITIONS

Independent Variables (treatment variables)

The three variables below were theoretically defined in the "Background" section of this chapter. Operationally, they are defined as:

1) **Computer-Assisted Instruction:** drill and practice instruction which directly teaches Dolch sight words in context by means of a student-operated question, response, and correct format on a computer.

2) **Precision Teaching:** a direct instruction approach to Dolch sight word instruction which relies on repeated reading, charting of progress and continuous evaluation.

3) **Basal Instruction:** the classroom application of the meaning-based Houghton-Mifflin program which indirectly introduces Dolch sight words.

Dependent Variables

1) **Basic Sight Word Vocabulary:** Acquisition of basic sight word vocabulary is theoretically defined as
the ability to instantly recognize any of a specified set of high utility words (Ekwall, 1976).

Acquisition of basic sight word vocabulary is operationally defined as the ability to pronounce correctly any or all of the Dolch Basic Word List on the Dolch Test. Correct pronunciation is judged by a trained tester.

2) **Reading Process**: Acquisition of reading process is theoretically defined as the improvement in the ability to effectively use the basic cueing systems (i.e., semantic, syntactic and orthographic) to decode and meaningfully interpret printed language (Goodman, 1967). Acquisition of reading process is operationally defined as the ability to correctly choose the most appropriate Dolch word from three alternatives on the Maze Test designed by the researcher.

3) **Spelling Ability**: Acquisition of spelling ability is theoretically defined as a developmental process of encoding, where the speller must record speech sounds by thinking, writing or saying the letters of a word in the generally accepted order (Westerman, 1971; Boyd and Talbert, 1971). Acquisition of spelling ability is operationally defined as the student's ability to write the Dolch Basic
Sight Words from the Spelling Test correctly after hearing them pronounced by the teacher.
CHAPTER II.

METHODS

SUBJECTS

This study included 80 primary (first through third) grade students, one-third of whom received instruction with CAI and Basal, one-third who received instruction through PT and Basal, and one-third who remained only in the Basal program. All students remained within the study until its conclusion.

The school is located in a rural community of about 2,000 people within 10 miles of a small urban district. The community itself falls within a middle to lower-middle socioeconomic range.

The school was the second choice of the researcher. The first request to research was rejected because of problems with availability of computers.

TREATMENT PROCEDURES

As noted in Chapter I, three treatment groups were used in this study: Basal instruction, which served as the control group; Precision Teaching (PT) plus Basal; and Computer-Assisted Instruction (CAI) plus Basal. Teacher effectiveness research has shown that achievement is affected by such factors as pace and level of instruction, feedback, academic-engaged time (the ratio of time that students spend on tasks at which they are successful and
that are tied to specific curricular objectives as compared to allocated instructional time), and periodic evaluation (curriculum objectives matched with evaluated learning outcomes), (Rosenshine, 1978; Rosenshine and Berliner, 1977; Barr, 1973-74); therefore, the experimental treatments were set up to include those dimensions of teaching. Procedures for all treatments are described below.

**Basal**

Children in this group participated only in the levelized Houghton-Mifflin Reading Program during the 90 minutes normally allocated to reading in their regular classrooms. The Houghton-Mifflin is a meaning-based approach where sound-controlled as well as irregular words are introduced in the initial phases. Students were introduced to Dolch words only as they randomly appeared in the series. Direct instruction of those words occurred as needed at the discretion of the teacher. "Teacher" in this design refers to the classroom teacher. Teachers participating all had one to three years of experience on the primary level, were randomly assigned to all groups, and followed similar procedures for teaching the Basal (using the sequence in the accompanying manual) and PT (see "General Instructions to Teachers" in the appendix).
PT

Children assigned to the PT group individually read the Dolch Basic Word List, starting with their levels of proficiency determined by the pretest, for one minute each day (see example in appendix). They also individually read a list of phrases containing the Dolch words at the same level for one minute each day (example is found in the appendix). The teacher identified the words incorrectly read, and the child re-read them properly. For the remaining eight minutes of their treatment, the children practiced identifying and writing, in a maze setting, the words they had missed in the one-minute timings (see example of off-line materials in appendix). As each student reached a proficiency level of 80 words-per-minute, he or she began reading new lists at the next higher level. (Note: the rate-for-mastery in PT has been debated by many practitioners [Cohen and Martin, 1971; Kunzlemann, 1970; Lindsley, 1971; Starlin, 1971; Lovitt, 1968; Zimmermann, 1971]. For the purposes of this study, Hoeltzel's recommendation of 60-80 words-per-minute for isolated sight words and 100-120 words-per-minute for words in context was used.)

Children in this group continued to receive instruction via the basal series in their regular classrooms during the treatment period.
CAI

Following initial instruction on the operation of the computer (see Gantt Chart in appendix), each member of the CAI group worked 10 minutes per day on the unit, using the Dolch Sight Word Software, an algorithm developed under an Apple Education Grant at the University of Montana in 1981. The program for each child began at one level below his competency level as determined by the pretest. A sentence appeared on the screen containing a Dolch word, and the child attempted to read the sentence aloud to a peer tutor. The Dolch word (or target word) then disappeared, and the reader re-entered it by "typing" in the correct word in the blank (see Fig. 1).

Figure 1
Dolch Software Instructional Sequence, #1

The sentence appeared and the student was encouraged to read it aloud:

I see a funny dog.

The target word then disappeared:

I see a ____ dog.

The reader typed in from memory:

funny
If the word was correct, he or she progressed to the next word on his level. If an incorrect response was entered, then "ghost" letters appeared in the sentence to aid the student (see Fig. 2).

**Figure 2**

*Dolch Software Instructional Sequence, #2*

\[
\text{I see a } \underline{dog}. \]

If the word was again entered incorrectly, four words appeared below the target word, and he or she tried to select the correct word and copy it into the sentence "frame" (see Fig. 3).

**Figure 3**

*Dolch Software Instructional Sequence, #3*

\[
\text{I see a } \underline{dog}. \\
\text{four said into funny} \\
\]

If the student missed it again, then the correct Dolch word appeared below the sentence for him or her to copy (see Fig. 4).
Any word missed would be reviewed in a different context later in the program. Before progressing to a higher level, the child successfully completed a separate mastery test, where words appeared only in isolation.

Children in the PT group, like those in the CAI, continued to participate in their regular basal program during the treatment period.

**INSTRUMENTS**

Three instruments -- The Dolch Test, The Maze Test and the Spelling Test -- were developed as tests of the dependent variables.

**Dolch Test**

E. L. Thorndike (1921) compiled one of the first reading vocabulary lists. He and other researchers had discovered that mastery of the relatively small number of high-utility words would facilitate reading. If the reader
were familiar with these often-printed words on sight, he or she could concentrate on obtaining meaning from the passage, as well as decoding unfamiliar words.

E. W. Dolch formulated his sight word list in 1939 from two primary-grade reading vocabulary lists -- the *Wheeler-Howell First Grade Vocabulary List* and the *Gates Primary Word List* -- and from the *International Kindergarten Union Vocabulary List* derived from pre-schoolers' vocabularies. Although there are currently many other lists which use computers to analyze high frequency words found in children's textbooks (e.g., Harris and Jacobson, 1972), the Dolch list is still one of the simplest and most effective forms used to teach and test sight words. Johns (1976) calculated that the Dolch still accounts for over 55% of the words found in grade 1 - 9 and over 50% of the words frequently used in adult materials.

