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ABSTRACT

A study investigated the effects of interactive CD-ROM software on children's reading comprehension. It explored whether 31 fourth-grade children in an elementary school in a suburban school district in the Midwest comprehended narratives better when reading from the printed page or from the same text displayed by the computer. One class read each narrative from the actual book and answered six multiple-choice questions about the story, while the second class read the same narratives from a computer and answered six multiple choice questions about the story. A three-way analysis of variance of comprehension scores revealed that reading from computers increased comprehension scores when subjects were reading the longer and more difficult narratives. Results indicated no difference when the two treatment groups were reading the shorter and easier narratives. (Contains 18 references.) (Author/TB)

INTERACTIVE COMPUTER SOFTWARE: THE EFFECTS ON YOUNG CHILDREN'S READING ACHIEVEMENT

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ABSTRACT

This study investigated the effects of interactive CD-ROM software on children's reading comprehension. It explored whether fourth-grade children comprehended narratives better when reading from the printed page or the same text displayed by the computer. One class of fourth-grade children read each narrative from the actual book and answered six multiple-choice questions about the story, while the second class of fourth-grade children read the same narratives from the computer and answered six multiple-choice questions about the story. A three-way analysis of variance on comprehension scores revealed that reading from computers increased comprehension scores when subjects were reading the longer and more difficult narratives. Results indicated no difference when the two treatment groups were reading the shorter and easier narratives.

INTRODUCTION

Since the late 1970s, microcomputers became affordable for widespread use in the schools (Bramble & Mason, 1985). As computer technology developed, the principal uses were computer assisted instruction (CAI) and computer managed instruction (CMI) (Mason, Blanchard, & Daniel, 1984). Several books were written in the 1980s that focused on using computers as an aid to reading instruction (Balajthy, 1986; Mason, Blanchard, & Daniel, 1983; Strickland, Feeley, & Wepner, 1987; Whitaker, Schwartz, & Vockell, 1989). Yet, Reinking and Bridwell-Bowles (1991) report that despite all the books that were written acquainting teachers with the use of computers in reading, few computer-based activities were an integral part of the reading program in most elementary schools.

Recent developments in microcomputer technologies have brought about the advent of reading texts displayed by a computer that provide comprehension related assistance. Much of the research about whether this type of presentation improves comprehension has been conducted by David Reinking. Studies by Reinking and Schreiner (1985, 1988) have investigated the effects on comprehension when reading expository material from a computer that provided the reader options for acquiring

information from a text such as pronunciation of words, definitions of difficult vocabulary, background information relevant to the topic, and the main idea of each paragraph. In the first study, Reinking and Schreiner (1985) investigated the effects of using textual manipulations to help good and poor fifth- and sixth-grade readers comprehend six expository passages. One group read the passages from the actual printed page while the experimental groups read the passages from the computer screen with no assistance, with optional assistance, and with mandatory assistance. Results indicated that comprehension increased for good and poor readers when manipulations of the text were mandatory. Reinking (1988) replicated his earlier study (Reinking & Schreiner, 1985) to investigate the effect of increased time on task when using textual manipulations. He concluded that increased comprehension was not due to increased time on task but speculated that it may be due to the active processing of the text, which was provided by the computer-based assistance.

Standish (1992) studied the effect of CD-ROM books (Discis Knowledge Research, Inc.) as a supplement to the basal reading program to improve reading comprehension. The treatment group had access to the CD-ROM based books which provided textual manipulations while the control group did not. The control group only had access to the computer

for drill and practice lessons. When comparing pre- and postreading comprehension test scores, results showed no statistical significance. But, the design in this study limits generalizations. For example, the treatment group contained more children reading at a lower level than the control group. The treatment group also contained children with behavior problems while the control group had no children with behavior problems.

We could locate no empirical documentation of the effects of computer-based assistance of narrative texts on students' comprehension when one group was reading narratives from the computer as compared to another group reading the same narratives from the actual book. Therefore, this current study was designed to investigate the effects on reading comprehension of fourth-grade students when reading narratives from the actual book as compared to reading the same narrative displayed by the computer. Specifically, it attempted to determine whether reading narratives from interactive CD-ROM technology displayed on the computer affects students' abilities to answer comprehension questions about each narrative.

