

THE EFFECTS OF THE USE OF **Reading Rods**[®]
MANIPULATIVES ON
EARLY LITERACY LEARNING

Dr. Ward Weldon
Project Advisor
University of Illinois at Chicago

Ms. Joyce Bristow
Project Advisor
Chicago Public Schools

ABSTRACT

The Effects of the Use of **Reading Rods**[®] Manipulatives on Early Literacy Learning

Purpose

The purpose of this study is to measure the effects on standardized test scores in grades 1 and 2 of a literacy instructional program that includes the use of **Reading Rods**[®] Phonics along with teacher orientation to the effective use of these instructional materials. The findings of this study will be used to suggest appropriate ways for teachers, school policy-makers and curricular materials developers to support student achievement of early literacy skills.

Methodology

Five hundred thirty-four urban first- and second-graders were pre- and post-tested on literacy skills in a study carried out in 2004-2005 in a large, Midwestern urban school district. Seven Experimental schools received the **Reading Rods** Phonics instructional materials and teacher orientation as to appropriate individual, small-group and large-group uses of these materials. Seven Control schools participated in testing but did not receive instructional materials or teacher orientation prior to student pre- and post-testing. Random samples of four or five students per classroom were tested on component sub-tests of the Illinois Snapshot of Early Learning (ISEL). Test results were analyzed to determine student progress between the December-January pre-test and the May-June post-test. Special attention was given to the measurement of progress by students failing to meet Target levels (50th percentile) on the pre-test.

Findings

Three forms of data analysis were performed:

1. A series of statistical (chi-square) tests were conducted to compare Experimental and Control Groups in terms of how many students scoring below Target in the Fall had met or exceeded Target scores in the Spring. (Raw scores needed to reach the 50th percentile were higher in the Spring, reflecting the fact that the entire norming group used to set Target level scores for this test had progressed to higher skill levels by Spring.)

On 8 of 10 ISEL sub-tests used (upper- and lower-case letter recognition sub-tests were combined for analysis), Experimental students crossed from below-Target performance in the Fall to Target-and-above performance at a higher rate than Control students, all chi-square tests > 9.1 , $p < .005$. That is, the differences on 8 of 10 sub-tests were statistically significant beyond the .05 level.

2. A series of statistical (analyses of variance) tests were conducted to compare the mean change from pre-test to post-test of all post-tested students (not just those below Target in the Fall) on 11 ISEL sub-tests. Experimental students showed greater gains than Control students on nine of the ISEL component test used, all F-tests > 4.5 , $p < .04$. That is, the differences on 9 of 11 sub-tests were statistically significant beyond the .05 level. The two sub-tests on which Experimental and Control Groups did not differ were Alphabet Recognition, Upper Case and Alphabet Recognition, Lower Case. There were ceiling effects noted on these two sub-tests, with both groups of students achieving scores very close to the maximum possible score.
3. Experimental students were classified according to the degree of implementation their teachers made of **Reading Rods** Phonics materials and strategies. Observers visited classrooms and interviewed teachers according to a degree-of-implementation rubric. Students in classrooms of maximum users gained more than students in classrooms of moderate users. Those in classrooms of minimum users gained least.

Recommendations

1. Teachers

Concrete manipulatives can assist student learning and should be used. They can be especially effective in helping below-target students to “catch up”. Small-group and differentiated instruction based on identified student needs should be included as part of early literacy instructional programs.

2. Educational Administrators

Use of literacy manipulative materials and associated strategies should be given full consideration in teacher professional development and supervision. This is especially important when significant numbers of low-achieving students are served.

3. ETA/Cuisenaire Product and Program Designers

The investigators have identified certain letter sounds and combinations that are frequently mistaken by low-achieving students. Product review and development should take this into consideration to make sure that students are helped to make correct identification and use of especially difficult language patterns.

Introduction and Theoretical Underpinnings

The **Reading Rods** Phonics program and is systematic and explicit phonics, and word analysis instruction is informed by the teacher guide. The manipulatives are color-coded plastic rods with consonants, vowels, and groupings of letters. These groupings include blends, digraphs, vowel combinations, and two- three- and four-letter word families. Students working with the **Reading Rods** Phonics program construct consonant-vowel-consonant-silent-e sequences (CVCe). Additionally, students build words using longer word families, make words using consonant blends and digraphs, and create diphthongs and common two- to-four-letter rimes. The rods are combinable by

interlocking them to form words, phrases and sentences. The interlocking process is designed to reinforce the left-to-right sequencing of letters and words in written English. There are also directional markings on the rods to indicate the directionality and sequences of letters in words and words in sentences. The rods and related supplementary materials are intended to provide visual and manipulative cues about the sounds and functions of letters and words. There are trays in which the rods are stored and arranged into meaningful sequences.

ETA/Cuisenaire has commissioned a research project to provide detailed information about the effectiveness of reading instruction that includes the **Reading Rods** Phonics program student manipulative materials, explicit teacher resources, and teacher orientation and conferencing activities provided in conjunction with these materials. Findings of this study will inform ETA/Cuisenaire personnel in research and development activities that respond to current federal and state literacy requirements. Findings also will be made available to schools and school districts using or contemplating using student manipulative materials in support of reading instruction.

This study is being carried out in 14 elementary schools of a large, Midwestern urban school district. The grade levels studied in this research project are grades 1 and 2. Primary grades were selected because of the great importance of student achievement of reading skills at early ages, and because of the relative lack of availability of standardized-test data about reading achievement at these grade levels. Group standardized testing of students in reading does not usually begin until grade 3. Teachers and curriculum planners who wish to improve student reading skills in grades 1 and 2 must rely primarily on standardized tests given individually to students or on non-standardized teacher-made tests. This study will provide additional data about the effects of various types of literacy instruction for beginning readers. Early success in reading may be expected to help students of all racial and income groups to have continuing success in the later primary grades, in intermediate grades, and beyond.

