NOTICE

The quality of this microform is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us an inferior photocopy.

Reproduction in full or in part of this microform is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30, and subsequent amendments.

AVIS

La qualité de cette microforme dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

S'il manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de qualité inférieure.

La reproduction, même partielle, de cette microforme est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30, et ses amendements subséquents.

EVALUATING THE INTERACTION OF PRIMARY STUDENTS WITH COMPUTERIZED BOOKS

by

Georgette Lamy, SEJ

B. Sc., University of Nelson, 1971

B. Ed., University of Saskatchewan, 1982

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS (EDUCATION)

in the Department

of

Education

SIMON FRASER UNIVERSITY

April 1990

ISBN 0-315-66170-4

Discis

May 4, 1990

Sister Georgette Lamy
Simon Fraser University
Excite Centre
Faculty of Education
Burnaby, BC V5A 1S6

[redacted]

Dear Georgette:

We have contacted F. Warne and Company in the UK, the publishers of Peter Rabbit, and anticipate no problem with the use of pictures from the Peter Rabbit Discis Book being printed in your Thesis. This is due to the nature of your work and its limited distribution. Discis, of course, has no objection to this use of the Discis Book and is fully supportive of your work.

Best regards

John D. Lowry

APPROVAL

Name: Georgette Marie Lamy

Degree: Master of Arts (Education)

Title of Thesis: Evaluating the Interaction of Primary Students with Computerized Books.

Examining Committee:

Chair: Robert Walker

Jaap Tuinman
Senior Supervisor

A.J. (Sandy) Dawson
Associate Professor

Geraldine Sinclair
Adjunct Professor

Milton McClaren
Associate Professor

Judith Scott
Instructor
Faculty of Education
Simon Fraser University
External Examiner

Date Approved 3rd APRIL, 1990

PARTIAL COPYRIGHT LICENSE

I hereby grant to Simon Fraser University the right to lend my thesis, project or extended essay (the title of which is shown below) to users of the Simon Fraser University Library, and to make partial or single copies only for such users or in response to a request from the library of any other university, or other educational institution, on its own behalf or for one of its users. I further agree that permission for multiple copying of this work for scholarly purposes may be granted by me or the Dean of Graduate Studies. It is understood that copying or publication of this work for financial gain shall not be allowed without my written permission.

Title of Thesis/Project/Extended Essay

Evaluating the Interaction of Primary Students with Computerized Books.

Author:

(signature)

Georgette Marie LAMY

(name)

3RD APRIL, 1990

(date)

Abstract

Discis Knowledge Research Inc. is recording children's literature and accompanying music on CD-ROM Macintosh discs. These CD-ROM discs can then be accessed by software to listen to the story, individual words or definitions.

The purpose of this study was to investigate the impact of a prototype Discis Book on students from kindergarten to grade three. It examined how long the book sustained children's interest and their patterns of interaction with it.

A case study approach was adopted involving observations and interviews with 52 children and 16 adults. Observations were carried out in a non-directive manner. Children were shown available options and allowed to explore the book. Child interviews investigated affective disposition towards listening and reading while adult interviews questioned acceptance and possible uses for the Discis Books.

The study showed that most children became involved with the story and learned something. In some cases, children learned to follow words in the correct order. In one case, a grade two child with a learning disability used the book to practise speaking.

Three exceptions indicate the need for guidance for some children. One kindergarten child showed a lack of interest. One grade one student explored program menus to the exclusion of the story. Another grade one student with a hearing impairment froze after her first choice.

Many children had difficulty with mouse movement and mouse actions. Children occasionally clicked too often on page turns and skipped pages. The lack of fine motor skills and poor hand-eye coordination hampered some children in their exploration.

Children enjoyed the book, liking the sound effects and the sentence reading. Several made good use of picture label and text matches. One English Second Language (ESL) student asked for frequent definitions.

Adults were enthusiastic and generally agreed that the CD-ROM Discis Book could be used with any primary student, especially with those with reading difficulties. Some suggested using adapted Discis Books with ESL students and adult illiterates. Criticisms included the problem of mapping sound to text for sentences requiring page turns, reading speed and level of some definitions. With some exceptions, the Discis Books were well received by both children and adults.

Acknowledgments

I would like to express my appreciation for the direction and encouragement of my senior supervisor, Dr. Jaap Tuinman, and in particular, the invaluable guidance and friendship over the past two years of my advisor, Dr. Gerri Sinclair.

My sincere gratitude goes to my community, Sisters Gilberte Painchaud, Thérèse Orieux and Denece Billesberger, for their support and understanding throughout the preparation and analysis of this study.

I would also like to thank the two principals and the teachers, parents, participating students and faculty members who graciously cooperated with the study.

Table of Contents

List of Tables

List of Figures

Chapter 1

Computerized Books

> Alice was beginning to get very tired of sitting by her sister on the bank, and of having nothing to do: once or twice she had peeped into the book her sister was reading, but it had no pictures or conversations in it "and what is the use of a book," thought Alice, "without pictures or conversations?" Lewis Carroll (1972, p. 1)

Introduction

A promising product, Discis Books, is coming into the educational market in April, 1990. Manufactured by a Toronto-based firm, Discis Knowledge Research Inc., these computerized books on CD-ROM discs allow children to control the audiovisual presentation of popular children's stories through interaction with a computer. Since the effectiveness of the program depends on this interaction, it becomes important to measure both the length of time that the children's interest remains engaged and the quality of their interaction with the program.

Problem Background and Rationale

When children ask adults to read aloud to them, there are needs being met -- the physical, affective and intellectual contact with an adult who is important to the child. Children can pay more or less attention to the story and still gain from the physical and affective contact. The computer, on the other hand, cannot meet these needs that children have vis-a-vis important adults; what computers do offer are, according to Salomon (1986, p. 20) "unique learning opportunities the realization of which greatly depends on learners' self-controlled, volitional engagement." Computers offer children a new medium which they can explore and from which they can learn, but what they gain from this interaction depends primarily on their motivation and what they bring to the experience (Benware and Deci, 1984). The computerized book's attractiveness, the novelty of using a computer and the difference in medium will undoubtedly have an effect as well, but it is essentially the children's motivation, their determination and their

attention or mindfulness that will determine their learning. The Discis Books have been structured in such a way that, although parents or teachers may set up optional features to match children's needs, the ultimate manner in which the books are used rests finally with the children using them. Beyond optional music and sound effects which accompany turned pages, all other computer events are user-initiated by mouse clicks on the computer screen.

In much computer-assisted instruction (CAI), a task is presented in order to engage the student's interest. An excellent example of this type of CAI is READER RABBIT, to be discussed later. Presented in a game format, these CAI programs engage interest through action, colour and a problem to be solved. The Discis Books have relatively static graphics, are presented in monochrome or colour depending on the system (Macintosh Plus or Macintosh SE; colour on a Macintosh II system) and do not present a specific task. Computer events are programmed to be totally dependent on the user's choices. This shows an underlying philosophy towards children's learning different from that of CAI. As Nelson (1987, p. DM 133) says:

> Instead of divising elaborate systems permitting the computer or its instructional contents to control the situation, why not permit the student to control the system, show him how to do so intelligently, and make it easy for him to find his own way? Discard the sequences, items and conversation, and allow the student to move freely through materials which he may control. Never mind optimizing reinforcement or validating teaching sequences. Motivate the user and let him loose in a wonderful place.
>
> Let the student control the sequence, put him in control of interesting and clear material, and make him feel good -- comfortable, interested, and autonomous. Teach him how to orient himself: not having the system answer questions, all typed in, but allowing the student to get answers by looking in a fairly obvious place. (Dialogue is unnecessary even when it does not intrude.) Such ultra-rich environments allow the student to choose what he will study, when he will study it and how he will study it, and to what criteria of accomplishment he will aim.

Since the children control the computer presentation both in pace and in content, it will be essential to observe: 1) how long the books sustain children's interest at each grade level from kindergarten to grade three and 2) children's pattern of interaction with the computer screen at each grade level. The pattern of interaction can be further observed for: a) the purposefulness or

the superficiality of the interaction level as measured by random or non-random clicks on pictures, words or sentences, b) an increase or decrease in this interaction while using the book and c) the particular features of the book used.

Discis Books may be used at different reading levels: 1) listening only while each sentence is being read, 2) reading along while each sentence is being read or 3) reading the book aloud or silently and clicking on unknown or difficult words only. It will be instructive to match use of reading levels with grade levels and determine at which point children decide to take on a greater responsibility in reading the Discis Books rather than in listening to them.

A further important question whose answer may be inferred through observation would be: "What are the students learning?" Are they gaining a greater understanding of vocabulary by listening to new words? Could they be developing better decoding skills by hearing and seeing difficult words? Is their comprehension improved by hearing words used in new contexts? Observation alone will not answer these questions but may point to the possible fulfillment of promises implied in giving children control of a computerized book and through it, control of their own learning in an 'ultra-rich environment'.

Problem Statement

Do the Discis Books, computerized books with "pictures and conversations", engage primary students for self-initiated language learning? Do they engage students enough to sustain their interest over a specific period of time? Does this format encourage student learning as observed through their attending behaviour and their purposeful interaction with the computer?