The *Dolch Basic Word List* (as graded by the University of Wisconsin Reading Clinic) was used in this design to test the subjects for basic sight word acquisition (a dependent variable). Each child read the Dolch Test orally to a trained test administrator, starting at the pre-primer level. If he or she paused for more than five seconds, the word was counted wrong. As soon as the student missed five or more words on a single level, the test was discontinued, and that level was counted as his or her level of proficiency (see test example and directions for administering in
The same test was used to note his or her reading level following the treatments.

In a modified cloze or "maze test" (Guthrie, 1974), a word is deleted from its instructional sentence, and often several words (including the correct word) are supplied from which the student chooses to complete the sentence (see Fig. 5).

Figure 5

Maze Test Format

We have a _______ and a ball.

We have a bat and a ball.

The validity of this procedure for testing words in context has been reported by Diederich, Freeman and Griffin (1978).

In this design, the maze format was used (with Dolch words forming the proper closure) to test children's acquisition of the reading process (a dependent variable) both before and after the treatments (see example of the Maze Test in appendix).
Spelling Test

Spelling words correctly, or encoding, is considered a useful part of the reading process, specifically in word recognition skills (Harris and Sipay, 1975). Because "poor reading is usually accompanied by poor spelling" (Harris and Sipay, 1975, p. 310), most diagnostic tests designed for reading also include a spelling component.

No treatment in this study was specifically designed to increase spelling ability (a dependent variable). The Spelling Test was administered, then, to record any incidental effects which might have occurred. With the "repeated practice" components of the experimental treatments, it seemed reasonable to expect that they might incidentally link the visual perception and memory aspects of spelling ability.

Five words were randomly selected from each level of the graded Dolch Basic Word List, so that a total of 25 words comprised the Spelling Test (see example in appendix). The test was given to all subjects before and after the treatments. The teacher simply read the words in isolation and the students wrote the words. The tests were corrected by the teacher. A word was misspelled if any letter was incorrect or unreadable.
Teacher Questionnaire

To collect and analyze teacher perceptions of the treatments, the program, and its future implications, a questionnaire was developed (see example in appendix). The instrument was pre-tested on non-participating teachers with CAI and PT experience from the same school and found to be valid. Final results are reported in Chapter IV.

DATA ANALYSIS AND DESIGN

Specifically, this study was designed to determine the differential effects of a Computer-Assisted Instruction (CAI) format and a Precision Teaching (PT) approach when used in conjunction with a typical Basal program operating on the primary level in a public school setting.

Experimental Design

The design selected to accomplish the purposes of the study was a true experimental design characterized by randomly assigning subjects to three treatments in a pre-test/posttest control group format (see Fig. 6). This design controlled for all sources of internal validity as outlined by Campbell and Stanley (1971). Its only limitation was the possible external interaction between the pretest and the treatment. This potential effect was minimized by the nonreactive nature of the pretests (reading and
spelling), the levelization of the pretests (discussed in
detail in the "Instructional Design" section of this chap­
ter), the age of the subjects, and the classroom setting,
where testing is a natural part of the subjects' environ­
ment.

Figure 6
Experimental Design

CAI
Subjects + Random Assignment = Pretest + PT + Posttest
BASAL

Statistical Design

The statistical design for this study was a 3 (CAI vs
PT vs Basal) x 2 (low vs average/high ability) x 2 (male vs
female) analysis of covariance (ANOCOV), using the respec­
tive pretest mean scores as covariates.

Instructional Design

The instructional design for the study is pictured in
Figure 7. Each block* represents 10 minutes of instruc­
tional time.

Initially three pretests were administered to all
primary students in the school. The pretests, as previously
described, included the Dolch Test, the Maze Test, and the Spelling Test. Only those students who showed sight word deficiencies (recognized fewer than 80% of the 220 words on the Dolch Test) were selected for the study, and only their pretest scores were retained as data. Permission was obtained from each child's parent or guardian (see permission form in appendix).

Figure 7
Instructional Design

<table>
<thead>
<tr>
<th>CAI Group</th>
<th>(Dolch) Computer*</th>
<th>(Math) PT*</th>
<th>← BASAL →</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT Group</td>
<td>(Dolch) PT*</td>
<td>(Math) Computer*</td>
<td>← BASAL →</td>
</tr>
<tr>
<td>BASAL Group</td>
<td>Basal Only*</td>
<td>(Math) Computer*</td>
<td>← BASAL →</td>
</tr>
</tbody>
</table>

The eighty subjects selected were randomly assigned to three groups on the basis of overall ability (low or average/high) and sex. Ability was determined on the basis of teacher evaluation. The CAI, PT and Basal treatments were then
randomly assigned to the three groups (see appendix for Cell Table). The CAI and PT groups received basal instruction in addition to the experimental treatment. In addition, the CAI group received PT instruction in math and the PT group received CAI math instruction in order to counterbalance for the motivational effect of computer use and control for reaction arrangements. The Basal-only (or control) group also used the computer for math instruction.

At the conclusion of the study (five weeks of approximately 10 minutes-per-day-per-student), all groups completed another set of three tests, corresponding to the pretests. Although the effect of testing was limited by the design selection, it was further controlled by: 1) levelization of the Dolch and Maze Tests. Students stopped reading at their frustration levels on the pre-Dolch Test and were tested at that level on the pre-Maze Test. Since most students increased at least one level by the date of the posttests, they were reading and tested at a higher level, or different form, of the pretest. 2) Lack of feedback. Students were not told which words, responses or spellings were correct or incorrect on the pretests. Thus, improvements made on the posttests were presumably the result of the treatments. 3) Age of the subjects. The students involved had not yet obtained the mental age to be able to remember specific word lists or sentences from the pretests and apply them on the posttests, five weeks later.
All posttests immediately followed the treatments. The Teacher Questionnaire (see example in appendix) regarding the program was also distributed at that time.
CHAPTER III.

RESULTS

Findings are reported according to the resultant performance in each of three areas: 1) Dolch Posttest performance, 2) Maze Posttest performance, and 3) Spelling Posttest performance. The overall pretest and posttest mean scores are depicted in Table 1.

Table 1
Pre and Posttest Mean Scores

<table>
<thead>
<tr>
<th></th>
<th>Dolch Test</th>
<th>Maze Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Basal</td>
<td>44.08</td>
<td>52.52</td>
</tr>
<tr>
<td>PT</td>
<td>36.70</td>
<td>52.15</td>
</tr>
<tr>
<td>CAI</td>
<td>41.93</td>
<td>63.79</td>
</tr>
</tbody>
</table>

* Adjustments were made for pretest differences

Spelling Test

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Post (Adj*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basal</td>
<td>58.16</td>
<td>67.36</td>
<td>66.33</td>
</tr>
<tr>
<td>PT</td>
<td>52.30</td>
<td>57.74</td>
<td>61.52</td>
</tr>
<tr>
<td>CAI</td>
<td>61.04</td>
<td>71.11</td>
<td>68.93</td>
</tr>
</tbody>
</table>

Except for spelling, the means demonstrated a hierarchy of treatment effects favoring CAI.