There are problems associated with individualized administration of grade 1 or 2 standardized reading tests. The procedure is time-consuming for teachers and may result in significant reductions of teacher time-on-task devoted to reading instruction. Thus, there is a danger that teachers may hurry students, give inadequate time to communicating the instructions related to each section of a standardized individually administered test or eliminate some sections of the individualized standardized tests. Also, the information gained from such individualized test-giving, if the classroom teacher is the test administrator, may be distorted by teacher expectations and by the lingering effects of past teacher-student interactions related to reading instruction or other matters. This study attempts to reduce distortions associated with test administration by the students' regular classroom teacher by using third-party test administrators. These test administrators are certificated teachers with graduate degrees, and with experience in reading instruction.

This study focuses on urban students in schools that serve many minority and low-income students. The effectiveness of the **Reading Rods** Phonics program intervention in such schools is of great potential interest to educators. This is especially true in light of mandates requiring "adequate yearly progress" for various sub-categories

of students in schools receiving federal funds. The designers of the **Reading Rods** Phonics program intervention materials have made efforts to coordinate this instructional approach with the learning standards developed by various states and with the mandates and guideline of federal or state funded literacy programs.

The instructional intervention examined in this study is more comprehensive than the making of an additional curricular material available to teachers and students. It also uses a variety of literacy teaching approaches that employs the **Reading Rods** Phonics program as part of an integrated curricular-instructional-assessment program that includes small-group instruction, classroom learning stations, center-based instruction, and differentiated instruction (with a particular emphasis on using **Reading Rods** Phonics program as a means of accelerating the progress of students who have not yet mastered basic literacy concepts and skills.) These teaching approaches are explicit in the teacher resources in the program. In order to provide information about the degree to which teachers in the Experimental Group made comprehensive use of the entire instructional intervention studied here, observer-interviewers categorized these teachers into “maximal,” “moderate,” and “minimal” users of the **Reading Rods®** Phonics program as a component of a broad-scale approach to literacy learning. The instructional supports are designed to help students develop knowledge about the predictable elements of the English language. The lessons are structured to include hands-on reading, conversations and connections, and review and reflection activities, called by Allington “thoughtful literacy” (Allington, 2001).¹

It is widely recognized that literacy is active skill or performance rather than a passive cognition or concept. The ability to read and write is learned and demonstrated by student action. Observer-interviewers in this study assessed the degree to which the **Reading Rods** Phonics program was used by teachers in this study to provide active learning opportunities for students. Such opportunities may occur in learning stations. The printed containers of the **Reading Rods** Phonics program kits are designed to be assembled for use as small-group learning centers.

This program may be used by teachers for whole-class instructional activities, or as one of several activity centers for students to work independently while the teacher is working on reading instruction with another group. In addition to the rods and trays the kits include overhead tiles suitable for projection onto classroom screens for either whole-group or small-group learning, and pocket chart cards, which can be sorted and placed in pockets at the learning station. **Reading Rods** Phonics also may be used by individual students to review concepts and skills previously introduced in whole-class or small-group activities. “Activity flipbooks” are included in kits to allow for student reinforcement of phonemic awareness and related literacy learning topics.

Teacher orientation to the effective use of the **Reading Rods** Phonics program is an integral part of the curricular and instructional program being studied in this research project. Teachers of each grade level are provided with professional development to familiarize them with the characteristics of **Reading Rods** Phonics. Professional

¹ Allington, Richard. (1999). *Thoughtful Literacy: The Key to Student Achievement, A One-on-One Interview*, Skylight Training and Publishing, Arlington Heights, IL.

development training sessions include demonstrations of recommended ways to use these materials for maximal support of student learning in a variety of classroom settings.

Reading Rods Phonics was introduced in 2000, but is based on earlier literacy research and instructional techniques. The rods have been called “Elkonin boxes,” in reference to the work of Russian psychologist, Elkonin, who studied student understanding of phoneme letter combinations. Elkonin asked students to arrange tokens symbolizing the phoneme sound in Russian into meaningful combinations to be displayed in display boxes. Students form subject-verb-object simple sentences and may add adjectives, adverbs and other qualifiers to provide more complex and complete meanings to the original simple sentences (Elkonin, D. (1973).²

Elkonin worked with an alphabet and linguistic structures very different from those used in English. This supports the theory that the analysis of language patterns into easily comprehensible units and the combination of the units into a wide variety of meaningful and complex communications is a technique that can be employed to support student learning of literacy in many languages with their contrasting semantic and linguistic structures. Subsequently to Elkonin’s work, researchers Wylie and Durrell, 1970, found that knowing 37 rimes of types that are used in **Reading Rods** Phonics’ instruction allows students to read nearly 500 primary-level words. These **rimes**, which are a big part of the reading puzzle, are shown below:

Table 1: Frequently Used Rimes

ack	ame	eat	ice	ot
ank	an	ell	ide	ore
ay	aw	est	ing	ock
ake	ash	ink	in	oke
ale	ain	ip	ine	op
ap	at	it	ick	uck
all	ate	ill	ight	ump
ug	unk			

The **Reading Rods** Phonics is based on research findings including those from two major studies: National Reading Panel Report, and Put Reading First. Research emphasizes the importance of explicit, systematic instruction for teaching reading, beginning with alphabet knowledge and phonological awareness. (Adams, 1990;³ Snow et, al, 1998)⁴

Methodology

This study uses a comparison of pre-test and post-test scores on the Illinois Snapshot for Early Learning (ISEL), one of two widely used measures of student reading

² Elkonin, D. (1973) USSR, Inj. Downing (Ed.), *Comparative Reading: Cross-National Studies of Behavior and Process in Reading and Writing*. (pp 551-579), NY: Macmillan.