To give a broader appreciation of the possible uses of the Discis Books for primary students, the study also observed adults using the book. The observation and interview materials gained at both the child and adult level then permitted a detailed evaluation of the Discis Books as to their potential in engaging primary students for self-initiated language learning. Features were

assessed as to their usefulness to the students as they interacted with the computer. Additional features to make these books a better educational instrument were arrived at through the results of the observations and interviews.

Research Design

The evaluation of a new media requires field trials and case studies. Johnston (1984a, p. 2) says: "decision makers desiring guidance can be helped by snapshots of how early adopters are using microcomputers and by hearing teachers and administrators tell their stories and express their judgments". (See also Johnston, 1984b; Rice, 1984).

The study was composed of two parts: case studies of students interacting with the computer and interviews of adults involved with reading education, these interviews to take place only after they experienced the computer materials. (For copies of letters of information to subjects and parents, permission forms, interview questions and the observation tool, see Appendices A - D).

Case Studies of Students

This is a qualitative study of the free or self-determined experience of students with electronic books. A wide range of observations were gathered of the many uses to which the materials were put by the children. Structuring the experience to that of only reading along with the Discis Books would have left out interesting possibilities of their use in a preliteracy stage. Of this Patton (1980, p. 41) says: "The strategy in qualitative designs is to allow the important dimensions to emerge from analysis of the cases under study *without presupposing in advance what those important dimensions will be.*" (Italics are the author's).

In order to leave the children as free as possible, they were discreetly observed from a distance so that the main external factor affecting them would be the computerized book itself.

Two schools were selected - one an urban school; the other, a rural school. Three boys and three girls were randomly selected in each of grades K to 3 in each school. This permitted the observation of students from a wide range of ages as well as from the same age group.

Students were shown how to use the mouse, turn the page and get the computer to read a sentence or an individual word or to present definitions and explanations. Once they understood the program and knew how to make choices, they were left alone with the computer while the researcher worked at a table about six feet away to the side and slightly behind them.

An observation tool, refined through use in a pilot study, was used by the researcher as students worked through the computerized book. This tool concentrated on student attending behaviours, student comments and the book features they used.

Students used the computerized book for as long as their attending behaviour indicated their interest. As soon as they displayed the desire for a change of focus by their bodily behaviour, they were asked to come for a closing interview and then were allowed to return to their classes.

Extra Student Observations

Two additional students from each grade level were given the opportunity for repeated use of the Discis Book. These observations were used to determine the increase or decrease in interest in computerized books, in purposeful interactions with the book, and in the relative frequency of use of different features as students became more accustomed to this reading medium.

There was observation of Discis Book use in leisure time (before school, recess time, noon time) to determine the quantity and quality of independent use and the appeal of the Discis Books outside of the researcher-determined experience. The grade level of the returning students, the time they devoted to the book and their pattern of student interactions in their self-initiated

experience were noted. There were no restrictions or expectations placed on the children's use of the book in leisure time nor were interviews conducted after this use.

Adult Interviews

These interviews investigated adult reactions to this use of computers in reading education. As well, their comments on the electronic book were noted while they experienced it. These adults included a university professor in the field of reading, a faculty associate experienced in primary education, primary teachers from kindergarten to grade three, parents, and two librarians. After their experience, they were asked for a short interview concerning their reactions to the Discis Books and their recommendations for future use of these materials.

Limitations of the Study

This study is limited to the observation of the self-determined and self-motivated experiences of students using a Discis Book with the default feature configuration. Teachers and parents may later set a specific time span, predetermined goals or a changed feature configuration for their own purposes.

The Discis Book is being compared to other computer-based reading programs only in manner of presentation, not in effectiveness. This study will compare the Discis Book to other computer-based reading programs in the use of audio feedback, the variety of language information they present, the level at which this information is presented -- word, paragraph or story levels -- and the user control which they permit.

Chapter 2

Review of Related Literature

CD-ROM computer-mediated books can be used at many levels in Language Arts instruction. Therefore a study using these books would touch upon varied topics in Language Arts such as emergent reading, reading in the Language Arts and computer use in Language Arts instruction.

One feature of computers is their ability, like books, to mix text and graphics. However, this mix may or may not be helpful in learning to read. Research on the use of illustrations in primary reading books will therefore be examined. Another major feature of the computerized book is the computer's ability to provide information on request; this necessitates an examination of research on self-initiated learning. Since the technology used is that of a CD-ROM disc controlled by the computer to provide sound, other topics such as multimedia computer applications and research studies of audio feedback in learning reading become relevant.

As the focus in education must be the student and the curriculum, not the computer and its software (Lundsteen, 1989), I will begin with an examination of topics which concern children and reading.

Emergent Reading

Research shows the importance of exposing children to written language from a very early age so that the relationship between written and oral language can be understood (Strickland and Morrow, 1988; Zarry, 1984). Zarry (1984, p. 42) goes on to suggest that "the argument for early reading is based on the integration of a three-way mental process that relates meaning, sound, and sight." Strickland & Morrow (1988, p. 70) point out that "reading and writing develop concurrently with oral language." Each language process is related to the other in informing and supporting it. (See also Tuinman, Johnstone and Pfaff, 1989; Weiss and Hagen, 1988). While young children are learning to talk, they integrate sounds with meanings. A total integration at

this stage would include seeing the written representations of the words as well. One manner of doing this is by drawing their attention to popular trade names, package and food labels while saying the words. Young children soon become aware of the meaning of the MacDonald arches and can pick out the preferred washing detergent from the supermarket shelves.

Another key language experience for young children is having an adult read aloud to them. Reading aloud promotes language literacy and is a significant source of vocabulary acquisition (Elley, 1989; Lundsteen, 1989; Martinez and Teale, 1988; McCormick, 1977; McCormick, 1983; Michener, 1988; Robson and Whitley, 1989; Roser, 1987; Trelease, 1989). Children will come to an adult for the rereading of a favorite story. This rereading, researchers are finding, is also important in developing language literacy and concepts (Lundsteen, 1989; Martinez and Teale, 1988; McCormick, 1983; Yaden, 1988; Yaden, Smolkin and Conlon, 1989).

Language Arts in the Primary Grades

Language Arts instruction is most important in early education because it forms the basis for learning how to communicate and understand others' communication for the remainder of children's lives. This area of study which includes reading, writing, speaking and listening permeates the whole school day and all subjects.

Since it is such an important area, there has been much research to discover more effective methods to teach the Language Arts. These studies have changed the approach taken in teaching Language Arts and so there has been a resulting shift in emphasis.

Previously, there was a stress on reading readiness with systematic instruction in various pre-reading and pre-writing skills (Strickland and Morrow, 1988). When reading was considered a behavioral skill, instruction centered on its distinct sub-skills (Hoskisson, 1977; Palincsar and Brown, 1986; Skinner, B., 1984). Now viewed as an integral part of Language Arts, reading is considered a process by which children relate the oral language they know to the written language they perceive (Chall, 1983; Combs, 1987; Cullinan, 1989; Hoskisson, 1977; Lundsteen, 1989).

As Hoskisson (1977, p. 48) says: "learning to read is a problem the child must solve, not a set of skills that he must be taught" and again:

> The child is faced with the prospect of conserving and maintaining what he knows while interacting with the many parts of his world that he does not know. To make sense of his world and to develop, the child pays attention to aspects of his environment that he can assimilate and accommodate to his cognitive structures. He adds to these cognitive structures and transforms them in a way that promotes his development. The child is the one who constructs his own knowledge and develops his own means of solving the problem of learning to read. (p. 48)

Because children need to see words used in a meaningful way, it becomes important for them to be given a lot of practice in reading, especially in context, and in hearing and reading good literature (Biemiller, 1978; Chall, 1983; Cullinan, 1989; Lundsteen, 1989; Roser, 1987; Zarrillo, 1989). This practice must be both oral and silent: oral for development of decoding skills and fluency for beginning readers; silent for content coverage as well as fluency for readers at a later stage (Allington, 1983b; Allington, 1984, Anderson, B., 1981; Chall, 1983; Moyer, 1982; Reitsma, 1988).

Reading Materials

There has been a shift from using the basal readers with their limited vocabularies to using trade books (Chall, 1983; Cullinan, 1989; Hiebert and Colt, 1989; Lundsteen, 1989; Martinez and Teale, 1988; Rasinski, 1988; Roser, 1987; Trelease, 1989). Because it is the children who must solve the problem of learning to read, books must be interesting. In fact, research has shown that the interest level is more important than readability (Anderson, Shirey, Wilson and Fielding, 1987).

On the other hand, children need guidance in their selection because poorer students often choose reading material too difficult for them (Anderson, Higgins and Wurster, 1985). This shift to allowing children more choice in their reading material as well as viewing them as responsible actors in the new approaches to learning to read requires us to look at their ability and desire to

make decisions and, if necessary, find ways to help them in their development of self-determination.

Time practising reading

Although essential for developing reading competence, time for oral and silent or independent reading in the school day is constrained. Moreover, poorer students cover less content in the allotted time for reading because teachers stress oral reading for them while giving better students more silent reading time (Allington, 1980a, 1980b, 1983a, 1983b and 1984).

Although children learn best in a personal interaction with a teacher (Anderson, Evertson and Brophy, 1979; Anderson, Mason and Shirey, 1984; Reitsma, 1988), time for personal attention in oral reading is severely limited (Leinhardt, Zigmond and Cooley, 1981). During their reading time, poorer students read less than better students. Poor students read slower and are focused, because of their lack of decoding skills, on pronouncing the words correctly rather than being encouraged to read for meaning (Allington, 1984; Anderson, Mason and Shirey, 1984; Combs, 1987; Hoffman, 1987).