Dolch Posttest

The treatment effects for the Dolch Test, or the effect of basic sight word vocabulary acquisition is reported p. 29.
<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariate (Pretest)</td>
<td>51585.365</td>
<td>1</td>
<td>51585.365</td>
<td>259.783</td>
<td>0.000</td>
</tr>
<tr>
<td>Main Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>2033.291</td>
<td>2</td>
<td>1016.646</td>
<td>* 5.120</td>
<td>0.009</td>
</tr>
<tr>
<td>Ability</td>
<td>1809.858</td>
<td>1</td>
<td>1809.858</td>
<td>+ 9.114</td>
<td>0.004</td>
</tr>
<tr>
<td>Sex</td>
<td>1022.307</td>
<td>1</td>
<td>1022.307</td>
<td>** 5.148</td>
<td>0.026</td>
</tr>
<tr>
<td>Interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment x Ability</td>
<td>699.504</td>
<td>5</td>
<td>139.901</td>
<td>0.705</td>
<td>0.622</td>
</tr>
<tr>
<td>Treatment x Sex</td>
<td>166.86</td>
<td>2</td>
<td>83.408</td>
<td>0.420</td>
<td>0.659</td>
</tr>
<tr>
<td>Ability x Sex</td>
<td>351.757</td>
<td>1</td>
<td>351.757</td>
<td>1.771</td>
<td>0.188</td>
</tr>
<tr>
<td>Treatment x Ability x Sex</td>
<td>128.383</td>
<td>2</td>
<td>64.192</td>
<td>0.323</td>
<td>0.725</td>
</tr>
<tr>
<td>Explained</td>
<td>57839.632</td>
<td>12</td>
<td>4819.969</td>
<td>24.273</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>13304.254</td>
<td>67</td>
<td>198.571</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>71143.887</td>
<td>79</td>
<td>900.556</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Significant results were found for the main effects of treatment, ability and sex as indicated in Table 2. Significant differences* were found among the Basal, PT and CAI treatments on the Dolch Posttest \( (F = 5.12, \ df \ 2/76, \ p > .01 = 4.88) \).

In addition, significant differences† were found between low ability and average/high ability students \( (F = 9.11, \ df \ 1/77, \ p > .01 = 6.96) \). As might have been expected, the average to high ability children outperformed the low children, no matter what their treatment group.

Finally, significant differences‡ were found between boys and girls on the Dolch Posttest \( (F = 5.14, \ df \ 1/77, \ p > .01 = 5.72) \). The differences between boys' and girls' performances favored the girls. The differences were consistent across treatment groups (see Comparative Mean Tables in appendix).

As Table 2 indicates, none of the interactions (treatment \( \times \) ability; treatment \( \times \) sex; ability \( \times \) sex; or treatment \( \times \) ability \( \times \) sex) were significant.

A regression analysis was used to determine which of the treatment contrasts (CAI vs PT; or CAI and PT vs Basal) contributed significantly to the differences among the posttest mean scores. Treatment contrast CAI vs PT did not contribute significantly to the posttest difference \( (F = 1.45, \ df \ 1/77, \ p > .01 = 4.88) \). Treatment contrast CAI and PT vs Basal did contribute significantly \( (F = 5.569, \ p > .01 = 4.88) \).
df 1/77, p>.01 = 4.88) to the variance among posttest mean scores. Both of the experimental treatment groups, CAI and PT, did significantly better than the Basal. The CAI and PT groups did not significantly differ in their performance on the Dolch Posttest.

Maze Posttest

The treatment effects for the Maze Test, or the effect of the acquisition of reading process, is reported in Table 3.

Significant differences* were found for treatment effects, as indicated in Table 3, among the Basal, PT and the CAI groups (F = 5.529, df 2/76, p>.01 = 4.88).

A regression analysis was done to determine which of the treatment contrasts -- CAI vs PT or CAI and PT vs Basal -- contributed significantly to the differences among posttest mean scores. As with the Dolch Posttest, treatment contrast CAI vs PT did not contribute significantly to posttest differences. However, treatment contrast CAI and PT vs Basal did contribute significantly (F = 7.705, df 1/77, p>.01 = 4.88) to the variance among posttest mean scores. Both of the experimental treatment groups (CAI and PT) showed results significantly better than the Basal. The CAI and PT groups did not differ significantly in their performance on the Maze Posttest.

No significant results are indicated among the main
effects of ability or sex. An interaction effect\textsuperscript{1} for the treatment and ability interaction is indicated in Table 3 (\(F = 2.855\), df 2/73, \(p > .065\)). The interaction effect is demonstrated in Figure 8 below:

Figure 8

\textbf{Interactions for Treatment x Ability: Maze}

From Figure 8, it can be seen that the most dramatic gains were made by the low ability PT group.\textsuperscript{1}

\textbf{Spelling Posttest}

The treatment effects for the \textit{Spelling Test}, or the effect of acquisition of spelling ability, are reported
### Table 3
**ANACOV for Maze Posttest**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariate (Pretest)</td>
<td>26373.017</td>
<td>1</td>
<td>26373.017</td>
<td>136.083</td>
<td>0.000</td>
</tr>
<tr>
<td>Main Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>2143.134</td>
<td>2</td>
<td>1071.567</td>
<td>* 5.529</td>
<td>0.006</td>
</tr>
<tr>
<td>Ability</td>
<td>107.500</td>
<td>1</td>
<td>107.500</td>
<td>0.555</td>
<td>0.459</td>
</tr>
<tr>
<td>Sex</td>
<td>121.031</td>
<td>1</td>
<td>121.031</td>
<td>0.625</td>
<td>0.432</td>
</tr>
<tr>
<td>Interaction</td>
<td>1997.030</td>
<td>5</td>
<td>399.406</td>
<td>2.061</td>
<td>0.081</td>
</tr>
<tr>
<td>Treatment x Ability</td>
<td>1106.412</td>
<td>2</td>
<td>553.206</td>
<td>2.855</td>
<td>0.065</td>
</tr>
<tr>
<td>Treatment x Sex</td>
<td>181.220</td>
<td>2</td>
<td>90.610</td>
<td>0.468</td>
<td>0.629</td>
</tr>
<tr>
<td>Ability x Sex</td>
<td>423.741</td>
<td>1</td>
<td>423.741</td>
<td>2.186</td>
<td>0.144</td>
</tr>
<tr>
<td>Treatment x Ability x Sex</td>
<td>464.326</td>
<td>2</td>
<td>232.163</td>
<td>1.198</td>
<td>0.308</td>
</tr>
<tr>
<td>Explained</td>
<td>31070.384</td>
<td>12</td>
<td>2589.199</td>
<td>13.360</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>12984.617</td>
<td>67</td>
<td>193.800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>44055.001</td>
<td>79</td>
<td>557.658</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
There were no significant differences for the main effects of treatment, ability or sex. Additionally, there were no significant interaction effects for treatment and ability or treatment and sex. An interaction effect (F = 2.906, df 2/76, p > .062) was indicated for treatment levels and sex. The interaction effect is noted below in Figure 9.

**Figure 9**

*Interactions for Treatment x Sex: Spelling*

From Figure 9, it can be seen that the most dramatic gains were made by the males. The females' performance actually showed a decrease.
<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariate (Pretest)</td>
<td>22539.982</td>
<td>1</td>
<td>25530.982</td>
<td>79.250</td>
<td>0.000</td>
</tr>
<tr>
<td>Main Effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment</td>
<td>649.270</td>
<td>2</td>
<td>324.035</td>
<td>1.142</td>
<td>0.325</td>
</tr>
<tr>
<td>Ability</td>
<td>532.257</td>
<td>1</td>
<td>532.257</td>
<td>1.872</td>
<td>0.176</td>
</tr>
<tr>
<td>Sex</td>
<td>0.538</td>
<td>1</td>
<td>0.538</td>
<td>0.002</td>
<td>0.965</td>
</tr>
<tr>
<td>Interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment x Ability</td>
<td>132.443</td>
<td>2</td>
<td>66.221</td>
<td>0.233</td>
<td>0.793</td>
</tr>
<tr>
<td>Treatment x Sex</td>
<td>1652.371</td>
<td>2</td>
<td>826.185</td>
<td>2.906</td>
<td>0.062</td>
</tr>
<tr>
<td>Ability x Sex</td>
<td>35.852</td>
<td>1</td>
<td>35.852</td>
<td>0.126</td>
<td>0.724</td>
</tr>
<tr>
<td>Treatment x Ability x Sex</td>
<td>200.908</td>
<td>2</td>
<td>100.454</td>
<td>0.353</td>
<td>0.704</td>
</tr>
<tr>
<td>Explained</td>
<td>25881.259</td>
<td>12</td>
<td>2156.772</td>
<td>7.586</td>
<td>0.000</td>
</tr>
<tr>
<td>Residual</td>
<td>19048.291</td>
<td>67</td>
<td>284.303</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>44929.550</td>
<td>79</td>
<td>568.728</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER IV.