³ Adams, M.J. (1990). *Beginning to Read: Thinking and Learning about Print*. Cambridge, MA: MIT Press.

⁴ Snow, C.E., Burns M.S., & Griffen, P. (Eds). (1998). *Preventing Reading Difficulties in Young Children*. Washington, DC: National Academy Press.

achievement in grades 1 and 2 in the urban school district studied. [The other is the Diagnostic Indicators of Basic Early Literacy Skills (DIBELS).] Both tests are given individually. The DIBELS is a set of fluency measures of how many words a child reads during a one-minute period. One of its purposes is to aid teachers in the early identification of students whose progress is below expectations. This identification can then lead to remedial or “catch-up” programs of instruction before a child has developed a long history of lower-than-expected achievement. The Illinois Snapshot for Early Learning also has measures of student fluency and reading speed. In addition, it provides other measures. The ISEL sub-tests used in this study are shown in the table below:

Table 2: ISEL Sub-Tests by Grade Level

First Grade	Second Grade
Alphabet Recognition, Upper Case	Spelling
Alphabet Recognition, Lower Case	Word Recognition
Phonemic Awareness	Reading Fluency
Letter Sounds	Passage Reading
Developmental Spelling	
Word Recognition	
Passage Reading	

These subtests were selected because of assumptions that **Reading Rods** Phonics intervention supports students’ future advances in literacy by focusing on these skill areas. Also because of research findings indicating that these particular skills are important components of student ability to obtain and communicate meaning through written language.

Teachers in Experimental schools were given four hours of orientation and teacher conferencing. The orientation topics were coordinated with a PowerPoint™ presentation to ensure that appropriate and similar concepts were included in all sessions. The seven Control Group schools received pre- and post-testing but no instructional materials until after conclusion of the study. Control Group schools received no training sessions. Samples of students in first and second grade classrooms of Experimental and Control Group schools were drawn on a random basis from alphabetical class lists. Every fourth or fifth name (depending on class size) was drawn for individualized pre- and post testing. The resulting sample sizes were 139 Experimental Group first graders, 137 Control Group first graders, 130 Experimental Group second graders, and 128 Control Group second graders. A review of statistical significance of findings, performed by an experienced and expert statistician, appears in the findings section of this report.

Pre-testing took place in December, 2004. Post-testing was done in June, 2005. A Year Two research study is planned for School Year 2005-2006. This study will allow for an assessment of effects of the **Reading Rods** Phonics program intervention over a longer time period than the approximately five months duration of instruction in this present study, and will facilitate longitudinal year-to-year comparisons.

Experimental and Control Group schools were selected to provide similar student demographic characteristics and similar prior student achievement levels. Fourteen schools participated, with seven serving as Experimental schools to receive the **Reading Rods** Phonics program intervention. The table below illustrates the ethnicity and income levels of Experimental and Control Group schools.

Table 3: Demographic Characteristics of Experimental and Control Group Schools

EXPERIMENTAL					
School	Total No.	Percent Low Income	No. Low Income	Percent African American * Hispanic **Caucasian	No. African American * Hispanic **Caucasian
A	243	80	194	93	226
B	677	87	589	99	670
C	934	61	570	99	925
D	404	89	360	100	404
E	576	34	196	11 ** 80	63 ** 460
F	469	93	436	99	464
G	989	99	979	6 * 90	59 * 890
Total	4202		3324		2812

Percent of Total Students in
All Experimental Schools = 77 percent Low Income

Table 4: Demographic Characteristics of Control Group Schools

CONTROL					
School	Total No.	Percent Low Income	No. Low Income	Percent African American * Hispanic **Caucasian	No. African American * Hispanic **Caucasian
H	312	34	106	17 **79	53 ** 165
I	814	92	749	98	798
J	781	96	750	99	773
K	639	93	594	100	639
L	502	97	487	99	497
M	287	80	230	100	287
N	1095	97	1062	2 * 97	22 * 1062
Total	4430		3978		3069

Percent of Total Students in

All Control Schools = 90 percent Low Income

Demographic Comparison of Experimental and Control Group Schools

The seven Experimental Group schools are compared in their school sizes, income-levels and racial-ethnic characteristics to the seven Control Group schools in Table 4 above. The total number of students in each group is similar, with 4,292 students in the Experimental schools and 4,430 in the Control Group schools. There is a somewhat lower percentage of low-income students in Experimental schools than in Control Group schools. The percentage in Experimental schools is 77 percent and in Control Group schools it is 90 percent. In both groups, there is one school with a percentage of low-income students that is much lower than for other schools in that group. In the Experimental Group, School E has 34 percent low-income students. In the Control Group, School H also has 34 percent low-income students. There is a school in the Experimental Group (School C) with 61 percent low-income students. The other 11 schools in this study all have low-income percentages ranging from 80 to 99 percent.

The percentage of African-American students in Experimental schools is 66 percent and in Control Group schools it is 69 percent. There are majority-Caucasian and majority-Hispanic schools in both groups. In the Experimental Group, School E has an 80 percent Caucasian student body and School G has a 90 percent Hispanic student population. In the Control Group, School H has 80 percent Caucasian students and School N has 90 percent Hispanic students. The range of school sizes is similar in the two groups. Experimental Group schools range in size from 243 to 989. Control Group school sizes range from 287 to 1,095.