This triple handicap for poorer students --covering less content, reading less in an oral reading time, and being focused on accuracy rather than meaning-- means that the gap between good and poor readers will get larger each month of the primary grades (Stanovich, 1986). Teachers seek to give students equal time but poorer students need something extra in order to make more effective use of this time.

Computerized or electronic books

Theoretically, electronic books with computer-mediated text can provide solutions to many of the difficulties in providing time for reading practice. Students can get individual practice listening to good literature, hear well-modeled speech and listen to the words as they follow along with the text. They can read the text aloud and check difficult or unknown words in complete

privacy. For shy students, it can be a convenient way to get individualized help. Students reading at a low level can read material at their language comprehension level and hear language at the correct rate and rhythm for good comprehension. Very flexible, these computerized books can be used for listening, for reading along while listening, for reading while checking unknown or difficult words, or for repeated reading. The latter is a method which has helped students having difficulty learning to read (Allington, 1983a; Chomsky, 1976; Conte and Humphreys, 1989; Dowhower, 1987; Dowhower, 1989; Moyer, 1982; Neill, 1979; Herman, 1985; Rashotte and Torgesen, 1985; Samuels, 1974). This method occasionally uses talking books -- books which are taped so that children can hear the book while following along with the text (Carbo, 1978; Conte and Humphreys, 1989; Dowhower, 1987; Dowhower, 1989; Samuels, 1979).

Research on Talking Books

Since children entering kindergarten and grade one already have an extensive oral vocabulary, teachers can build on this strength. Hoskisson (1977) developed a strategy called assisted reading to introduce children to books. In this strategy, parents read aloud to their children, following the line of print with a finger. The children repeat words after their parents. Eventually, the children can move a finger under the line of print. A second stage starts when the children ask to read some words without assistance. The parent leaves out words for the children to insert. Finally, the third stage is reached when the children read most of the words and parents supply unknown or difficult words. Computerized books can be used in the same way by primary children. They can click on all the words or on whole sentences until they get to a stage where they can read silently and click on only those words they need.

For the beginning reader, there has to be a mixture of word decoding strategies as well as listening. Children eventually have to learn to focus on the letters (Reitsma, 1983). However, since reading goes beyond just saying words, teachers must focus on comprehension from the beginning. Samuels (1979) has pointed out that the method of repeated readings overcomes the

decoding barrier to comprehension as children become more fluent with the materials (See also Dowhower, 1989; Herman, 1985; LaBerge and Samuels, 1974; Moyer, 1982). In his method, children reread short and meaningful passages of a story until a predetermined level of fluency is reached. The emphasis is on speed over accuracy so that students do not become fearful of making mistakes. This repeated reading can be done with or without listening to tapes (Samuels, 1979).

Chomsky (1976) used similar techniques with poor readers in third grade who could read words but lacked fluency and comprehension. Carbo (1978) used tape-recorded books with students having severe learning handicaps. She added page numbers and pauses on the tape so that listeners could turn to the correct page and follow along. Because she synchronized text with tape, she called her method, the "talking book" method.

Gamby (1983) would disagree with the title of Chomsky's method. He separates the concept of talking books from that of taped books. Talking books are books recorded at a normal reading rate; taped books are those recorded at a slow and a medium rate. He used talking books right from grade one to let children listen to them. He did not introduce taped books until the latter half of grade two for children to follow along. According to his definition, Samuels and Chomsky used taped books. Although Carbo called her method one of using talking books, she read the books at varying paces depending on their difficulty and the reading level of the student to whom they would be matched. Her tapes, then, would be classified by Gamby as taped books. This distinction becomes important in examining computerized books which can control the reading rate by inserting pauses between phrases.

Dowhower (1987) conducted an experiment with second-grade readers in which students with good decoding skills but poor reading rates used repeated reading training, some with tapes and some without. Rate, accuracy and comprehension improved under both conditions, with prosodic reading (reading in meaningful phrases) most improved by using tapes. She also found

that these gains transferred to unpracticed, similar passages. The more effective practice was using a series of passages rather than one passage only.

Dowhower does not state the pace of the taped reading but she does mention that the use of tapes was more helpful for students initially reading below 45 words per minute (wpm) and that children were encouraged to read along with the tape. This would imply that the reading pace was slow, as in taped books.

Conte and Humphreys (1989) sought to verify the instructional effectiveness of repeated reading with tape-recorded material (RRT). They found a significant change in oral reading for the RRT group but not in the control group which read from basal readers. Their research differs from Dowhower's in that all Conte and Humphreys' groups used tapes, and reading materials were changed between the groups. They also indicate that it was important to tape materials at a speed appropriate to each child. Their materials were taped at three speeds: 30 wpm, 60 wpm and 120 wpm. Children used materials that were slightly faster than their reading rate.

Schneeberg (1977), reported a four year study on the use of listening while reading in grades one to four in which the use of teacher-prepared taped books at a Listening Center was one aspect of the program. Besides higher achievement, students developed positive attitudes towards reading. (See also Neill, 1979). It is impossible to determine what effect the taped books at the Listening Center had on the overall results.

The pace of talking books could raise a problem for listeners. McMahon (1983) studied the ability of first- and third-grade children's ability to listen and read simultaneously. Two versions of stories were prepared in which there were discrepancies; one text, the other taped. She found that all the first-grade students and many of the third-grade children could not perform the mismatch task at the read-along rates. These rates, determined by finding the median of taped materials for grade 1 and grade 3 students, are 112 wpm and 141 wpm respectively. The children's skill in detecting mismatches broke down beyond 35% above their individual oral reading paces. Since the median oral rate for grade 1 students was 29 wpm and for grade 3

students was 71 wpm, the median rate at which children could follow along would be 39 wpm and 96 wpm respectively. She does say, however, that it is possible that the task demands are greater than simply reading along. About the ability of children to read while listening, she comments: "The results obtained demonstrate that children are able to read and listen simultaneously as early as first grade." (p. 46).

Generally, the research shows that repeated reading with or without tapes leads to increased reading rates and accuracy in the practiced passage and new unpracticed passages. Both lead to an increase in comprehension of the practiced text which seems to carry over to new unpracticed text at similar reading levels. Repeated reading with tapes helps children's prosodic reading in which the children segment text into meaningful phrases with few inopportune pauses and good voice inflection (Dowhower, 1989).

These researchers studied repeated reading with text and tape-recorders. Other researchers have used computers to study repeated reading or to study other methods for improving reading; some of these research designs also include an audio component.

Carver and Hoffman (1981) used a PLATO computer terminal to present programmed prose in a repeated reading format with two groups of six high school students who read poorly. Programmed prose consists of paragraphs in which missing words have to be inserted, given a choice of two words. At the end of 50 to 70 hours each on the terminal, students had improved in reading that particular type of prose. However, gains in fluency could not be shown to transfer to general reading ability. Their conclusion is that the repeated reading method may be useful to students while they are learning to decode because it is the written form that they have trouble comprehending, not the same sentence presented aurally.

Olson, Foltz and Wise (1986) studied the audio component in researching ways of helping children learn reading. The computer gave optional speech feedback with whole words or with syllabication. Fifteen reading disabled students from 8 to 12 years of age were told to target each word they did not recognize. As a control, some stories were read without speech feedback.

From their results, the researchers suggested that speech feedback was the primary factor that improved word recognition. Because of computer storage limitations, this study utilized synthesized speech which can be very difficult to understand.

Synthesized speech is computer generated by the translation of ASCII code (written text) through applying complex grapheme-phoneme correspondence rules. Special pronunciations are stored for the most frequent exceptions (Olson and Wise, 1987). Olson and Wise (1987) studied the intelligibility of DECtalk's synthesized speech and found that nine learning-disabled students between 8 to 12 years of age could identify correctly 95% of the words. DECtalk is a relatively expensive text-to-speech synthesizer, marketed by Digital Equipment Corp. in 1984. A more common and inexpensive text-to-speech synthesizer is the Echo II synthesizer produced by Street Electronics for the Apple IIe. Its intelligibility was rated by Olson, Foltz and Wise (1986) at only 40%. Speech feedback, important for word recognition, must be intelligible or it is worthless. Either inexpensive synthesized speech devices must be improved tremendously or better technology must be used in their place.

Roth and Beck (1987) attempted to improve speed and accuracy in comprehension by improving decoding skills. In this study, they focused on words in order to develop these skills in students who compensated for weak decoding skills by depending on sentence contexts. One program presented a game-like activity in which students constructed words from sets of subword letter strings. This computer program used digitized speech as corrective feedback and for requested assistance when students were stymied. The second program presented another game-like activity in which students listened to and saw words in which the middle portion was changed, such as bat, bait, bet, beet. Once the instructional phase was finished, a maze was shown in which the student had to find the nearest letter string that matched the spoken one. The audio component was used to focus student attention on the middle vowels in the tutorial section and to present the problem in the game section. The researchers found that fourth-grade students gained the equivalent of a year in decoding and word recognition skills if they had been low in

those skills. Their ability to comprehend phrases and sentences also showed a gain of a year relative to a control group. However, there was no improvement in comprehension at the passage level.