CONCLUSIONS AND IMPLICATIONS

GENERAL CONCLUSIONS

From these findings it can be concluded that:

1) CAI and PT (plus Basal) are superior to the meaning-based Basal alone in producing significant gains in basic sight word acquisition in primary grade students.

2) CAI did not differ significantly from PT in producing gains in basic sight word acquisition, reading process acquisition or spelling ability.

3) CAI and PT (plus Basal) are superior to the meaning-based Basal alone in producing significant gains in the acquisition of the reading process in primary grade students.

4) Precision Teaching (plus Basal) appears to have a more facilitative effect for low ability primary grade students in the acquisition of the reading process.

5) No differences were found among the treatment groups in improved spelling ability.

6) The Basal appears to have a more facilitative effect on spelling ability for primary grade males than for either sex in other treatment groups.

The expectation that CAI and PT would differ from the
Basal was confirmed for basic sight word acquisition and for reading process acquisition. However, the expectation that CAI would prove superior to PT was not confirmed.

Discussion, Conclusions 1, 2, and 3

With respect to the first three conclusion -- that the CAI and PT treatments did not differ from each other but were superior to the Basal in basic sight word and reading process acquisition -- two theories and additional explanations emerge. First, it may be possible that factors other than specific methodology may underly treatment effect. For example, both CAI and PT contain elements that the teacher effectiveness studies have shown to be related to achievement. Both treatments rely heavily on feedback, pace and level of instruction, periodic evaluation and academic-engaged time (Rosenshine and Berliner, 1977). In other words, a combination of teaching effectiveness factors may be more important than surface differences in technology or methodology in producing learning gains. This is the teaching effectiveness theory.

The second theory can be termed the internal locus of control theory. Locus of control is defined as the extent to which an individual feels in control of his or her immediate environment. A student who has a feeling of "environmental mastery" has an internal locus of control, while a student who has a feeling that the environment...
has mastered him or her has an external locus of control (Morgan and Culver, 1978). Both PT and CAI seem to reflect methodology that would logically foster an internal locus of control. CAI treatment, for example, allowed students to control their own level and pace of instruction. Also the students had absolute control of when and how the computer would respond. The fact that the computer always responded in some way was controllable by the student. Other researchers have shown achievement to be significantly greater when under learner control rather than program control (Campanizzi, 1978).

In the PT treatment, while students could not control the responses of the teacher, they could exercise a degree of control over the pace and the rate of improvement in learning. The degree of presence of locus of control factors seems to be reflected in the fact that CAI held a slight edge within the posttests (see Table 1) over PT in facilitating basic sight word and reading process acquisition.

An additional explanation of the results concerns reading for comprehension. While the PT treatment included an aspect of oral reading, the CAI system did not absolutely require it. Peer tutors did not read to students who could not grasp the material, nor did they assist them in understanding it. There is an alternate version of the Dolch software used in this
program which incorporates a voice synthesizer to read the words and sentences to the student. Such a system might have shown the CAI treatment to be significantly different from PT.

Finally, duration of the treatments themselves might have been too short to show differences between CAI and PT. Atkinson's study (1966), for example, showed gains in a five month period. The small gain of CAI over PT shown in this study might have increased given more time. The children appeared to be more comfortable with the machines and to be moving through the levels more rapidly toward the end of the project.

Discussion, Conclusion 4

With respect to conclusion four, that PT appears to be more effective for low ability students in the acquisition of reading process, three explanations are plausible.

1) The low CAI group may have been limited by a ceiling effect, since their pretest scores were considerably higher than the low Basal or low PT (see Comparative Mean Tables in appendix). 2) Perhaps the lower achieving students did not learn the word while practicing on the computer, but simply learned the sequence of letters. Though the higher-achieving students were able to read the words in context in the CAI treatment, the lower-ability children found the task difficult and often would not read to their tutors. One child was observed typing in the
word "eight" correctly, but could not read the word when asked. The problem might well have been overcome by the incorporation of the voice synthesizer.

With the PT group, each child met with his or her teacher and read the words, both in isolation and in phrases. The teacher helped the child read words he did not know, and then the child continued to read the words in daily timings until the words were mastered.

3) The third explanation rests on the effect of practice. Repetition until mastery has been well documented as an effective reading acquisition tool (Carnine, 1976; Chomsky, 1978). Apparently, though, these children were only able to process the words in context, as they showed no significant gains while reading the words in isolation.

Discussion, Conclusions 5 and 6

In discussing conclusion number five, that no overall differences were found among the treatment groups in spelling ability, it becomes evident that the treatments were not specifically designed to teach spelling and therefore there was no indirect differential effect or spelling effect. Although CAI, the only treatment with an incidental spelling component (i.e., high frequency words, self-correction, whole word approach, test-then-study method, and 10-15 minutes per day practice (Loomer,
1978), it is possible that the regular spelling programs given by the classroom teachers also possessed these components.

Secondly, young spellers pass through the phonetic stage of spelling during the first through third grades and do not move into the orthographic or the morphemic and syntactic stage until later. Thus most students at this stage are likely to make the same types of errors (Beers and Beers, 1981). Additionally, some children need teachers to detect and teach to spelling pattern errors in order to see similarities among words and be able to spell them (Nolen, 1980).

Finally, a study of children in grades 1-4 given a list containing both high and low frequency words showed that high frequency words were spelled correctly twice as often as low frequency words (Beers, Beers and Grant, 1977). Thus, the potential for spelling Dolch words should be approximately the same no matter how the treatment varied.

Surprisingly, the Basal did have an effect for males in that treatment group (conclusion six). They surpassed either sex in any other treatment group, except females in CAI. The Basal actually had a depressant effect on females' spelling ability (see Fig. 9). This finding runs counter to the prevailing research and literature regarding sex differences and language ability (Asher, 1977).

The study design which resulted in relatively small
cells could have produced the result. Perhaps the males in the basal program were more receptive to a wider variety of words and thus intuitively developed more spelling strategies than were students in other treatment groups. Moveover, the time spent on CAI and PT may have partially inhibited the spontaneous development of spelling strategies for females. As this finding is certainly not conclusive, further research is indicated as to the effects of basals, CAI and PT on spelling abilities of males and females.

**IMPLICATIONS FOR FURTHER RESEARCH**

In addition to the spelling research noted above,

1) additional studies are indicated in spelling competence as an indirect result of other language-related activities.

2) CAI studies over several months appear to be desirable.

3) CAI studies in reading using voice synthesizers should prove successful.

4) Supplemental programs with code-emphasis basal series should be examined.