The conclusion drawn from these data by the authors is that the Experimental and Control Groups of schools are closely similar in school sizes and racial-ethnic composition. There is a difference in percentages of low-income students with the Experimental Group low-income percent at 77 and the Control Group percent at 90. In order to provide an analysis of Experimental and Control Group schools with more closely similar socio-economic status (as measured by percent of students qualifying for free or reduced-cost school meals) a sub-set of six schools from each group has been selected. In this sub-sample analysis, the six Experimental Group schools have a low-income percentage of 84 percent and the Control Group schools have 80 percent of students falling into this category. Results from the entire groups and the sub-sets will be presented in the Findings section.

School-wide student achievement for Experimental and Control Groups is compared in Table 5. These data give a general perspective of the schools' general performance levels but are limited to standardized test scores that are available for third grade. Nevertheless, this is useful background information showing that the general levels of prior school effectiveness in the Experimental and Control Groups are roughly similar, with the exception of the year 2004 as noted below.

Table 5: School-wide Reading Achievement, Experimental and Control Groups

Percent At / Above National Norms Grade 3 Reading Comprehension		
	Experimental	Control
2003	38.8	36.4
2004	48.3	37.3
2005	34.6	36.37

School-wide achievement in reading is closely similar for the Experimental and Control Groups in the years 2003 and 2005. Experimental Group percents of students at or above national norms are considerably higher than those for the Control Group in the year 2004. This data is for students in grades higher than those examined in this research.

The Experimental and Control Groups are similar in size. There are 139 Experimental Group first-grade students and 137 first-grade Control Group students. In the second grade, there were 130 Experimental and 128 Control Group students. The students in both groups were selected for testing on a random basis with (range of numbers per classroom) students selected from each of the 14 first grade and 13 second grade Experimental Group classrooms and 13 first and second grade Control Group classrooms. Experimental Group teachers were classified by observer-interviewers as maximal, moderate or minimal implementers of **Reading Rods** Phonics instructional strategies.

An interview and observation rubric (see Table 6) were developed to describe the degree to which classroom teachers used **Reading Rods** Phonics materials and strategies. This rubric is designed to classify teachers as maximal, moderate, and minimal users of the **Reading Rods** Phonics program. This classification allows a comparison of student achievement scores based on the assessed degree to which the students' teachers made use of **Reading Rods** Phonics during the intervention.

Table 6: Teacher Interview Observation Rubric

Maximal	Moderate	Minimal
Inclusion of teacher-directed modeling of Reading Rods Phonics program in small or full group lesson-unit planning.	Inclusion of teacher-directed modeling of Reading Rods Phonics in small or full group lesson-unit planning at least 2 times per week.	Inclusion of teacher-directed modeling of Reading Rods Phonics in small or full group lesson-unit planning 1 or fewer times per week.
Evidence of all students interacting in the Reading Rods Phonics program work 5 times per week for 15 – 20 minutes per session.	Evidence of all students interacting in the Reading Rods Phonics program work 3-4 times per week for 15 – 20 minutes per session.	Evidence of all students interacting in the Reading Rods Phonics program work 2 or fewer times per week for 15 – 20 minutes per session.
Students engaged in writing through journaling or book reviews at least 2 times per week.	Students engaged in writing through journaling or book reviews at least 1 time per week.	Students engaged in writing through journaling or book reviews 0 times per week.
Students independently use Reading Rods Phonics' games 4 or more times per week.	Students independently use the Reading Rods Phonics' games 2 -3 times per week.	Students independently use the Reading Rods Phonics' games 1 (or fewer) time per week.

Findings

An Analysis of Below-Target Students Achieving Target-and-Above Levels During this Intervention

Individual student gains achieved between the time of the Fall-version ISEL pre-test and the Spring-version post-test have been analyzed. This analysis is used to group students into the categories of those who meet or exceed the “Target” level identified in the ISEL Test Manual and/or into the “Watch” category defined in that Manual. Target level has been set at scores achieving or exceeding the 50th percentile of the state-wide norming group used for this test, with the “Watch” category defined as “at or below the 20th percentile of the norming group.” Table 6 shows the number of students who were below target level in the Fall pre-test but met or exceeded target in the Spring post-test. The table shows this information separately for each of the ISEL components tested.

Table 7: Number of Students Who Were Below Target Level in the Fall Pre-test but Met or Exceeded Target in the Spring Post-Test

GRADE 1							
Total N Not Meeting Target in the Fall / Total N Meeting and Crossing Target in the Spring							
	Alphabet Recognition Upper	Alphabet Recognition Lower	Phonemic Awareness	Letter Sounds	Developmental Spelling	Word Recognition	Passage Reading
Experimental Total N = 139	17 / 14	59 / 48	77 / 74	51 / 45	58 / 48	52 / 45	11 / 7
Control Total N = 137	25 / 20	54 / 38	71 / 36	55 / 29	54 / 19	47 / 22	6 / 2
GRADE 2							
Total N Not Meeting Target in the Fall / Total N Meeting and Crossing Target in the Spring							
	Spelling	Word Recognition	Fluency	Accuracy			
Experimental Total N = 128	66 / 62	72 / 66	71 / 62	58 / 50			
Control Total N = 130	63 / 38	78 / 42	64 / 33	62 / 35			

As shown in the Table 7, there were substantial numbers of first grade Experimental Group students leaving the below-Target category of the 49th percentile and lower. This movement is most striking for the Phonemic Awareness skill where 96 percent (74 of 77) of students below the 50th percentile in the Fall had advanced to 50th percentile or above Target levels in the Spring. This improvement is statistically greater than that of the Control Group [$\chi^2(1) = 31.6, p < .001$]. On the same skill, fewer than half (36 of 71) Control Group students reached Target level. There is cause for concern about the future literacy and other academic achievements of the 35 Control Group students who were below Target in both Fall and Spring testing for the skill of Phonemic Awareness. On the Letter Sounds, Developmental Spelling, and Word Recognition subtests, significantly more Experimental Group students reached Target levels than did Control Group students, all chi-squares > 9.2 , all p-values $< .005$. The Experimental and

Control Groups did not differ statistically on the Alphabet Recognition or Passage Reading sub-tests, the chi-squares < 1.1, p-values > .3.