The digitized speech used by Roth and Beck can be of excellent quality, depending on the sampling rate. However, the higher the sampling rate, the more storage space in memory is required for the sound. Because of this requirement, digitized speech feedback is useful only for lists of words or short excerpts.

McConkie and Zola (1987) developed a computer system to enable people with poor reading skills to read passages beyond their normal reading ability. Their computer controlled a tape-recorder. Readers could touch any word on the computer screen with a light pen and that word would be said. Their initial research was with adults reading at or below grade four level. The adults found this environment to be comfortable and helpful. The researchers foresee that "future developments of the system will allow a person to find out what a word means, and perhaps to get a paraphrase of a difficult sentence, among other things." (pp. 105-106).

McConkie and Zola stored their speech as analog signals directly to the hard disk (Olson and Wise, 1987). This provided very quick access and rendered good quality speech but would again entail large storage requirements.

Reitsma (1988) studied seventy-two first-grade students in three experimental conditions: guided reading, reading-while-listening, and independent reading with optional computer-generated speech feedback. The third experimental condition presented natural speech feedback through a computer-controlled tape-recorder for words students desired. Students were then tested on twenty target words which had been included once in each of the five short stories. His results showed that both the guided-reading condition, in which students read orally and had to correct all their errors themselves with guidance from the teacher and the speech-select condition, in which students read independently but could ask for the spoken form of any word as often as they wished, were effective in increasing reading fluency. He suggests "The involvement of the

subjects in actual reading may well be the major component that affects growth in reading achievement." (p. 231). He also points out that in the reading-while-listening method, the student does not have to pay attention to the written words. About computer-aided reading he says:

> As a supplement to regular teacher-led reading instruction, computer-aided reading in which responses can be carefully monitored and controlled may thus prove particularly helpful in providing the extensive practice poor readers need without much cost in teacher time and effort.
>
> Because poor readers experience their most severe difficulties in the area of decoding, that is, in making the translation between graphemic and phonemic information...(Stanovich, 1986), the use of speech devices in computer-aided reading practice may have major advantages over common workbook exercises or independent reading practice. (p. 233).

And further:

> It is important to note that the student should be utterly in charge of determining whether and when speech help for particular words is needed. This last point has important implications for the design of microcomputer programs as instructional devices in reading. As shown in this study, the active role of the student seems vitally important if improvements are to be achieved. Only when beginning readers are engaged in efforts to read on their own as much as possible can gains in reading skill be expected. Given this condition, a computer-based speech-feedback system could well be a promising and useful tool in reading instruction. (pp. 233-234).

Reitsma points to a possible failing in the reading-while-listening method and that is to ensure the engagement of the students in attending to the written text while they are listening. This attention, required for learning, is called mindfulness (Chanowitz and Langer, 1980; Salomon, 1984; Salomon and Leigh, 1984). Even though students may be well motivated to pay attention, the reading speed may be too fast for them to follow along or they can become distracted. What is needed is some way of ensuring at least a minimal amount of interaction before the tape continues in order to allow students to return to the task at hand. The independent reading condition with the request for audio feedback upon need provided that interaction.

What is missing in the audio feedback method for single words is the prosodic reading development that can be enabled by hearing a skilled reader speaking. This requires that the good reader read the whole text. The PLATO *Talking Page* program, to be discussed later, had a

mixture of both sentence and word reading stored on a disc. However, it was expensive and its speech system was synthesized and minimally reliable.

Even though synthesized speech is becoming quite recognizable with the more expensive synthesizers, it is not the best example for young readers to hear and imitate. Digitized natural speech, however, requires a great deal of storage space. This handicap can now be overcome with the new CD-ROM technology used with the Discis Books in which the whole book is read by professional speakers so that children can hear good prosodic reading as well as individual words.

But the responsibility for learning rests on the user of the books, so it becomes important to examine the ability of young children to choose wisely.

Self-initiated Learning

Children coming into kindergarten have been actively involved in learning since birth. A human's primary motivational propensity is to be effective in producing changes in his/her environment. De Charms (1968, p. 269) says that the person:

> ...strives to be a causal agent, to be the primary locus of causation for, or the origin of, his behavior; he strives for personal causation. This propensity has its roots in his earliest encounters with his environment, forces him to actively engage his environment thereby testing and deriving valid personal knowledge from it, and is the basis for specific motives. His nature commits him to this path, and his very life depends on it.

Children have the motivation to learn and usually enter the school environment with curiosity and eagerness (Bruner, 1966) but this curiosity declines through the years (Harter, 1981). As subjects involved in their education, they must determine their needs and be allowed to make meaningful choices (Condry, 1977; de Charms, 1968; Fisher, Blackwell, Garcia and Greene, 1975; Kinzie and Sullivan, 1988; Lacey, 1979; Langer, 1980; McReynolds, 1971; Stipek and Weisz, 1981; Swann, Stephenson and Pittman, 1981; Wang and Stiles, 1976). It is this active involvement that will be a large factor in their eventual success in reading (Chanowitz and Langer, 1980; Skinner and Chapman, 1984).

Although many psychologists have been stressing the importance of student control in learning, some experiments have shown that not all students can make wise choices in CAI (Gay, 1986; Goetzfried and Hannafin, 1985; Gray, 1987; Kern and Khalik, 1988; Steinberg, 1977; Tennyson, 1980; Tennyson, 1981). Although children must perceive freedom of choice, there must be some guidance or direction in the exercise of this freedom. With this direction, researchers have shown that there is more learning (Hannafin and Colamaio, 1987; Harris and Cody, 1988).

Illustrations in Primary Reading

One area which must be examined is that of the use of illustrations in primary books. This is an important topic because most, if not all, children's books abound with illustrations.

Yaden (1988) noticed the importance of illustrations to beginning readers as he began looking at the type of questions children pose about books during reading aloud time. Over half (56%) of the questions posed by his 5 year old son, David, were about the illustrations. He explains that in young children, there is a tendency to view the illustrations as an integral part of the text. In a longitudinal study with 3 to 5 year old children, Yaden, Smolkin and Conlon (1989) observed that the most frequent questions asked during their reading aloud time at home were about illustrations. They suggest that the children initially interpret the stories from the pictures alone and eventually pay more attention to the story line or text.

Samuels (1970) did a more detailed study of the effects of illustrations in early reading books. He studied their effects on learning to read, on comprehension of the story and on student attitudes. He found that illustrations interfered with the acquisition of a sight vocabulary, could not be shown conclusively to aid comprehension but did influence attitudes. He suggests that if the purpose of illustrations in books is to influence students by making them more appealing, then they do have a place. Otherwise, he found that pictures are distracting to a focus on words. He suggests that either pictures be shown to children during the preliminary discussion of a story or

that pictures be separated from the text in the book. A further possibility which he did not suggest is that of having a book displayed by a computer with the computer's ability to manipulate text dynamically. While the book is being scanned for interest, pictures could be included; while being used to practice reading a second time, pictures could be excluded. This brings us now to the discussion of computer-assisted instruction in Language Arts.

Computer-Assisted Instruction (CAI) in Language Arts

With computers as with any other medium, it is not the medium itself that influences learning but what it does (Balajthy, 1983b; Clark, 1983; Merrill, 1988). A computer can give individualized instruction, but then so can a teacher. There are time and class size factors involved in the teacher's ability to give personal attention just as there are time, software availability and cost factors involved in students' access to computers. Since each medium has its purpose and strengths, the relative effectiveness of computer programs for learning achievement over other methods of teaching will not be examined as it is beyond the scope of this paper. Computer use in Language Arts is not being examined here for its ability to replace teaching, but for the computer's ability to supplement good teaching, to give immediate feedback in drill and practice programs and to provide a learning environment for students as an extension of the teacher's presence and guidance. Each computer program will be examined for those evolutionary aspects which are improvements over previous programs in providing quality Language Arts instruction.

Early CAI in Language Arts on Mainframe Computers

Three early computerized reading programs were the Brentwood Project (later called the Stanford Project after the university conducting it), the PLATO (Programmed Logic for Automatic Teaching Operation) Project and TICCIT (Time-Shared, Interactive, Computer-Controlled Information Television) (Mason, 1980). Developed about the same time, these programs

provided computerized reading activities following different goals and philosophies and using varied technology.

The Stanford Project provided CAI reading instruction of 15 to 30 minutes a day for first- to third-grade students in California, as well as other states (Atkinson, 1974; Kamil, 1987). Students used a Model-33 teletypewriter and earphones for typed and audio components.

This CAI program was divided into eight parts or strands: introduction to the system, letter identification, sight-word recognition, spelling patterns, phonics, spelling, word comprehension, and sentence comprehension. Each student's level and entry into further strands depended on his or her previous mastery of earlier strands. Criteria for exercises were developed using mathematical models; student ability was estimated by analyzing the response record on all previous words. These results were then used to determine what materials to present in the next session and the relative time to give to each strand.

This project gave individualized instruction for students, at their pace and for their needs. The drills were at the word level rather than words in context. All control was at the program level. Materials used only text and sound, no graphics. Rude (1986, p. 7) summarizes its limitations: "It was expensive to connect terminals via telephone lines to large mainframe computers, the computers were relatively slow by today's standards, software material was primarily text oriented, and many of the computers were unreliable."