5) Much work needs to be done in software evaluation, not only in isolation, but in conjunction with other instructional materials.
IMPLICATIONS FOR TEACHING

In addition to the results reported in the study, the Teacher Questionnaire (based on a 93% return) indicated that:

1) The children enjoyed the CAI program more than the PT, but liked the PT more than the Basal.
2) The introduction of the PT and CAI treatments did not unduly disturb the regular classroom procedure.
3) The teachers would continue to use CAI and PT as basal supplements after the study had ended.
4) The increase in sight word acquisition in their students appeared to be slightly more positively correlated with CAI than PT.

This study has further substantiated the assertions that reading instruction can be significantly improved by supplementing the basal program. It also further supports the use of CAI as an instructional tool and establishes the validity of Precision Teaching for sight words when used in conjunction with a meaning-based basal series in the primary grades.

For school districts which cannot presently afford computers in every classroom, making those it does have available to beginning reading classes is certainly indicated. For schools without computers at all, PT as
a supplement to early reading instruction appears to be a viable alternative.
COMPUTER INSTRUCTION SAMPLE

THIRD GRADE*

1  I WILL CALL YOU TODAY IF I CAN.
   I GOT UP TODAY AT SEVEN.

2  MAY I KEEP IT?
   WE WILL KEEP THIS ONE.

3  THERE ARE SIX OF US HERE.
   ALL SIX OF THEM WANT TO GO.

4  IT IS HOT TODAY
   IT IS TOO HOT TO PLAY

5  WE WILL RIDE TOGETHER IF WE CAN
   WE WILL PLAY TOGETHER TODAY.

6  HELP ME CLEAN THE HOUSE.
   DID YOU CLEAN IN HERE?

7  I CAN DRAW A TREE.
   WILL YOU DRAW MY CAT?

8  I WILL SHOW IT TO YOU
   PLEASE SHOW ME AGAIN.

9  DO NOT FALL DOWN.
   IF I FALL I WILL HURT MYSELF.

10 I GOT UP AT SEVEN.
    WE GOT TO READ TODAY.

11 WE SHALL BE BACK SOON.
    I SHALL GO NOW.

12 THIS IS MY OWN BIKE.
    DO YOU OWN A CAR?

13 I AM SEVEN TODAY.
    ALL SEVEN OF US WILL GO TOGETHER.

14 PLEASE TRY TO FIND IT.
    I WILL TRY TO READ THIS.

15 WE WILL GROW A TREE.
    WILL I GROW SOON?

(Underlined words disappear from the computer screen. The child must then re-enter them by typing.)

* This sample is from the third grade level. Other programs, from pre-primer through grade three, follow the same format.
<table>
<thead>
<tr>
<th></th>
<th>Basal Students</th>
<th>CAI Students</th>
<th>PT Students</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>25</td>
<td>28</td>
<td>27</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>16</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>9</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td><strong>Low Ability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male &amp; Female</td>
<td>6</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Avg/High Ability Male &amp; Female</td>
<td>19</td>
<td>21</td>
<td>15</td>
</tr>
<tr>
<td><strong>Low Ability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>3</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Females</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td><strong>Avg/High Ability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>13</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>Females</td>
<td>6</td>
<td>10</td>
<td>6</td>
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</table>
### Table 5 - Dolch x Ability

<table>
<thead>
<tr>
<th></th>
<th>Lo Pre</th>
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<th>Avg/Hi Pre</th>
<th>Avg/Hi Post</th>
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</thead>
<tbody>
<tr>
<td>Basal</td>
<td>22.67</td>
<td>26.00</td>
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<tr>
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### Table 6 - Dolch x Sex

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<tbody>
<tr>
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<td>49.44</td>
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<tr>
<td>CAI</td>
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<td>PT</td>
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</table>

### Table 7 - Maze x Ability

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<th>Lo Pre</th>
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<th>Avg/Hi Pre</th>
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</thead>
<tbody>
<tr>
<td>Basal</td>
<td>53.33</td>
<td>56.67</td>
<td>76.05</td>
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<tr>
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<td>75.71</td>
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<td>46.67</td>
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</table>
Table 8 - Maze x Sex

<table>
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<th>Female Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basal</td>
<td>64.38</td>
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Table 9 - Spelling x Ability

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<td>Basal</td>
<td>46.00</td>
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Table 10 - Spelling x Sex

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<tbody>
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<tr>
<td>CAI</td>
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<td>76.62</td>
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<tr>
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<td>50.82</td>
<td>53.82</td>
<td>54.80</td>
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DOLCH BASIC WORD LIST

As Graded by the University of Wisconsin Reading Clinic

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<tr>
<th>PRE-PRIMER</th>
<th>PRIMER</th>
<th>FIRST GRADE</th>
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<tbody>
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<td>1. a</td>
<td>1. all</td>
<td>1. after</td>
</tr>
<tr>
<td>2. and</td>
<td>2. am</td>
<td>2. again</td>
</tr>
<tr>
<td>3. away</td>
<td>3. are</td>
<td>3. an</td>
</tr>
<tr>
<td>4. big</td>
<td>4. at</td>
<td>4. any</td>
</tr>
<tr>
<td>5. blue</td>
<td>5. ate</td>
<td>5. as</td>
</tr>
<tr>
<td>6. can</td>
<td>6. be</td>
<td>6. ask</td>
</tr>
<tr>
<td>7. come</td>
<td>7. black</td>
<td>7. by</td>
</tr>
<tr>
<td>8. down</td>
<td>8. brown</td>
<td>8. could</td>
</tr>
<tr>
<td>9. find</td>
<td>9. but</td>
<td>9. every</td>
</tr>
<tr>
<td>10. for</td>
<td>10. came</td>
<td>10. fly</td>
</tr>
<tr>
<td>11. funny</td>
<td>11. did</td>
<td>11. from</td>
</tr>
<tr>
<td>12. go</td>
<td>12. do</td>
<td>12. give</td>
</tr>
<tr>
<td>13. help</td>
<td>13. eat</td>
<td>13. going</td>
</tr>
<tr>
<td>14. here</td>
<td>14. four</td>
<td>14. had</td>
</tr>
<tr>
<td>15. I</td>
<td>15. get</td>
<td>15. has</td>
</tr>
<tr>
<td>16. in</td>
<td>16. good</td>
<td>16. her</td>
</tr>
<tr>
<td>17. is</td>
<td>17. have</td>
<td>17. him</td>
</tr>
<tr>
<td>18. it</td>
<td>18. he</td>
<td>18. his</td>
</tr>
<tr>
<td>19. jump</td>
<td>19. into</td>
<td>19. how</td>
</tr>
<tr>
<td>20. little</td>
<td>20. like</td>
<td>20. just</td>
</tr>
<tr>
<td>21. make</td>
<td>21. must</td>
<td>21. know</td>
</tr>
<tr>
<td>22. me</td>
<td>22. new</td>
<td>22. let</td>
</tr>
<tr>
<td>23. my</td>
<td>23. no</td>
<td>23. live</td>
</tr>
<tr>
<td>24. not</td>
<td>24. now</td>
<td>24. may</td>
</tr>
<tr>
<td>25. one</td>
<td>25. on</td>
<td>25. of</td>
</tr>
<tr>
<td>26. play</td>
<td>26. our</td>
<td>26. old</td>
</tr>
<tr>
<td>27. look</td>
<td>27. out</td>
<td>27. once</td>
</tr>
<tr>
<td>28. red</td>
<td>28. please</td>
<td>28. open</td>
</tr>
<tr>
<td>29. run</td>
<td>29. pretty</td>
<td>29. over</td>
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<td>30. said</td>
<td>30. ran</td>
<td>30. put</td>
</tr>
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<td>31. see</td>
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<td>31. round</td>
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<td>32. saw</td>
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<td>33. say</td>
<td>33. stop</td>
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<td>34. to</td>
<td>34. she</td>
<td>34. take</td>
</tr>
<tr>
<td>35. two</td>
<td>35. so</td>
<td>35. thank</td>
</tr>
<tr>
<td>36. up</td>
<td>36. soon</td>
<td>36. them</td>
</tr>
<tr>
<td>37. we</td>
<td>37. that</td>
<td>37. then</td>
</tr>
<tr>
<td>38. there</td>
<td>38. there</td>
<td>38. think</td>
</tr>
<tr>
<td>39. you</td>
<td>39. they</td>
<td>39. walk</td>
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<tr>
<td>40. where</td>
<td>40. this</td>
<td>40. were</td>
</tr>
<tr>
<td>41. too</td>
<td>41. under</td>
<td>41. when</td>
</tr>
<tr>
<td>42. under</td>
<td>42. want</td>
<td></td>
</tr>
<tr>
<td>43. want</td>
<td>43. was</td>
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<tr>
<td>44. was</td>
<td>44. well</td>
<td></td>
</tr>
<tr>
<td>45. well</td>
<td>45. went</td>
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<td>46. went</td>
<td>46. who</td>
<td></td>
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<tr>
<td>47. what</td>
<td>47. what</td>
<td></td>
</tr>
<tr>
<td>48. white</td>
<td>48. white</td>
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<td>49. who</td>
<td>49. who</td>
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<td>50. will</td>
<td>50. will</td>
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</tr>
<tr>
<td>51. with</td>
<td>51. with</td>
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SECOND GRADE
1. always  
2. around  
3. because  
4. been  
5. before  
6. best  
7. both  
8. buy  
9. call  
10. cold  
11. does  
12. don't  
13. fast  
14. first  
15. five  
16. found  
17. gave  
18. goes  
19. green  
20. its  
21. made  
22. many  
23. off  
24. or  
25. pull  
26. read  
27. right  
28. sing  
29. sit  
30. sleep  
31. tell  
32. their  
33. these  
34. those  
35. upon  
36. us  
37. use  
38. very  
39. wash  
40. which  
41. why  
42. wish  
43. work  
44. would  
45. write  
46. your  