For the second grade, the percentage of Fall below-Target students meeting the Target-level requirement in the Spring is greater for Experimental than for Control Group students in all four skill areas tested, all chi-squares > 12.1, all p-values < .001. The greatest in improvement for the Experimental Group students occurred on the Spelling sub-test. The least improvement for Control Group students occurred on the Word Recognition sub-test, where 36 of the 78 did not meet or pass the target in the Spring.

The method of analysis (movement off below-Target to Target category of 50th percentile or higher) was selected because the investigators have studied the potential of **Reading Rods** Phonics as an effective catch-up strategy. **Reading Rods** Phonics instruction emphasizes small-group and individual work with hands-on manipulatives. The percentages of students crossing from below to at or above target are shown in Table 8 for the entire 14-school sample and in Table 9 for the 12-school subset.

Table 8: A Comparison of the percents of Experimental and Control Group Students Not Meeting Target in Fall but Meeting/Exceeding in Spring, Entire 14 School Sample

First Grade			Second Grade		
ISEL Components	Experimental	Control	ISEL Components	Experimental	Control
Alphabet Recognition Uppercase/ Lowercase	82% Upper 81%	80% Upper 70% Lower	Spelling	94%	60%
Phonemic Awareness	96%	51%	Word Recognition	92%	54%
Letter Sounds	80%	53%	Fluency	87%	52%
Developmental Spelling	83%	35%	Passage Comprehension: Accuracy	86%	56%
Word Recognition	87%	47%			
Passage Reading	64%	33%			

Table 9: A Comparison of the percents of Experimental and Control Group Students Not Meeting Target in Fall but Meeting/Exceeding in Spring, Subset of 12 Schools Sample

ISEL Components	First Grade		Second Grade		
	Experimental	Control	ISEL Components	Experimenta l	Control
Alphabet Recognition	80% Upper	78% Upper	Spelling	94%	62%
Uppercase/ Lowercase	81% Lower	69% Lower			
Phonemic Awareness	96%	47%	Word Recognition	92%	51%
Letter Sounds	88%	50%	Fluency	84%	46%
Developmental Spelling	83%	38%	Passage Comprehension: Accuracy	94%	54%
Word Recognition	86%	44%			
Passage Reading	64%	20%			

These data raise the question of why there was a substantially greater percentage of Experimental than Control Group students achieving target or higher levels when they had failed to achieve target levels in Spring. The Experimental Group intervention included the small group instruction and intervention supported by **Reading Rods** Phonics curricular materials and teacher orientation, which were not available to Control Group students. The rationale for emphasizing the movement of students from 49th percentile or lower to 50th percentile or higher is that the investigators have studied the potential of this intervention to contribute to “turn-around” achievements by early readers who have been experiencing obstacles and frustrations in their literacy learning. It should be noted that the ISEL has different versions for Fall and Spring administration for each of the grade levels studied. That is, the Fall pre-test and Spring post-test measure the same literacy skills but do so with differing test items. It is also significant that “Watch” and “Target” levels are recalculated for the Spring post-test.

Raw scores needed to be at “Target” (50th percentile) or above percentiles in the Spring post-test are usually higher than the raw scores required to be at these levels in the Fall pre-test. (The raw scores required for 20th and 50th percentile rankings on the pre- and post-test are shown in Table 10 below). This reflects the fact that students would need to grow in literacy skills between pre- and post-testing just to maintain at their same percentile ranking when compared to the norming-group students. The word “usually” is used to reflect the fact that first-grade Phonemic Awareness and second-grade Word Recognition tests have target levels that are the same in Fall and Spring. The raw scores associated with the various “Watch” and “Target” levels are shown below:

Table 10: 50th “Target” and 20th “Watch” Percentile Scores for ISEL Grade 1

ISEL Tested Skills	Highest Possible Score	Fall	Spring
		Watch Target	Watch Target
Alphabet Recognition: Upper and Lower case	54	51 53	53 54
Phonemic Awareness: Initial Consonants	10	9 10	9 10
Letter Sounds	26	16 20	21 25
Developmental Spelling	27	11 15	19 23
Word Recognition	22	5 11	18 21
Passage Reading	20	0 03	13 16

Table 11: 50th “Target” and 20th “Watch” Percentile Scores for ISEL Grade 2

ISEL Tested Skills	Highest Possible Score		Fall	Spring
			Watch Target	Watch Target
	Fall	Spring		
Spelling	10	10	02 04	02 05
Word Recognition	22	22	9 10	9 10
Fluency	NA	NA	43 74	64 99
Passage Comprehension: Accuracy	100	100	87 96	98 100

The awareness by students of the sounds of individual letters is a basic ability for which educators can and should support student perfection. For this skill a raw score of nine of 10 is the 20th percentile in both Fall and Spring and 10 of 10 is the 50th percentile at both testing times. Missing even one initial consonant sound of 10 by a first-grader sends a warning message to student, teacher and parent.

We are dealing with a ceiling effect. To be at or below 9 of 10 on this very basic literacy skill of identifying sounds of initial consonants puts a student at “Watch level” in both tests. Likewise, to identify all 10 correctly is only to reach the same level as more than half of the norming group. Ten out of 10 is considered necessary by the investigators in this study in order for students to be able to progress appropriately to more advanced literacy skills.