Another early program was PLATO, first developed in 1960 at the University of Illinois under the direction of Donald L. Bitzer (Obertino, 1974). PLATO is the acronym for "Programmed Logic for Automatic Teaching Operation" (Mason 1980). In 1971, the PLATO project turned to reading activities and in 1972, students wore headphones and sat at PLATO IV coloured touch-screen terminals. The initial thrust was towards developing activities for kindergarten and grade one students.

The materials consisted of different activities: games such as "Concentration", interactive storytelling, and sound identification practice. In this project, the aim was to offer a wide range of

learning modes in order to appeal to different cognitive styles. These exercises spanned a wide range of listening activites as well, from matching the phoneme of a word with its orthographic representation to listening to a story in which children choose alternatives for branching. During the story, full-colour slides were projected on the computer screen.

An interesting facet of the PLATO project was its use of sound. Twenty-three minutes of random-access messages were stored on compact discs, any message retrievable by the computer within 0.5 seconds. Another use of sound was in the TALKING PAGE, developed as part of the PLATO Early Reading Curriculum Project. Its description by Geoffrion and Geoffrion (1983, pp. 46-47) is especially valuable in providing an example of an earlier version of computerized books:

> The *Talking Page,* developed as part of PLATO Early Reading Curriculum (PERC) Project by John Riskin and Priscilla Obertino, uses a creative approach to print awareness. The *Talking Page* displays an exact reproduction of a storybook, one page at a time. When a child touches one of the words displayed on the screen, the computer reads the word aloud, using a synchronized speech device. Touching a dot at the beginning of a line reads the whole line. Children can reread lines or change the sequence at will by touching the dots. Special boxes at the bottom of the screen let children flip pages forward or backward. The PERC projects adapted several popular children's books to this format and provided teachers with an easy method for inserting stories dictated by the children.
>
> The *Talking Page* activity is valuable because it heightens children's awareness that print conveys the story information. Touching a picture or some other portion of the screen does not produce speech. Because children can replay words and phrases many times, this activity helps reinforce the concept that words carry invariant meaning. The ability to control the story by touching different lines keeps the student actively involved in the book.
>
> Unfortunately, PERC's *Talking Page* has not been replicated on many computer systems other than PLATO because it requires a tremendous amount of speech and a touch-sensitive screen. Both of these are expensive additions to a computer system. The speech production device used in this project was only minimally reliable. Nevertheless, the Talking Page remains an intriguing example of what is possible.

The PLATO project designers studied child behavior during their lessons and found that this behavior fell into one of four categories: active non-conventional, active conventional, passive conventional, and passive non-conventional. Active non-conventional children do not

follow directions but try to experiment with the equipment and explore that world. Active conventional children follow directions and work within the parameters indicated. Passive conventional children require direction or an invitation to use the equipment. Passive non-conventional children do not respond to messages and do not explore the equipment. They need encouragement from a human helper. In order to enable all four behavioral categories, their answer was to provide "enough variety so that every child will encounter some activities which he enjoys and which build his confidence." (Obertino, 1974, p. 13).

The PLATO Project differed from the Stanford project in several ways: it left the curriculum control in the hands of the teacher, provided for storytelling, and made extensive use of colour and animated graphics. The Stanford Project presented an integrated series of exercises within a controlling environment while the PLATO Project offered a wide range for the teacher's and children's selection. These two projects portray two differing approaches to computerized lessons: a behavioral approach with the computer in control and the child acted upon and a cognitive approach with the child in control, making choices for his or her learning. The Stanford Project also demonstrates the early tendency of computer programs to bypass the teacher, keeping the control in the programmed design.

The third system, TICCIT, developed by Hazeltine and Mitre Corporation, used its own special terminal (Kamil, 1987; Mason, 1980). Brigham Young University worked with it. Its main differences were a special keyboard which could provide objectives, rules, examples (hard or easy), practice exercises, and advice on progress according to the keys pressed by the student, as well as a display for television video tapes which could be viewed in full motion or frame by frame.

All three systems contain audio components but this system differs from the Stanford Project and PLATO in that it provides full motion video under computer control rather than text only or animated graphics with sound. Like PLATO, it offers student control but like the Stanford Project, it seems to be more integrated, since it presents material centered about the

videotape. However, TICCIT may not be as flexible for use in early primary grades. One example of its use is as a supplement to class discussions in a critical reading college course (Mason, 1980).

Microcomputer CAI in the Language Arts

Language arts is one of the largest areas of computer-assisted instruction in the elementary school (Balajthy, 1987a; Becker, 1987). From kindergarten to grade 3, 17% of CAI is used in reading, 18% in Language Arts and spelling, and 5% for writing (Becker, 1987). However, there has been somewhat of a disenchantment with the software available for reading teachers and with research on the effectiveness of CAI (Bracy, 1989; Brandon, 1988). In some cases, the computer is used as an electronic workbook with the teacher having no control in the child-computer dialogue (Geoffrion and Geoffrion, 1983; Johnston, 1987; Kleinmann, 1987). Over 50% of CAI for the elementary school is drill and practice or tutorial programs (Becker, 1987; Naiman, 1987; Strickland, Feeley and Wepner, 1987). Naiman (1987, p. 198) points out that "few programs even begin to use the power of the computer". Streibel (1986, p. 147) suggests that drill and practice CAI are part of a behavioral learning culture and "do not lead to critical thinking or personal empowerment".

With the philosophical change in the teaching of Language Arts, a change in the computer software for Language Arts instruction is required. Some reading researchers target new directions for software development: giving control to the student (Balajthy, 1987b; Dwyer, 1980a; Dwyer, 1980b; Geoffrion and Geoffrion, 1983; Jonassen, 1985; Jonassen and Hannum, 1987; Jonassen, 1988; Kearsley and Frost, 1985), increased interactivity (Brandon, 1988; Hooper, 1987), alternatives to typing for preschoolers, talking computers (Geoffrion and Geoffrion, 1983; Kamil, 1987; Olson, Foltz and Wise, 1986; Olson and Wise, 1987; Reinking, 1987; Reitsma, 1988), flexibility for different learning styles (Kern and Matta, 1988; Megarry, 1988), sentence or text level applications (Miller and Burnett, 1987), creative use by students

(Nix, 1988), expanding options for acquiring information from the text (Reinking, 1987; Reinking, 1988), and dynamic books (Weyer, 1982; Yaskelovich, Mayravitz and Van Dam, 1985).

On the other hand, Salomon and Gardner (1986) caution teachers that the use of all CAI programs must be determined by the teacher. It is possible that some programs may benefit some learners while inhibiting others. Students differ in abilities, inclinations, perceptions or cognitive styles. Naiman (1987, p. 198) warns that "standards for what is possible in educational program design seem to be determined by the latest introduction from the commercial hardware manufacturers--more memory, faster speed, better graphics, improved sound output, more attractive appearance or type." (See also Balajthy, 1987b). Teacher guidance remains a necessary prerequisite for effective student use of CAI.

Sample Microcomputer CAI Programs

Although there are many microcomputer CAI programs for Language Arts, I will look at a few representative programs for use in teaching Language Arts in the primary grades. The choices will range from early programs to more recent ones.

MECC Elementary Volume 7, an early set of programs written for the Apple II, contains nine computer programs of which six can be used for early reading or reading readiness practice: three are drills on alphabet letters and the sounds they represent; three are different versions of a concentration type of memory game. MECC is an acronym for the Minnesota Educational Computer Consortium, an organization set up to create and distribute educational software programs for that state and other school districts which license their software.

CATERPILLAR and TRAIN by Mike Fish present random sequences of five letters of the alphabet with one letter missing. Students must type the missing letter. CATERPILLAR presents upper case letters; TRAIN, lower case letters. If students type the correct response another section of the caterpillar or the train is added. If students type an incorrect response or wait over

35 seconds, the entire alphabet is printed across the bottom of the screen with a flashing box in the location of the missing letter. After ten correct answers, the caterpillar changes colours.

However, even in this simple program there are certain problems. First, the letter 'A' is never chosen because the randomly chosen space cannot be in the first position. Second, there can be a difficulty with typing lower case letters with a keyboard that has upper case keys. Children have to recognize the difference between upper and lower case and be able to match the two representations for each letter. Third, although the aim of the two programs is to drill the letters of the alphabet, a subskill the program requires is that of being able to find the keys on the keyboard. The lack of keyboarding skills in young children is a confounding factor; this complication is unnecessary for the particular skill being practiced.

Another early reading program on this diskette is A IS FOR APPLE by Curt Bring. A picture is presented on the screen with a different letter at each corner of the screen. Students must choose which letter begins the name of the object pictured. The objective of this program is to identify the initial sound of an object's name and recognize the letter associated with that sound. The teacher can edit the list, controlling the number of questions and which letters are available to the students at any particular time.

This program requires students to know the alphabet letters and which sound they represent when used at the beginning of a word. It provides a drill in matching letters with initial sounds, a skill to be learned before using the program.