METHOD

Subjects

The subjects in the study were 31 fourth-graders from an

elementary school in a suburban school district in the Midwest. One group of 14 students read narratives from the printed pages of actual books, while the other group read the same narratives from the computer screen.

Materials

Books. The seven books used by the actual book group were selected because the exact duplicates were also available on CD-ROM (Discis Knowledge Research Inc.). Five of these books are mainly stories of contemporary, urban, and domestic life. These include Thomas' Snowsuit, The Paper Bag Princess, and Mud Puddle by Robert Munsch; Heather Hits her First Home Run by Ted Plantos; and Moving Gives Me A Stomach Ache by Heather McKend. Munsch's books have been described by Ellis (1985) as picture books that are full of contemporary references to computers, chewing gum, snowsuits and cheeseburgers.

The remaining two books used in this study, The Tale of Benjamin Bunny and The Tale of Peter Rabbit by Beatrix Potter, are a more classic picture-book style. The Tale of Peter Rabbit is considered by Hearn (1977) as "one of the few twentieth-century classics which has become part of the folklore of childhood" (p. 563).

From the set of seven books, five were categorized as shorter and easier narratives and two as longer and more difficult narratives. The Fry

Readability Graph was used to compute the mean readability of each book. The mean readability estimates for the less difficult books were grade equivalent scores of 3, 5, and 6. Mud Puddle was at grade-level 3; Heather Hits Her First Home Run, The Paper Bag Princess, and Moving Gives Me A Stomach Ache were at grade-level 5; and Thomas' Snowsuit was at grade-level 6. The average length of these books was 22 pages. The more difficult and longer books had a mean estimate of grade-level 7 and were 59 pages in length. These books were The Tale of Benjamin Bunny and The Tale of Peter Rabbit.

Computer Programs. The Discis Books: Adventures in Learning were used by the computer group in this study. The content of the seven programs was derived from the above books' original pages and features the actual text and illustrations. The reader may listen to the story read aloud or enjoy background music and sound effects by clicking on the loud speaker icon. Martin (1992) reports that comprehension is encouraged by textual manipulations such as a single click of the mouse on any word or picture element to obtain pronunciation and syllables and in-context explanation of every word in the text. In addition, readers may click on either the left or right corners to turn the book pages. Several Apple Macintosh computers and CD-ROM drives were used to read the Discis

Books. The Discis Books used for this study were: Thomas' Snowsuit, The Paper Bag Princess, Mud Puddle, Heather Hits Her First Home Run, Moving Gives Me A Stomach Ache, The Tale of Peter Rabbit and The Tale of Benjamin Bunny.

Instruments. The dependent variable for this study was student scores on paper-administered comprehension questions. Six multiple-choice comprehension questions were developed by the researchers for each book. Of the six items, there were two literal, one vocabulary, and three inferential questions.

Procedures

Both the actual book group and the computer group participated in seven sessions. For both groups, these sessions occurred over an eight-week period with 60 minutes allotted for each session. In an attempt to make instructions consistent, each group received the same introductory remarks by their classroom teacher.

Each session was conducted by the classroom teacher in the same manner. After the students read a narrative, the students answered six comprehension questions related to the text. The order of the narratives and classics was counterbalanced as illustrated in Figures 2 and 3. The comprehension items were scored and shared with the participants at the

beginning of the next session.

The primary difference in the tasks for the two treatment groups was that the actual book participants read the books from text written on paper while the computer participants read the books from the computer screen. In the computer group, subjects were familiarized with the operation of the computer and the textual manipulation of the interactive CD-ROM software before the first session.

In order to find out how the students' comprehension abilities varied between the two classes, a major analysis consisted of a three-way (2 treatment X 2 text type X 2 sex) repeated measure analysis of variance (ANOVA) using performance on comprehension as the dependent variable. The between-subject factors were treatment and sex; the within subject factor was book type.