In the other literacy skills measured in this study, the Spring post-test raw scores for both “Watch” and “Target” levels are higher than scores at these levels in the Fall pre-test, as shown below in Table 12. Substantial improvement is needed just to maintain a student’s relative ranking from Fall to Spring inasmuch as the entire norming group shows substantial raw score increases.

Comparison of First Grade Control Group and Experimental Group Mean Gains Between Pre- and Post-Test, Entire Fourteen -School Sample

In this analysis, the scores on all pre- and post-tests are presented as mean scores. Gains from pre- to post-test are compared to see if students receiving the **Reading Rods** Phonics program intervention had gains significantly greater than Control Group students. Gains by Experimental and Control Group students completing both the Pre- and-Post tests are compared in Table 12 below:

Table 12: Comparison of First Grade Control Group and Experimental Group Mean Gains Between Pre- and Post-Test, Entire Fourteen School Sample

	First Grade Experimental			First Grade Control			Advantage
	Pre-Test Mean	Post-Test Mean	Gain	Pre-Test Mean	Post-Test Mean	Gain	
Alphabet Recognition Uppercase 26/26	23.89	24.45	.56	20.71	21.31	.60	.04 Control
Alphabet Recognition Lowercase 28/28	25.41	26.22	.81	21.87	22.86	.81	Equal Gains
Phonemic Awareness 10/10	7.61	8.88	1.17	6.80	7.69	.89	.28 Experimental
Letter Sounds 26/26	18.53	22.91	4.38	15.80	18.58	2.78	1.60 Experimental
Developmental Spelling 27/27	13.24	22.91	8.89	11.44	15.87	4.43	4.46 Experimental
Word Recognition 22/22	11.45	18.88	7.73	9.31	13.43	4.11	3.62 Experimental
Passage Reading 3 Target Pre 16 Target Post	7.73	15.66	7.93	7.15	12.43	5.28	2.65 Experimental

First-grade students were pre- and post-tested on seven ISEL components. There were 139 Experimental Group students completing both tests and included in the following analysis. There were 137 such Control Group students. Students who scored a perfect score on the pre-test were not post-tested because their high pre-test scores brought a ceiling effect into play, making it impossible for them to show substantial gains on post-testing.

The effect of post-testing only those students below pre-test cut-off scores is to further focus this analysis on students most in need of "catch-up" gains. The investigators wish to test the hypothesis that lower-achieving first-grade students can make rapid gains at this critical beginning point in their school experiences through the use of such interventions as the **Reading Rods** Phonics program.

Second-grade students were tested on four ISEL components, as detailed below. The number of second-grade students completing both the Pre-Test and Post-Test were 128 in the Experimental Group and 130 in the Control Group.

Table 13: Comparison of Second Grade Control Group and Experimental Group Mean Entire Fourteen School Sample

	Second Grade Experimental			Second Grade Control			Advantage
	Pre-Test Mean	Post-Test Mean	Gain	Pre-Test Mean	Post-Test Mean	Gain	
Spelling 10/10	3.40	6.60	3.20	3.82	6.24	2.42	.78 Experimental
Word Recognition 22/22	12.26	18.33	6.07	11.92	16.43	4.51	1.56 Experimental
Reading Fluency Correct words per minute	62.77	90.09	27.32	65.35	85.60	20.25	7.07 Experimental
Passage Reading Percent Words read accurately	80.90	91.78	10.88	85.88	91.02	5.44	5.44 Experimental

Comparison of Mean Pre- to Post-Test Gains by a Sub-Sample of Six Control- and Six Experimental Group Schools in Which Experimental Schools Have a Higher Percentage of Low-Income Students.

The researchers have examined gains between the Fall Pre-test and Spring post-test for a sub-sample of 12 of the 14 schools in the total sample. The purpose of this examination is to determine the amounts of differences between Experimental and Control schools for a sub-sample in which there is a somewhat lower socio-economic status of students (as indicated by the percentage of students qualifying for free or reduced-cost school meals). As mentioned above, in the total sample of 14 schools, the

Experimental schools had a lower percentage of low-income students (77 percent, compared with 90 percent for the Control schools). In the sub-sample of 12 schools presented above the six Experimental schools have 84 percent low-income students and the Control schools have 80 percent low-income students.

Table 14: First Grade Gains Compared for Twelve-School Sample

	Experimental	Control	Loss/ Gain	
Alphabet Recognition Uppercase 26/26	- .41	- .40	.01* lesser loss by Control	*Pre-test scores were near the ceiling score of 26 for both Control and Experimental Groups on the pre-test and only students scoring a significant percentage below the ceiling on the pre-test took the post-test on this component of the ISEL.
Alphabet Recognition Lowercase 28/28	+ .14	- .56	.70 ** Greater gain by Experimental	
Phonemic Awareness 10/10	1.30	.88	.42 Greater gain by Experimental	
Letter Sounds 26/26	4.57	2.92	1.65 Greater gain by Experimental	** As with Alphabet Recognition, Upper Case, there were ceiling effects noted for this component, and only lower-scoring students were post-tested.
Developmental Spelling 27/27	9.36	5.55	3.81 Greater gain by Experimental	
Word Recognition 22/22	7.46	4.31	3.15 Greater gain by Experimental	
Passage Reading 3 Target Pre 16 Target Post	8.34	6.56	1.78 Greater gain by Experimental	

A series of statistical tests (analyses of variance) showed that the mean change from pre-test to post-test in scores on the Letter Sounds, Developmental Spelling, Word Recognition, and Passage Reading sub-tests were significantly greater for the Experimental Group students than for the Control Group students, all F-tests > 14.4, p-values < .001. The Experimental Group also scored significantly better than the Control Group on the Phonemic Awareness [$F(1, 239) = 4.5, p < .04$], the difference was less than on the other sub-tests. The Experimental and Control Groups did not differ in performance on the Alphabet Recognition sub-tests, $F_s < 2.3$; however, this statistical test was based on far fewer scores because most students were performing at ceiling on the pre-test.