Another program from MECC is DOLCH WORDS Vol. 1 & 2, written by students of Computer Studies at the Campbell River Junior High School in Campbell River, B. C. The diskettes contain twenty four programs with 10 sentences each - 2 programs in each of 12 levels of Dolch words (words which are commonly confused with another word). Programs are of the drill and practice type. Students choose between a Dolch word and its distractor in each given sentence. The reading level is grade 5 - 7, although Dolch words can occasionally be recognized

by students with lower reading levels. The teacher's guide presents the complete list of words in any level. I have chosen a few words from levels one and twelve as an example:

Level 1	a	the	pair	she	you	to
Level 12	sing	only	every	thank	now	wish

A menu provides students with a choice of difficulty level. Once in a program, the computer provides a sentence with a Dolch word and its distractor. By pressing the space bar, students remove the two choices and type in the correct word. Both correct and incorrect answers receive a comment. If the answer is incorrect, the computer repeats the question.

Eg. I like to eat/ate cake on the floor.

After five questions, the computer displays the score and allows students to quit or continue.

The Teacher Guide is excellent, giving the list of words studied in each program. This allows for teacher choice of levels to be studied on a given day. However, the program is confusing to run as the space bar must be pressed at all times except when giving the answer. Pressing the space bar before pressing RETURN inserts an extra space in the word which then becomes interpreted as a wrong answer.

MISSING LINKS, developed in 1983 by Sunburst Communications, is a game for one or two players. The players choose a book, one of nine passages from that book, and one of nine formats for missing letters. These formats are special ways of printing passages. The nine formats are: all vowels left out, alternate letters missing, all letters missing except for the first letter of each word, alternate words missing, consonants missing, all letters missing except for the last letter of each word, all words missing except for the first of each sentence, all letters missing with dashes to represent the letters and finally no clues whatsoever. Participants choose the number of tries that they can have before the computer fills in the empty spaces. A score is given at the end of the passage showing the number of letters that were filled in out of the total number possible, and the number of letters that were filled in at the first try.

The program can be adapted to younger children by presetting beginning options for them to go directly into the game. Since parents or older children can enter passages into the computer, this program can be excellent for young children practising reading or older children memorizing notes.

The use of a passage, rather than just a word as in the game Hangman, can result in a focus on comprehension although it can not ensure this focus. The given passages are chosen from various literature books, such as The Secret Garden by Frances Hodgson Burnett and The Lion, The Witch and The Wardrobe by C. S. Lewis. This may encourage the students to get the book from the library to read later on their own. The game format appeals to children in a way that a simple drill cannot.

There are different qualities of CAI available for teachers to use with their students. Naiman (1987, p. 192) describes a "second generation" of software as consisting of programs

> designed, often by a team of educators and programmers and graphic artists, to take advantage of the rapid development of professional programmers' tricks and utilities. ... It learned from the insidious addiction of the arcade game and made for snazzier programs.

The following CAI programs are representatives of this "second generation" of software.

READER RABBIT, developed in 1984 by The Learning Company, consists of four games: SORTER, LABELER, WORD TRAIN and MATCHUP. In SORTER, students match words to a target pattern such as: d--, or -o-, or --g. The emphasis is on recognizing words which have the same letter in the same position. In LABELER, students unscramble letters to spell words that name pictures. Three pictures are given, with three boxes containing the beginning letters, the middle letters and the ending letters. Students choose the required letter from a box for each picture. In WORD TRAIN, students load a train with words differing by one letter for previous word. In MATCHUP, students choose from six ways of matching pictures with words or words with words.

These games do not require alphabet keys except for the I, J, K, M keys for motion so the extra skill of keyboarding is not required. SORTER and WORD TRAIN are excellent drill and

practice programs for students who need to focus on individual letters in words. However, SORTER goes so quickly that even adult players must focus on just the position in order to react quickly enough. There is no time to see the letter in context and read the word. WORDTRAIN allows for slower work but, since the 'words' are occasionally pseudo-words, there is not much point in viewing the letter in context. LABELER is excellent drill and practice for beginning spelling. As there are no extra letters, students can use a process of elimination to spell the words required to match the pictures.

The programs are very colourful. Although the colour may add to the appeal, it serves a useful purpose in LABELER where the first, middle and last letters are different colours. Sounds and the dancing rabbit reward the student for solving problems correctly.

MAGIC SPELLS, developed in 1984 by The Learning Company, consists of two games: SCRAMBLE SPELLS and FLASH SPELLS. A SPELLS WRITER editor is included to create new word lists. Points are determined by the ability to unscramble words and type them correctly in the first game, by the ability to remember the words momentarily displayed and to type them correctly in the second. The reward for each is a treasure chest with gold.

This program is basically a spelling drill game. The fantasy elements, sounds and reward serve as motivation to solve the spells (For a taxonomy on motivational aspects of computer games, see Malone and Lepper, 1987). There is a choice of many word lists as well as the possibility of making up new ones, so the game will not lose its appeal too quickly.

KIDSTIME, developed in 1986 by Great Wave Software, is a collection of five educational games for pre-school children. These games use the Macintosh rather than the Apple II computer.

DOT-TO-DOT, the first and easiest of the KIDSTIME programs, permit children to join dots by moving the cursor from one number to the next (or one letter to the next, depending on the option chosen). Several puzzles are included on the disk and there is the possibility of the teacher creating new puzzles. This program's objective is to learn the numbers and letters in order.

ABKEY is used next to help children learn the names of the alphabet letters. As the child finds the related key on the keyboard, synthesized speech is used to say the letter. Instead of uppercase or lowercase letters alone, the child can choose easy or hard pictures or any combination of these four options. For the pictures, the children must type the first letter of the object's name. The computer will say the first letter of the word or the whole word, depending on options chosen. Different levels of difficulty add to the game's challenge and permit all students to benefit from the game. The learning objectives are to drill the alphabet keys, to recognize the first letter in object names, and to develop keyboarding skills.

A third game is MATCH-IT. In one type of this game, shapes or pictures are randomly placed on the screen. Each shape or picture has a match somewhere else on the screen. The children must drag matching shapes or pictures up to two empty boxes at the top of the screen. An added difficulty is that of having the shapes or pictures hidden and revealed only when the shape or picture is dragged to the top box.

Two other types of MATCH-IT games provided in KIDSTIME are 1) completing a large picture by dragging mixed up pieces into their correct position and 2) finding a card which matches top and side labels in a grid. All three of these games emphasize hand-eye coordination, problem-solving and pattern recognition. These matching programs can be constructed by the teacher as well.

The fourth game in KIDSTIME is actually a word processing program. The children type in a story. The synthesized voice can read each word as it is typed or the whole story as a unit. To make the story more interesting, little pictures can be used instead of words and the voice will read the object. Letters are typed by pressing the keyboard key or clicking the mouse on a screen version of the keyboard.

The instant audio feedback is very satisfying to young authors and this can be a check for correct spelling. However, the computer program that provides the synthesized voice does not

take into account all the exceptions so some words may be mispronounced even if they are spelled correctly.

This program can be used by parents or teachers to provide talking books for children. The adult can enter in the story and the children can listen to the story as they read along. The tempo and pitch of the synthesized voice feedback can be adjusted to suit individual needs.

The final program in KIDSTIME is KIDSNOTES. This program displays a piano keyboard and a musical score on the screen. Children can create songs or listen to prepared songs while watching notes in the score being highlighted as they are played. The computer keyboard can also be used to play, with the bottom row of keys corresponding to the white keys on the piano keyboard and keys in the second row from the bottom corresponding to the black keys. Although early use of this program may include random playing on the keys, children may develop a few basic musical skills. Difficult for most young children to use meaningfully, it does provide an opportunity for musically inclined children to learn by playful discovery.

Seen throughout the five KIDSTIME programs is an indication of the growing trend to give control to the children and especially to the adults who can customize the games to suit individual needs and interest. Another common trend is the growing use of the computer as tool. STORY WRITER especially demonstrates this use. Children create stories and listen to the computer read them back using the Macintosh's synthesized speech program, MacinTalk. The computer is used to enhance their learning and the emphasis is on content, not on the computer program.

A curriculum program which also uses synthesized speech for children's writing is THE WRITING TO READ SYSTEM developed on IBM computers. This system encompasses a multimedia literacy program for young children and has been gaining widespread acceptance in the U.S.A., Mississippi being one state in which every child in kindergarten and first grade will be using it in the next year ("Computers the weapon," 1990). The curriculum program uses computers, tape-recorders, typewriters and written materials to teach the children to read and

write. Computer instruction presents coloured pictures on the screen while the synthesized speech tutors the child to saying the correct phoneme sounds while they type the word.

Strickland, Feeley and Wepner (1987) reports that results were very favorable for kindergarten pupils using this program but that there were no differences between comparison groups at the end of the first grade. On the positive side, some students were highly motivated to write and have brought creative writing to enter into the program for the computer to read to them. On the other hand, the tutorial part of the program stresses words out of context so it does not give the child a sense of the purpose of reading nor is this method consistent with current Language Arts research.

Another literacy program which is used on the IBM computer is the Phonetic Alphabet Literacy System (PALS). This curriculum system contains videodisc materials, teacher manuals, workbooks and wordprocessing materials. Students access the videodiscs through the computer for aural-visual practice. The story is read to them as they see the text on the screen. Students control the computer by touching the monitor screen to indicate their readiness to continue to the next page. It has been used for adult literacy and for ESL students.

Many of the CAI programs discussed, such as READER RABBIT, are of the drill and practice variety, with an emphasis on letters or words. Miller and Burnett (1987) report that only about 10% of software deals with Language Arts at sentence or text level. (See also Rubin, 1983). This is unfortunate since after students build up a sight vocabulary of common words, they can learn new words in context and the emphasis becomes that of reading comprehension, reading for a purpose and reading interesting material (Anderson, Higgins and Wurster,1985; Anderson, Shirey, Wilson and Fielding, 1987; Elley, 1989).