THIRD GRADE
1. about  
2. better  
3. bring  
4. carry  
5. clean  
6. cut  
7. done  
8. draw  
9. drink  
10. eight  
11. fall  
12. far  
13. full  
14. got  
15. grow  
16. hold  
17. hot  
18. hurt  
19. if  
20. keep  
21. kind  
22. laugh  
23. light  
24. long  
25. much  
26. myself  
27. never  
28. only  
29. own  
30. pick  
31. seven  
32. shall  
33. show  
34. six  
35. small  
36. start  
37. ten  
38. today  
39. together  
40. try  
41. warm  

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Dear Parent:

We have just completed the computer research project at Lolo School. We measured the children's oral reading ability, silent reading ability and spelling ability before the program began and also after it ended.

Here's what we found:

The children who participated in the regular reading program increased 8% *

Those who received PT instruction in addition to the regular reading program increased 15% *

Those children who were asked to read 10 minutes per day at the computer in addition to their regular reading program increased 22% *

We are very excited about the results of this program. Not only did your child learn to read better, we now know that a computer and the precision teaching approach in addition to the regular program will help all children to learn to read. In addition, most of the children thought the program was not tedious learning at all, but great fun!

Thank you for allowing your child to participate.

* raw gain only
<table>
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<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
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General Instructions to Teachers

1. Only those children in the computer group should use the Dolch computer program. All others should use math computer programs.

2. All children may use any of the off-line materials (cards, workbook pages, games).

3. Please try to re-schedule absentees and others who missed their regular Dolch PT or Dolch computer programs. (Math PT or math computer make-ups are not required.)

4. Only one child should be at the computer at a time during the Dolch period. Your tutors will help monitor. If other children consistently "tell the answer" to the child working at the computer, the final results of the study may not be accurate.

5. If your tutor does not arrive at the proper time, let Rhonda know. She'll send an alternate.

TREATMENT OUTLINES

Computer Group:

1. Schedule these students so that they have a definite 10-minute period every day to work at the computer. Enter their names and reading level on the program manager (I'll help, if you wish).

2. Let the tutors know which students they will be assisting.

3. If the children finish the computer loop before 10 minutes elapse, the tutors should have them work on the off-line materials, based on their working level, during the remainder of the 10-minute period.

4. Second and third grade children in the computer group will be coming to the first-grade rooms according to established schedules.

5. Have the tutors note the children they assist, the beginning and ending times for each child and any exceptions (absentees, machine difficulties, etc.) on the Data Treatment Form.

6. Please use 10 minutes of your math period each day to have all children work on PT math drills. The 10 minutes should include a one-minute timing, plus verbal practice drills, flash cards, math games or any other reinforcement exercises -- based on the one minute timing sheet you are using.

PT Groups

1. Work with these children separately from the regular basal groups.
2. Listen to each child read the Dolch words for one minute, then the Dolch phrases for one minute. While one child is reading, have the others work on off-line materials based on the word or words they mis-read the day before.

3. You may wish to have these children chart their daily progress.

4. Note any exceptions on the Data Treatment Form.

5. Allow this group of children to work with math on the computer at least 10 minutes at some time during the rest of the day. (No need to record those periods on the Data Form, though.)

6. Second and third grade children working on Dolch with PT should report to Linda's room at 1:45 daily. Their math computer time is on the schedule attached.

**Basal Group:**

1. Work with these children in their regular groups. No charting or recording is necessary for them.

2. Allow all the first grade basal readers a 10-minute math period on the computer some other time in the day. Second and third graders need not do this. Since all the first graders are in the same room, it is only fair that they all have a chance to use the computer.

Have fun!! Don't panic! All types of deviations are correctable. If you have any questions or suggestions before or during the program, be sure to let me know.

Thanks so much for your cooperation!
Directions for administering the pre-test and completing the pre-test data form:

1. List the reading teacher's name and today's date at the top.

2. Call each student up individually.

3. List the student's name and the initials (or last name) of his/her homeroom teacher on the first available line.

4. The number at the top of the word list page indicates the reading level of the test:
   
   1 - pre-primer  
   2 - primer  
   3 - first grade  
   4 - second grade  
   5 - third grade

5. Keep a set of the test for your notes and give a clear copy to the student to read.

6. Have the child begin reading the pre-primer list unless you are sure he is competent at a higher level.

7. If he pauses for more than 5 seconds, tell him the word and count it as an error.

8. If he misreads a word and immediately self-corrects, do not count as an error.

9. Record the number of errors he made on each list that he reads beside his name.

10. As soon as the child misses 5 words on a list, stop the testing.

11. Sign your name on the back of the pre-test data form.

12. If you have any questions during the testing, feel free to ask!

Thank you for your help!!