Table 15: Second Grade Gains Compared for Twelve School Sample

	Experimental	Control	Loss/ Gain
Spelling 10/10	3.39	2.18	1.21 Greater gain by Experimental
Word Recognition 22/22	6.87	3.85	2.92 Greater gain by Experimental
Reading Fluency Correct words per minute	30.16	16.66	13.50 Greater gain by Experimental
Passage Reading Percent Words read accurately	16.41	3.53	12.88 Greater gain by Experimental

A series of statistical tests (analyses of variance) showed that the mean change from pre-test to post-test in scores on all four sub-tests were significantly greater for the Experimental Group students than for the Control Group students, all F-tests > 6.1, p-values < .015. Thus, superior gains for the Experimental Group extend into the second grade.

In sum, students in Experimental schools out-gained those in Control schools with the exception of the Alphabet Recognition sub-tests. This consistent pattern in a sub-sample in which the Experimental schools have higher percentages of low-income students indicates that there are important beneficial effects to low-income using the **Reading Rods** Phonics intervention program.

Analysis and Commentary on Comparisons of Gains by Experimental and Control Groups

For the entire sample of 14 schools, with two exceptions, the Experimental Group out-gained the Control Group on the eleven ISEL sub-tests given to first- and second-grade students in this study. The two exceptions were (1) the small out-gaining of the Control Group over the Experimental Group on Alphabet Upper Case Awareness by .04 of a possible score of 26, and the identical gains by both groups of .81 of a possible score of 28 on Alphabet Lower Case Awareness.

The pre-test scores for the Control Group on these two sub-tests were lower than those for the Experimental Group. This gives the Control Group greater opportunity for gain between Pre- and Post-Test. On these two sub-tests, Experimental Group students had little room for improvement from Pre-Test scores of 23.89 out of 26 for Upper Case Alphabet Awareness and 25.41 out of 28 for Lower Case Alphabet Awareness.

The high scores for both pre-test and post-test for both the Experimental and Control Groups on Alphabet Awareness indicate that first graders were, in general, well aware of alphabet letters and their sounds at the time of the November-December pre-tests. While this is an encouraging report, Alphabet Awareness is a basic skill urgently needed as a foundation for the development of additional and more complex later literacy skills.

The nine ISEL sub-tests on which the Experimental Group out-gained the Control Group included such complex operations as Spelling, Word Recognition, Accuracy of Passage Reading and Reading Speed and Fluency. Especially large outgainings by the Experimental Group when compared with Control Group occurred in first-grade Spelling where the Experimental Group gain of 8.89 of 27 possible was more than double the Control Group gain of 4.43, in first-grade Word Recognition where the Experimental Group gain of 7.73 of 22 possible was 1.88 times the Control Group gain of 4.11, and in second-grade Passage Reading where the Experimental Group gain in percentage of words read accurately of 10.88 percentage points was double the gain of 5.44 percentage points by the Control Group. The staff development provided to Experimental Group teachers included an emphasis on using **Reading Rods** Phonics materials to support instruction in such complex literacy skills as those mentioned above.

Ceiling effects can sometimes reduce the amount of gain that is possible between pre- and post-tests. That is, a student who makes the highest possible score on a pre-test cannot show a gain on the post-test. In this regard, it should be noted that only students scoring below the pre-test scores indicated in Table 11 and 12 were post-tested and are included in this analysis of students completing both the pre- and post-tests.

The effect of post-testing only students scoring lower on the pre-test is to focus this analysis on students in need of “catch-up” gains. The investigators wish to test the hypothesis that students with comparatively lower literacy achievement can benefit quickly and substantially from the **Reading Rods** Phonics intervention program. The students included in this study are ones whose past academic progress provides opportunity and need for rapid improvement.

Effects on Student Achievement of Maximal, Moderate, and Minimal Implementation of the Reading Rods Phonics Intervention

Tables 16 and 17 show the degree of teacher implementation of the **Reading Rods** Phonics intervention together with the numbers of students failing to meet target in the Fall but achieving it in the Spring. Experimental Group teachers were working with small numbers of students who failed to meet target in Fall. **Reading Rods** Phonics was introduced during teacher orientation as a means of supplementing other instruction in ways that are most effective for students in need of extra help in meeting ISEL target scores. These include learning stations and differentiation of instruction using concrete manipulative materials in support of targeted student skills in need of improvement.

It is significant that teachers using **Reading Rods** Phonics in the maximal ways (as specified in Table 6) have substantially greater success in helping students who failed to achieve target in the Fall to achieve it in the Spring. Tables 16 and 17 show that the percentages of students crossing from below “Target” to above target during the intervention period are greatest for maximally implementing teachers and least for minimally implementing teachers.