STORY WRITER in KIDSTIME and the reading back feature of students' creative writing in THE WRITING TO READ SYSTEM are examples of programs which use audio feedback for compositions entered by the children. They deal with Language Arts at the text level. They relate oral and written language while they stress student creativity. The emphasis is taken away from

decoding words and is put on comprehension of the words in context. This is an example of the computer being used as a tool. Children learn content through the computer; they are not learning about the computer itself. Also, the programs are not traditional CAI because they are open-ended, dependent upon children's responses. The other games in KIDSTIME, however, and the tutorial feature of THE WRITING TO READ SYSTEM would be closer to traditional CAI in that student responses are checked for being right or wrong.

Another limitation in traditional CAI is that the computer presentation and possible student responses are predetermined by the programmer. This fits in well with the previous view that learning reading consists in learning a distinct set of subskills. However, if computer-assisted learning takes into account the newer view that reading is a problem for the child to solve, children will have to be given greater control and programs will have to allow for student control.

New developments in computer software are changing the locus of control from the computer program to the user. Some of these programs are tool programs. STORY WRITER is an example of this type of program which present the power of the computer to the children for their use. Other programs follow a philosophy of providing an information space for the user to explore. The generic term for this second type of program is 'Hypertext' but other terms, hypermedia and multimedia, have also been coined to describe programs with the similar aspect of user control for a multi-dimensional information space.

This change of focus in educational computing complements the shift in the Language Arts focus. With reading viewed as a process to learn by active engagement on the part of children rather than skills to be developed in a behavioristic manner, it is timely that computer software should also change in focus from child as object to child as subject.

Hypertext and Multimedia

Hypertext, also known as nonlinear text, is a way of creating text on computers with interactive branches or links. The original idea was conceived by Vannebar Bush in 1945 (Bush,

1986; Fraase, 1990) expanded by Doug Engelbart (Engelbart and Hooper, 1986) and named by Ted Nelson in 1967 (Barrett and Paradis, 1988; Conklin, 1987; Nelson, 1974). Windows on the computer screen are associated with material in a database; links are provided between individual sections in the database. Of the power of hypertext, Anderson (1989b, p. 97) suggests that "the real power of the computer is in organizing information much more powerfully than can ever be conveyed in the linear manner of the printed page." Barrett (1988, p. XV) states: "Hypertext and hypermedia environments permit... non-linear documents, creating a mirage of depth in the collapse of space and time within the computer."

One of hypertext's key facets is in the control it gives to the user (Anderson, 1989a; Carr, 1988; Conklin, 1987; Gay, 1986; Jonassen, 1988; Marchionini, 1988; Megarry, 1988; Oren, 1988; Younggren, 1987). Multiple links and pathways are set up for the user to browse. However, these lead to two main problems in the use of hypertext: disorientation and cognitive overload (Barrett, 1988; Carr, 1988; Conklin, 1987; Jonassen, 1988; Marchionini, 1988; Marchionini and Shneiderman, 1988; Oren, 1988; Oren, 1990; Yankelovich, Meyrowitz and Van Dam, 1985; Younggren, 1988). Well-conceived links, navigational tools and maps in well-structured hypertext can help the user to access the knowledge more easily (Apple Computer, 1989; Jonassen, 1988; Keyes, Sykes and Lewis, 1988).

There are educational problems as well: the lack of teacher control of the information accessed by students or the possibility of missing key concepts, possible misconceptions of the relationships between two linked materials, and inefficiency of time allocation by poor students (Carr, 1988; Gay, 1986; Harris and Cody, 1988; Morariu, 1988). These are questions whose study is beyond the scope of this paper but which will be examined in so far as they affect computerized books.

Conklin (1987, p. 18) extends the concept of hypertext to hypermedia, in which the elements in the database can be a mixture of media: "text, graphics, digitized speech, audio

recordings, pictures, animation and film clips". (See also Ambron, 1987; Jonassen, 1988; Yankelovich, Meyrowitz and Van Dam, 1985).

Anderson (1989a, p. 92) draws this distinction between multimedia and interactive multimedia:

> If you use a desktop video system to create a videotape with your Macintosh and then lay down a sound track, you have created a multimedia presentation. But the real potential of the computer is in offering the user alternate paths; interactive multimedia transforms the user from passive observer into active partipant, greatly heightening the impact of a presentation.

The idea of multimedia itself has been around for quite a while in the form of audiovisuals, with slide projectors, filmstrips, movie projectors, VCR's and tape-recorders. However, the computer is now being used to bring together visuals, sounds, graphics and textual information in an integrated manner. The computer controls videodisc players, CD-ROM players, VCR's, and presents a mixture of graphics and text on its own screen. It is this bringing together of the visual, the audio, graphics and textual information in an integrated manner that is called multimedia. The computer takes care of accessing relevant visual or sound media at the proper time.

Hypermedia computer programs that can access videodisc players and/or CD-ROM drives are:

HyperCard, SuperCard and Plus for the Macintosh

Linkway, Plus and others (presently in development) for the IBM

TutorTech and HyperStudio for the Apple IIGS

Although multimedia can be employed in many areas of society, the use of multimedia in the field of education is of particular relevance to us. The above mentioned programs; with their possible incorporation of multimedia, may have quite an impact on education (Ambron, 1990; Hooper, 1990; Jenkins, 1990; Semper, 1990) but so far there are few researchers studying this impact (Hooper, 1987; Keyes, Sykes and Lewis, 1988; McCarthy, 1989; Romeu, 1988; Strickland, Feeley and Wepner, 1987); however there are some early beginnings (Schaffer and Hannafin, 1986). The use of multimedia programs such as HyperCard becomes important to study because

there are many B.C. schools developing applications with HyperCard. (Moran, 1989). (For a listing of 1989 computer projects in B.C. schools, including the eighteen projects using HyperCard, see Appendix E.)

Multimedia Use of Computers in Learning

The teaching of some subjects can be enriched by a multimedia approach. Friedlander, (1986, p. 125) says of theater that it becomes "tame and improvished in the classroom: unidimensional". In order to act against this, Stanford University began in 1984 to develop an animated theatre simulation. The prototype consisted of three parts: a videodisc tutorial that taught the relationship of text interpretation to performance, a visual data base of theatre and art history on videodisc, and THE THEATREGAME: a computer simulation of a Hamlet stage in which students could work with design and stage choices while taping their version of the scene with a tape-recorder for synchronized play-back. With this material, students learn the text of the play, observe professional performances and participate in performances themselves. Students thus study theatre through many approaches, including experience.

Another application of interactive videodiscs in education is Robert G. Fuller's *The Puzzle of the Tacoma Narrows Bridge Collapse* (Fuller, 1985). In this interactive videodisc, students watch the Tacoma Narrows Bridge collapse of 1940 and are invited to solve the mystery with physics principles.

Although there were over 200 videodiscs listed in 1984 (Kearsley and Frost, 1985) the computer's ability to control videodiscs within hypertext programs has added another dimension. Up to this time, videodiscs could be interactive only as permitted by the programmed branching on the videodisc. With hypertext programs controlling the videodisc player, any previously made videodisc can be re-purposed to suit the developer's goals by allowing individual slides or video clips to be accessed.

Some multimedia programs include videodiscs made especially to go with the program. PALENQUE, a program developed by The Center for Children and Technology at New York's Bank Street College of Education, uses a CD-ROM player, an IBM PC AT, and digital video interactive boards (McCarthy, 1989). Palenque itself is the site of a Mayan ruin in the Yucatan. The site was filmed in 16mm film from every different angle and view. The film was then digitized in order to bring the images under the control of the computer. Students can click on objects in the picture. This interaction may allow movement in a direction or call up visual, audile or textual information For example, by clicking on the monkey, the student can obtain information about the types of monkeys that live there, see pictures of a particular type of monkey, and hear how that monkey sounds. Although an excellent example of what is possible, this project is very expensive. It is also not commercially available as it was developed for demonstration. On the other hand, the re-purposing of commercial videodiscs is an inexpensive way to incorporate slides or video footage into a multimedia presentation.

Since videodiscs can store 54,000 slides, 1/2 hour of full-motion video or a combination of these per side in CAV (Constant Angular Velocity) format or one hour of full-motion video per side in CLV (Constant Linear Velocity) format (Ito, 1988; McCarthy, 1989), one videodisc alone, such as the BioSci disc from Videodiscovery, can contain a wealth of slides. Accompanying hypertext programs create visual databases or access video clips for the illustration of a concept.

Similarly, compact discs in audio format can be accessed by hypertext programs. The BEETHOVEN HyperCard Stacks developed in 1989 by Voyager for the Macintosh is an excellent example of a multimedia approach to learning (Onosko, 1990). One of the stacks reviews the principles of listening to music while another portrays Beethoven's life and time through graphics and text. Both allow the user to listen to Beethoven's Ninth Symphony while reading. Another stack shows a detailed analysis of the symphony, encouraging the user to listen to a part of the symphony as it is described or to an audio clip illustrating a concept about symphonies.

With any of these programs, the aim is always to engage the user in active learning. The presentation of information, no matter how interesting, must eventually pall. Creative development of hypertext applications seeks to incorporate some interaction on the part of the user beyond clicking, browsing and reading.