RESULTS

Analysis of Iowa Test Scores

In order to get an indication of the students' abilities in each intact classroom, t-tests were employed to explore differences in vocabulary, reading, and language scores earned on the Iowa Tests of Basic Skills (ITBS). One week after the data were collected, the ITBS was administered to the subjects in this study. Results indicated that

abilities of the two intact classrooms were not different and were good in all areas tested. Means, standard deviations, and t-values are summarized in Table 1.

Passage Comprehension

A three-way (2 treatment X 2 text type X 2 sex) repeated measures analysis of variance (ANOVA) was computed to test for differences between the means of total scores for the shorter and easier narratives and means of total scores for the longer and more difficult narratives on the comprehension questions when reading from the actual book as compared to reading from the computer. The data displayed in Table 2 reveal an interaction between treatment and textbook type, $F(1,27)=17.42$, $p<.00$. This interaction was important as it showed that reading from computers made a difference when subjects were reading the longer and more difficult narratives. These differences in mean scores did not occur when the two treatment groups were reading from shorter and easier narratives. Figure 3 presents a graphic display of this treatment type by textbook type interaction. There were no sex differences.

Session Order Interaction

The order of reading the narratives was counterbalanced as illustrated in Figures 1 and 2. In order to test for familiarity with

computers over time, a three-way (2 Treatment X 2 Sex X 7 Sessions) ANOVA was employed. The results showed no significant differences (decrease or increase in scores) over time, $F(6,162)=.37$, $p<.89$. The treatment effect was consistent over time. In other words, participants were not getting a practice effect with computers. These findings also indicate that there was a main effect for the computer group as the mean scores were consistently higher over time than the actual book group.

DISCUSSION

This study provides insight into the effect of interactive computer software on students' reading comprehension when reading narratives. The analysis of variance showed significantly higher comprehension scores when students were reading the longer and more difficult narratives from the computer. These results support the notion that when reading more difficult and more lengthy narratives, the textual manipulations of the interactive CD-ROM software produce higher scores on comprehension questions related to the text. An implication of this result is that teachers should explore the use of interactive computer technology to facilitate the comprehension of longer and more difficult narratives.

More instructional research studies are needed to continue to determine the effects of interactive CD-ROM software on reading comprehension when reading narrative texts. These studies need to be conducted using poor readers as well as good readers. Another suggestion for future research in this area would be to use two different computer groups along with the actual book group. One computer group would read the narratives from the computer screen with no textual manipulations while it would be mandatory in the other computer group to use computer manipulations. A study of this nature would provide much needed information of why the students did significantly better on longer and harder narratives when reading from the computer.

While affective changes were not documented in this study, students using the CD-ROM software clearly enjoyed the background music, sound effects, and the textual manipulations. Typically, children were overheard laughing out loud as they read from the computer screen or making such comments as, "I've been waiting to read this one." Such enjoyment and eagerness for reading should be at the heart of an instructional program that develops good readers.

Table 1

Percentile Ranks for Vocabulary, Reading, and Language from the Iowa Tests of Basic Skills.

	Subtests								
	Vocabulary			Reading			Language		
Group	M	SD	t-value	M	SD	t-value	M	SD	t-value
1 (N=17)	71.06	17.09		76.18	19.38		77.12	13.92	
			-.24			1.38			-.23
2 (N=14)	72.71	20.83		65.57	23.48		78.31	14.38	

Group 1=Computer Group
Group 2=Actual Book Group

Table 2

Analysis of Variance Results for Reading from the Actual Book and the Computer

Source	DF	Sum of Squares	Mean Square	F-Ratio	p-Level
Between Subjects					
Group	1	4.39	4.39	10.67	.00**
Sex	1	.33	.33	.80	.38
Group X Sex	1	.01	.01	.02	.88
Error	27	11.11	.41		
Within Subjects					
Booktype	1	6.30	6.30	26.32	.00***
Group X Book type	1	4.17	4.17	17.242	.00***
Sex X Book type	1	.01	.01	.02	.88
Group X Sex X Booktype	1	.40	.40	1.66	.21
Error	27	6.46	.24		