Sam Hollingsworth
<table>
<thead>
<tr>
<th>go</th>
<th>for</th>
</tr>
</thead>
<tbody>
<tr>
<td>find</td>
<td>come</td>
</tr>
<tr>
<td>can</td>
<td>big</td>
</tr>
<tr>
<td>away</td>
<td>a</td>
</tr>
<tr>
<td>where</td>
<td>yes</td>
</tr>
<tr>
<td>we</td>
<td>two</td>
</tr>
<tr>
<td>to</td>
<td>the</td>
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<td>see</td>
<td>run</td>
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<td>play</td>
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<td>were</td>
<td>walk</td>
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<tr>
<td>then</td>
<td>them</td>
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<td>take</td>
<td>stop</td>
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<tr>
<td>round</td>
<td>put</td>
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<tr>
<td>open</td>
<td>over</td>
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</tbody>
</table>
green   goes   fast   their
many   made   gave   sit
pull   or   would   off
sing   right   always   found
tell   sleep   five
those   these   been
use   us   why
which   wash   best
work   wish   its
your   write   call
because   around   don't
buy   before   upon
does   both   read
first   cold   very
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<th>ten</th>
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<td>far</td>
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<td>own</td>
<td>drink</td>
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<td>about</td>
<td>shall</td>
<td>cut</td>
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<tr>
<td>six</td>
<td>small</td>
<td>bring</td>
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<tr>
<td>today</td>
<td>together</td>
<td>warm</td>
</tr>
<tr>
<td>try</td>
<td>yellow</td>
<td>start</td>
</tr>
</tbody>
</table>
1. I see a dog.
   (find, away, funny)

2. We can go for the ball.
   (little, make, look)

3. May I go with my mother?
   (in, I, to)

4. The ball is green.
   (not, one, and)

5. I can see and play.
   (red, run, yes)

6. This is red.
   (in, see, one)

7. Here is a funny cat.
   (three, the, to)

8. I see big dog.
   (and, a, I)

9. Here is the blue ball.
   (my, me, it)

10. You can see and run here.
    (find, blue, jump)

11. I say, "come here!"
    (see, where, ssid)

12. The can is little.
    (red, run, three)

13. Is my mother?
    (we, there, for)

14. Are my cat?
    (you, yes, in)

15. Can I see there?
    (there, go, two)

16. Can we see daddy?
    (there, the, find)

17. Come here.
    (is, in, it)

18. Jump there.
    (down, the, find)

19. Come and see the funny dog.
    (help, here, where)

20. "Where is?"
    (it, I, to)
1. We want to go.
   (yes, all, well)

2. We will go and see the goat.
   (soon, good, so)

3. My hat is little.
   (no, into, too)

4. You must this now.
   (did, no, do)

5. That is a cake.
   (pretty, please, they)

6. I to go now.
   (new, have, under)

7. I to ride in the car.
   (did, want, what)

8. Can come with me?
   (find, he, say)

9. That was a jump.
   (soon, out, good)

10. What you say?
    (did, ride, white)

11. The ball is new.
    (but, there, brown)

12. Will you go now?
    (pretty, please, this)

13. That man funny.
    (four, white, was)

14. I saw there was to see.
    (no, what, will)

15. Who will this birthday cake?
    (he, ate, eat)

16. This is black car.
    (our, out, ran)

17. I here to play.
    (at, on, am)

18. You be good in the house.
    (like, must, into)

19. There are fish in there.
    (no, on, do)

20. We you run.
    (say, saw, soon)
1. I know to open the box.
   (had, how, her)

2. Fly the airplane so I can see you.
   (again, going, every)

3. Please him!
   (some, stop, could)

4. The shoe was too little.
   (know, give, just)

5. Please her play a game with us.
   (let, put, live)

6. I will run, and I will walk.
   (then, take, then)

7. I play with my duck day.
   (may, think, every)

8. The cow is the barn.
   (by, of, fly)

9. You can stop I do.
   (walk, then, when)

10. I to school every day.
    (open, walk, give)

11. I will give some money.
    (him, his, had)

12. My sister is away.
    (five, after, going)

13. Give the last kitten.
    (then, then, thank)

14. her to come to your party.
    (ask, as, any)

15. friend found a pony.
    (how, has, his)

16. Balloons, birds and airplanes
    (by, fly, may)

17. Put the cake in a pan.
    (could, think, round)

18. The dog catch the cat.
    (may, any, walk)

19. Did you bring me toys?
    (can, after, any)

20. Please me to the zoo.
    (both, take, her)
1. It is too __________ to play.
   (call, pull, cold)
2. I am going to __________ in my bed.
   (sleep, found, around)
3. Tell me __________ the rain falls.
   (which, why, would)
4. Where is __________ new house?
   (those, tell, their)
5. You __________ say that.
   (always, around, green)
6. What is __________ name?
   (sit, its, don’t)
7. I __________ I had a pony.
   (stop, take, wish)
8. What __________ your horse eat?
   (goes, does, many)
9. She __________ will this for a penny.
   (buy, been, why)
10. I __________ will the car for you.
    (write, off, wash)
11. I have __________ games to play.
    (many, very, always)
12. I __________ your coat on the bus.
    (first, found, would)
13. This is __________ my party.
    (five, first, sleep)
14. We can go by car __________ bus.
    (or, use, us)
15. __________ you build a train?
    (would, made, cold)
    (tell, right, those)
17. He __________ the kite fly.
    (gave, made, been)
18. We saw __________ TV shows at home.
    (five, call, sing)
19. Don’t __________ its tail.
    (tell, pull, both)
20. Have you __________ on the fire truck?
    (been, before, because)

Level 4
1. We will go to the zoo if he can.
   (shall, today, carry)
2. We always eat at seven.
   (shall, own, six)
3. My big sister and I play together, yellow, myself.
4. I am going to draw and color a kitten.
   (draw, drink, shall)
5. Try not to fall down on the ice.
   (full, fall, shall)
6. I have my bat and ball.
   (if, ten, own)
7. I will try to hurry.
   (try, far, only)
8. I like to blue, red and yellow flowers.
   (laugh, grow, seven)
9. The book is yellow and bears.
   (light, yellow, about)
10. I want a cold drink of water.
    (drink, draw, warm)
11. I have ducks in a cage.
    (if, ten, keep)
12. I sang a very long song.
    (long, never, bring)
13. I myself in the race.
    (hot, today, hurt)
14. There is a light in the window.
    (laugh, light, carry)
15. I can ride the horse by myself, together, draw.
16. She is kind to all animals.
    (keep, hold, kind)
17. How can the rocket go?
    (fell, never, for)
18. Please start the game over.
    (small, start, seven)
19. It is too warm for a coat.
    (warm, draw, shout)
20. This house is too far for all of us.
    (each, shall, well)
Spelling List

Please administer this test by reading the words in isolation. Wait 15-20 seconds, then continue to the next word.
Mark any words wrong that are spelled incorrectly and/or are unreadable.

Thanks!

1. big
2. find
3. it
4. make
5. not
6. came
7. did
8. ran
9. ride
10. what
11. give
12. him
13. just
14. let
15. then
16. been
17. first
18. green
19. sit
20. wash
21. about
22. draw
23. fall
24. got
25. laugh
<table>
<thead>
<tr>
<th>funny</th>
<th>can</th>
<th>look</th>
<th>come</th>
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<tbody>
<tr>
<td>The funny dog can come.</td>
<td>I can find you.</td>
<td>I can look for you.</td>
<td>You can come in.</td>
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</table>

<table>
<thead>
<tr>
<th>funny</th>
<th>can</th>
<th>look</th>
<th>come</th>
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</thead>
<tbody>
<tr>
<td>Come in here.</td>
<td>It can not up here.</td>
<td>See my car.</td>
<td>We go there.</td>
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</table>
Permission Form

To the parent(s)/guardian(s) of ___________________________

Lolo School and the University of Montana are beginning a research program involving the use of computers in the teaching of reading. Your child has been selected to participate, with your permission.

During the project (which should last a total of 8 - 10 weeks), your child will be taught how to use a computer to do reading drills, play games and work mathematical problems.

For four of those weeks, we will monitor your child's progress in reading while practicing with the computer, along with his/her regular classroom instruction. Work with the computer will last approximately ten minutes per day. The activities of this project are the same as those to be found in most regular classrooms.