Table 16: Numbers of First Grade Students Failing to Reach Target Level in Fall but Reaching It by Spring, Shown by Teacher Degree of Implementation of Small Group Reading Rods Phonics Instructional Strategies

First Grade Experimental Schools							
	Alphabet Upper Case	Alphabet Lower Case	Phonemic Awareness	Letter Sounds	Developmental Spelling	Word Recognition	Passage Reading
Maximal	1/1	3/3	3/3	3/3	4/4	3/3	1/1
	2/2	4/4	6/6	5/5	4/4	2/2	All students met Fall target
	1/1	4/4	6/6	5/6	2/2	5/5	All students met Fall target
	1/1	6/6	7/7	2/2	3/3	4/4	All students met Fall target
	1/1	8/8	8/8	4/4	5/5	4/4	All students met Fall target
	2/2	6/6	4/4	4/4	4/4	4/4	1/1
	4/5	3/6	7/7	2/2	3/3	3/3	All students met Fall target
Moderate	1/1	4/5	4/4	3/3	4/6	1/3	All students met Fall target
	All students met Fall target	2/2	4/5	4/4	4/4	3/3	All students met Fall target
	0/1	4/4	4/5	4/4	4/4	5/5	All students met Fall target
	3/3	1/4	4/4	4/4	4/5	3/5	All students met Fall target
	All students met Fall target	2/5	5/5	1/1	4/4	3/3	All students met Fall target
Minimal	1/2	1/3	4/5	1/2	1/5	0/4	1/0
	2/2	3/3	7/8	2/4	2/6	3/6	1/0

Table 17: Numbers of Second Grade Students Failing to Reach Target Level in Fall but Reaching It by Spring, Shown by Teacher Degree of Implementation of Small Group Reading Rods Phonics Instructional Strategies.

Second Grade Experimental Schools				
	Spelling	Word Recognition	Reading Fluency Correct words per minute	Passage Reading Percent Words read accurately
Maximal	5/5	8/8	5/8	2/2
	6/6	6/7	5/5	3/3
	6/6	7/7	6/6	6/6
	7/7	4/4	5/5	5/5
	4/4	4/4	7/7	2/2
	6/6	5/5	5/5	3/3
	3/3	3/3	4/4	5/5
	4/4	5/5	4/4	5/5
Moderate	6/6	5/5	6/6	4/4
	5/5	6/6	5/6	6/6
	1/1	3/3	3/3	1/1
Minima I	5/6	7/8	4/8	5/8
	4/7	4/7	3/7	3/7

Comparisons of Student Gains in Classrooms of Maximally, Moderately, and Minimally-Implementing Teachers

In the interpretation of Tables 16 and 17, substantial numbers of both Experimental and Control Groups achieved target on the Fall pre-test. Furthermore, in recognition of the successful efforts of Control and Experimental Group teachers substantial numbers of those who did not meet target in the Fall were able to do so in Spring. Nevertheless, the percentages of students crossing from below target to above target are greater for Experimental Group teachers.

Twenty-seven Experimental Group first- and second-grade teachers participated in this study. All were observed and interviewed to determine the degree to which they implemented the **Reading Rods** Phonics intervention program. A rubric was used to classify these teachers into maximal, moderate, and minimal users of **Reading Rods** Phonics. Fifteen teachers were identified as maximal users. Eight were classified as moderate users, and four as minimal users, according to the rubric.

Student achievement in classrooms led by teachers in these three categories was measured. The method of measurement was to identify students who scored below target levels in the Fall pre-test and then determine how many of these students had reached target or higher levels in the Spring post-test.

It should be re-emphasized that the target levels for the Spring post-test are usually higher than those required to meet “Target” levels in the Spring. The raw scores needed to achieve “Target” level are shown below (or on page blank) for each of the six items tested for first-graders and each of the four items tested for second-graders. Thus, students who moved from below “Target” in Fall to above “Target” in Spring gained enough to meet the (higher) post-test requirements in Spring even though they failed to meet the (lower) requirements identified by the test-maker in order to be “Target” in the Fall pre-test. This method of analyzing student achievement was selected in order to test the capacity of the **Reading Rods** Phonics intervention program to support teacher efforts to help students who are performing below the 50th percentile to make rapid strides in the key literacy skills included in this study.

The conclusion drawn from these data by the investigators is that maximum use of the **Reading Rods** Phonics intervention program is associated in this study with the movement of almost all below-“Target” pre-testing students to score levels at or above the higher requirements to be on “Target” by the time of the Spring post-test.

Comparisons may be made among maximum, moderate, and minimal implementers. Of the 157 possible crossings into “Target” level or above students in the classrooms of the eight moderate adopters, there were, in fact 139 such crossings, for an 89 percent rate of passing from below to at or above Target by these students. In regard to the four minimally-implementing teachers, their students achieved 62 of the 88 crossings possible for a rate of 70 percent. Even in the classrooms of minimally implementing teachers, substantial gains from pre- to post-test were made by 70 percent of these students. However, the gains by students in moderately-implementing classrooms were greater than those in minimally-adopting ones, and the greatest gains occurred in maximally-implementing classrooms.

This suggests that some of the student gains are associated with instructional and curricular factors not directly related to the **Reading Rods** Phonics intervention program, but that the combination of **Reading Rods** Phonics intervention with other effective literacy learning strategies can have a distinctly beneficial effect for students entering first- or second-grade with literacy skills below target levels.

Recommendations

The investigators wish to make recommendations to teachers in their classroom practices, and also to educational administrators and policy-makers as they develop curricular and instructional policies and practices, and to ETA/Cuisenaire designers and developers.

The recommendations for teachers are that manipulatives can support and extend literacy instruction for all students, but that lower-achieving students can be helped to achieve “turn-arounds” through good integration of manipulatives into a comprehensive program of literacy instruction. Such a comprehensive program should include small-group and individual “hands-on” learning activities as well as large-group instructions.

To administrators and policy-makers, we recommend that careful consideration be given to making curricular materials and staff development available to teachers in ways that allow for direct focus on the particular skills needed by individual lower-achieving students. We also recommend that the general classroom level of active and well-focused student learning experiences be supported by diagnostic assessments allowing teachers to determine in precise ways which students are most in need of which kinds of learning experiences.

The investigators have identified certain letter sounds and combinations that are frequently mistaken by lower-achieving students. Product review and development should be done to make sure that students are helped to make correct identification and use of especially difficult language patterns.