*p<.05
**p<.01
***p<.001

Figure 1. The Order of the Sessions for the Computer Group

	Session							
Student Code	1	2	3	4	5	6	7	T
1	N	N	C	C	N	N	N	36
2	N	N	N	C	C	N	N	40
3	N	N	N	N	C	C	N	38
4	N	N	N	N	N	C	C	37
5	N	N	N	N	N	C	C	37
6	C	N	N	N	N	N	C	37
7	C	C	N	N	N	N	N	39
8	N	C	C	N	N	N	N	37
9	N	N	C	C	N	N	N	35
10	N	N	N	C	C	N	N	36
11	N	N	N	N	C	C	N	39
12	N	N	N	N	N	C	C	40
13	N	N	N	N	N	C	C	35
14	C	N	N	N	N	N	C	40
15	C	C	N	N	N	N	N	37
16	N	C	C	N	N	N	N	41
17	N	N	C	C	N	N	N	39

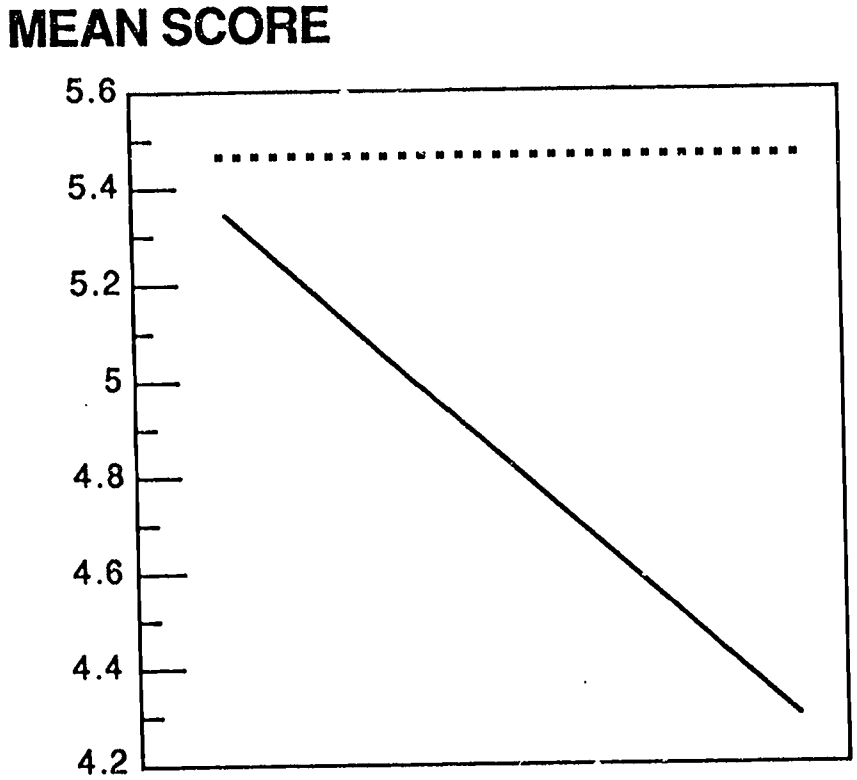
N=Narrative
C=Classic
T=Total Score Earned
Note: Scores can range from 0-42; 42 is high

Figure 2. The Order of the Sessions for the Actual Book Group

	Session							
StudentCode	1	2	3	4	5	6	7	T
18	N	C	C	N	N	N	N	39
19	N	N	C	C	N	N	N	39
20	N	N	N	C	C	N	N	35
21	N	N	N	N	C	C	N	29
22	N	N	N	N	N	C	C	39
23	C	N	N	N	N	N	C	35
24	C	C	N	N	N	N	N	32
25	N	C	C	N	N	N	N	34
26	N	N	C	C	N	N	N	32
27	N	N	N	C	C	N	N	37
28	N	N	N	N	C	C	N	38
29	N	N	N	N	N	C	C	36
30	C	N	N	N	N	N	C	36
31	C	C	N	N	N	N	N	39

N=Narrative
C=Classic
T=Total Score Earned
Note: Scores can range from 0-42; 42 is high

Figure 3. Graph of Interaction between Treatment and Textbook Type



Method of Reading	Computer	Actual Book
Longer and more difficult narrative —	5.33	4.29
Shorter and easier narrative •••	5.44	5.43

Figure 3. Graphic Interaction between Treatment and Textbook Type

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