At the end of the project, we will compare the achievement scores of the computer-assisted group with a group who received reading instruction from the teacher. We will look at the results to see whether computers are beneficial in this type of instruction. We will then notify you of the results and answer any questions you may have about them.

Your child's scores will not be reported individually, but as a group to insure complete privacy. Names will not be disclosed. The benefits of this project to your child range from the excitement of learning to use a computer, to increasing reading skills during the project.

You are free to withdraw your consent for your child to participate at any time.

If you have any questions regarding this program, please note them on the back of this form, or feel free to call or visit your child's teacher.

Please indicate one response:

I give permission for my child ___________________________ to participate in the reading research project at Lolo School.

_________________________________________  __________
Signature                                   Date

My Child ___________________________ may not participate in the reading research project at Lolo School.

_________________________________________  __________
Signature                                   Date

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PRE-TEST DATA

Teacher __________________________ Date Administered __________

<table>
<thead>
<tr>
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PT SAMPLE DRILL *

Instructions: Read as many words as you can in one minute.

how       when       round       live
again     walk       may       know
stop       him       any       could
just       going     take       an
let       them       think     over
then       ask       some      after
every     his       over      any
by       fly       old       from

Now read as many phrases as you can in one minute.

open the box       give him some       I know how
fly the airplane     is going away       the old tree
please stop him      ask her to       over the hill
just too little     they all can       he had the
let her play        it may catch       I am going
then I will         bring me any       after the game
play every day      take me to       I like her

* First grade level. Other lists were used for all levels, pre-primer through grade three.
TEACHER QUESTIONNAIRE
(Circles numbers are the mean scores for each question. 14 out of 15 teachers responded.)

Please take a few moments to fill out this questionnaire regarding the computer research project. Your name is not required. Please return the completed form to the box located in the Teacher's Lounge. Thank you.

1. Did you feel positively about PT before the project began?
Circle one choice

<table>
<thead>
<tr>
<th>3</th>
<th>2</th>
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<td>somewhat agree</td>
<td>no opinion/somewhat disagree</td>
<td>strongly disagree</td>
<td>strongly disagree</td>
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</tr>
</tbody>
</table>

2. Did you feel positively about CAI before the project began?
Circle one choice

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</table>

3. Did you feel your training in CAI was adequate?
Circle one choice

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<td>no opinion/somewhat disagree</td>
<td>strongly disagree</td>
<td>strongly disagree</td>
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</table>

4. Did you feel your students' training time in CAI was adequate?
Circle one choice

<table>
<thead>
<tr>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>-1</th>
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<td>strongly disagree</td>
<td>strongly disagree</td>
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</tbody>
</table>

5. Did you feel your training in PT was adequate?
Circle one choice

<table>
<thead>
<tr>
<th>3</th>
<th>2</th>
<th>1</th>
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</tbody>
</table>

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6. Do you feel the software was useful instructionally?
Circle one choice

<table>
<thead>
<tr>
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<th>1</th>
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<tbody>
<tr>
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<td>somewhat agree</td>
<td>no opinion/ slightly disagree</td>
<td>slightly disagree</td>
<td>disagree</td>
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</table>

7. Did you see any noticeable improvements in your sight word deficient students?
Circle one choice

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8. If the answer to question #7 was positive, would you attribute the growth to CAI?
Circle one choice

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</table>

9. If the answer to question #7 was positive, would you attribute the growth to PT?
Circle one choice

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</table>

10. If the answer to question #7 was positive, would you attribute the growth to the basal program?
Circle one choice

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</table>

11. If the answer to question #7 was positive, would you attribute the growth to other influences?
Circle one choice

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</tbody>
</table>
12. Did the children seem to enjoy the CAI program?
Circle one choice

3  2  1  0  -1  -2  -3
strongly agree somewhat no opinion/ somewhat disagree strongly
disagree
agree not applicable disagree strongly
disagree
to me

13. Did the children seem to enjoy the PT program?
Circle one choice

3  2  1  0  -1  -2  -3
strongly agree somewhat no opinion/ somewhat disagree strongly
disagree
agree not applicable disagree strongly
disagree
to me

14. Was the researcher helpful?
Circle one choice

3  2  1  0  -1  -2  -3
strongly agree somewhat no opinion/ somewhat disagree strongly
disagree
agree not applicable disagree strongly
disagree
to me

15. Although the program may have represented a change in classroom routine, would you agree that the project did not adversely affect your class?
Circle one choice

3  2  1  0  -1  -2  -3
strongly agree somewhat no opinion/ somewhat disagree strongly
disagree
agree not applicable disagree strongly
disagree
to me

16. Would you use CAT as part of your classroom reading program again?
Circle one choice

3  2  1  0  -1  -2  -3
strongly agree somewhat no opinion/ somewhat disagree strongly
disagree
agree not applicable disagree strongly
disagree
to me

17. Would you use PT as part of your classroom reading program again?
18. Do you feel the tutors benefited from their involvement in the program?

Circle one choice

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<td>agree</td>
<td>not applicable</td>
<td>disagree</td>
<td>strongly disagree</td>
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</tbody>
</table>

19. Do you feel the school benefited from the program?

Circle one choice

<table>
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20. Please add any additional comments including suggestions or changes in the program itself, in the Dolch software, or in the training session.
The Dolch Sightword Acquisition Program is designed for teaching the 220 sightwords on the Dolch list using a microcomputer. The package consists of two computer programs and a set of printed materials for classroom use.

The first computer program is a keyboard tutorial designed to familiarize young children with the Apple II keyboard. The tutorial is self-prompting and should be used in conjunction with teacher or peer group assistance. The tutorial covers the following:

- numbers: 1, 2, 7, 0.
- special keys: RETURN, SPACE BAR, SHIFT, +, =, -.

In pilot testing, 8th grade students were trained in one day to use the keyboard tutorial. They in turn helped 1st grade students learn the keyboard using the program. All of the 1st grade students learned within one week using this tutorial.

The sightword acquisition program consists of 220 Dolch words presented initially in context. The words are broken into five grade levels of approximately 40 words each. The grade levels relate to the difficulty of the words and are identified as follows:

- level 1: pre-primer
- level 2: primer
- level 3: 1st Grade
- level 4: 2nd Grade
- level 5: 3rd Grade

Each level is further subdivided into 4 "subcomponent" tutorial "parts" with mastery tests following each.

A pupil may be started at any level. The initial level will be determined by the teacher after administering an oral Dolch test.

The main function of the computer is to display target sight words on the screen in various contexts. The word is flashed and then removed from the screen and the pupil is asked to type the word back into a configurated target using the keyboard. Each student will require about ten minutes to complete a "subcomponent" (part) tutorial.
This gives the student time to work with at least 10 words. The computer will also present mastery tests to students after they have passed through each 10 word "subcomponent" (part) level in the list. The program is therefore able to keep track of the students' progress and the words they are having trouble with on an individual basis. The program also presents those words missed on the first try on each tutorial segment the next time a pupil comes to the computer and before the mastery test is given.

The seatwork materials include worksheet sets and flash cards. The worksheets are packaged in sets according to level. Each level is color-coded for easy identification. Two sets of flash cards are also included with the target words printed on them.

One set is printed with normal characters for quick oral identification, the other set is printed using a traceable "ghost" character set for matching and writing activities. The cards are also color-coded by grade level using the same colors as the worksheets.
<table>
<thead>
<tr>
<th>Student</th>
<th>Treatment Form</th>
<th>Starting Time</th>
<th>Ending Time</th>
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**OBSERVATIONS AND COMMENTS**

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