An excellent example of the incorporation of further interaction, THE MYSTERY FOSSIL from the University of New York presents an anthropological problem to the learners who may browse through graphical and textual information about human anthropology, measure the picture of the mystery fossil and compare it to other pictures until they guess which fossil they have. Interactivity consists in answering questions, typing a report and working with graphs to place the date of the fossil -- all of which are printed directing from the stack as their assignment.

Besides using multimedia applications created by others, students themselves can use multimedia programs to communicate ideas in this new medium (Hooper, 1987; Nix, 1988). This opens up a new way of organizing and presenting information for students. Students create their own applications: select information, analyse relationships and structure their knowledge through links, search for illustrations and graphical representations of concepts and choose video or audio clips to enhance and supplement their presentations.

This new medium can be used resourcefully to draw out creativity in its users. Durlak (1989, p. 35) says "the creation of multimedia presentations is therefore, at its heart a pedagogical endeavor and a human design endeavor, an endeavor in enhancing general human expression and comprehension". (See also McCarthy, 1989).

Amplifying on the ways computers (and computer use in multimedia) can be used to aid learning, Kozma (1987, p. 23) lists:

- supplementing limited working memory by making large amounts of information immediately available for the learner's use;
- making relevant, previously learned information available simultaneously with the acquisition of new information;
- enabling learners to quickly retrieve previously learned information that is needed to help them in learning specific new information;

- prompting the learner to structure, integrate, and interconnect new ideas with previous ones;
- providing for self-testing and practice, thus increasing the retrievability of information;
- enabling the learner to represent ideas both verbally and pictorially; and
- providing for the easy movement, consolidation, and restructuring of information needed by students as their knowledge base grows.

Multimedia can become a tool in the hands of the students to initiate and further the learning in areas of interest to them.

Some reservations educators may have about the future of multimedia are: the cost of the equipment and teachers' readiness to adopt these methods themselves or to encourage students to use them in their studies. Either one of these reservations may slow the adoption of multimedia as a method of learning.

Jachymn, Allington and Broikou (1989) estimate that although a lot of time is spent on workbooks and worksheets, they do not seem to be particularly effective for developing reading abilities in children. Yet schools spend approximately $30 to $100 a year per second-grade student on this method. Since computers are already being bought, using them for multimedia would entail only the additional expense of laserdisc players, CD-ROM drives and discs which can be purchased by lessening the expenditures on workbooks and worksheets.

Concerning teacher attitudes, Fuller (1985, p. 37) says: "It is clear to all of us in education that students are coming to us with more interest and expertise in interactive learning, especially through the use of arcade games and microcomputers, than we faculty members possess." Students given time, encouragement and peer coaching can master hypertext programs quickly. Teachers must trust students in this area in which they have less expertise and comfort.

CD-ROM and Hypertext

The CD-ROM technology previously mentioned enhances and requires hypertext. It requires hypertext in order to put the tremendous amount of data at the control of the user and it enhances it by providing storage space for audio or visual data for computer-mediated multimedia.

Compact discs (CD) were first announced in 1982 (Megarry, 1988). (See Appendix F). In 1985, Philips/Sony developed CD-ROM discs in which the sound is replaced by data. CD-ROM discs are extremely durable, made of a thin sheet and heat sensitive and reflective metal encased in plastic. The disc is capable of storing 60 or 70 minutes of speech -- about 600 megabytes of storage (Megarry, 1988; Phillipo, 1989). A disc, therefore, can store a book read by a professional reader, along with the pronunciation of single words and much more. The technology is now advanced enough to permit computerized books with natural speech.

A new CD-ROM format, CD-ROM XA, announced in 1988 (see Appendix F) will hold 16 hours of audio. This massive storage capability will permit compact discs to store long stories.

Summary

The focus in education on children, their needs and their choices, the shift in Language Arts in perceiving reading as a problem for children to solve, the direction in computer programs to provide user control in an information-rich environment, the research on the value of hearing good reading while following the written word and the current level of technology all come together at this time to support the viability of using Discis Books for learning and for practicing reading. It thus becomes imperative to observe a wide range of children using them in natural surroundings to ensure that the books' use is beneficial to early readers.

Chapter 3
Materials, Methodology and Procedure

Introduction

Because this study is a critique of the Discis Books at the same time as it is an observation of how young students use them, it becomes essential to examine the Discis Books and their features.

Discis Books

The Discis Books consist of two parts: a CD-ROM disc which contains a particular story and a Macintosh program which accesses any of the Discis CD-ROM discs. (For information about CD-ROM discs, see Appendix F).

Since the Discis CD-ROM discs use the ISO 9660 format, they can be read by CD-ROM players which can be connected to either a Macintosh or an MS-DOS computer. Although the accompanying program at this time limits Discis Books to the Macintosh environment, the common CD-ROM disc format allows for the future possibility of creating an MS-DOS computer program to access the same disc.

Discis Books can be run on any Macintosh without difficulty although the display size and color will vary with the system. On a Macintosh Plus or SE, the Discis Book is displayed in monochrome; shown on a Macintosh II screen, it uses the full size and colour capabilities of that screen.

The first Discis Book to be pressed (1989) was that of "The Tale of Peter Rabbit" by Beatrix Potter. This prototype was originally used by John Lowry, the chairman of Discis Knowledge Research Inc., as a demonstration disc and it was the disc used in this study. Being a

developmental model, it did not have the colour capabilities of future releases as well as other improvements made as a result of this field test and that of others.

Philosophy and Pedagogy of Discis Books

The Discis Knowledge Research Inc. have three policy statements concerning their vision of the purpose and use of the Discis Books. They believe that the work that they are doing is to offer one expression of professional pronunciation and of definitions which can improve children's understanding of literary works. It is not their intention to provide a definitive pronunciation or meaning of an author's words. They believe that their books are to complement the reading of other books, that the use of their books will stimulate children to explore other books. The Discis Book is not meant to take the place of hand-held books. Finally they believe that sitting at a computer to read cannot replace sitting on a parent's lap while parent and child read together. The Discis Book may help provide an alternative for children lacking in that experience.

Books can be approached with differing goals. One person may want to enjoy a story while another may want to use it to learn to read. Teachers ask children to take a book, realizing that the practice of reading will help them learn to read. Children may take the same book because they wish to read an entertaining story. They realize that a whole new world opens up to them in interesting books. Discis Books can be used for either goal, reading for interest or reading as practice. A captivating story may be appealing to children who can already read well and they may read it as a Discis Book. The interest factor in this case is the story and its presentation. The same story may appeal to children who have difficulty reading; for them the interest factor is still important but the fact that it is in a Discis Book format permits them to listen or read independently, asking for help for difficult or unknown words. In both cases, music and interactive illustrations add elements not found in ordinary books.

In discussing the results of this study the emphasis is often on using Discis Books for learning. This bias must not obliterate the fact that the Discis Book can be interesting for children who do not need its help for learning to read.

Following a discovery approach, the Discis Books give children the responsibility of determining how the computer is to be used. The books provide audio information in a non-obtrusive way and it is only through interaction that this information can be accessed. The children are the actors. They choose to listen to full sentences, to individual words or to definitions and explanations; they determine when to turn the page; they click on pictures for object names. The books are there for the children.

This emphasis on the children's responsibility to choose assumes that children are capable of recognizing their needs and can be self-motivated to interact in a meaningful way with an information source to fulfill those needs. Curiosity and an attraction to the novelty of using a computer to access music and speech will create an initial interest but for this interest to be sustained, the children must be self-motivated.

In order to be self-motivated, there must be a goal on the part of the children, whether recognized by them or not. The children may desire to learn to read and perceive the Discis Books as a means to achieve this goal. They may be interested in reading a particular story, especially if the teacher has read all or part of it in the classroom. Children may perceive the relevance and ease of this manner of learning. They may also see results. They may see that the Discis Books can open them up to a wealth of interesting stories previously unattainable because of their limited reading vocabulary. Students embarrassed by their lack of reading skills may perceive the individual use of Discis Books as a discreet way of requesting information and this aspect of privacy may become a motivational factor as well. This privacy may also have the effect of allowing them to play and explore book features.

Although extremely important in the utilization and reception of the Discis Books, the motivation of the children who use the books and their subsequent goals are beyond the scope of this study. This initial investigation aims at breadth in behavioural observation of children using the books rather than depth in a motivational or goal-oriented study.

The Discis Books do not only give control to the children but they also give control to parents and teachers who will be overseeing the children's use of these materials. Adults (and even experimenting children) can customize the books to suit individual desires and needs. These features, described in a later section, allow for individualization and demonstrate a non-autocratic and non-deterministic view of computer programming. The adult determines the children's needs in a specific locale and time and customizes the features to maximize the relevance of the children's choices.

Readability and Reading Speed in "The Tale of Peter Rabbit"

To determine the readability of "The Tale of Peter Rabbit," three sections were entered into the Readability program found on the MECC School Utilities Vol. 2 disk. The sections, taken from various parts of the story, had 147, 188 and 211 words respectively. The statistics given by the Readability program can be found in Table 1.

According to the different measurements, the readability measurement of "The Tale of Peter Rabbit" can be considered to be from a grade 4 to a grade 7 reading level. It would seem that "The Tale of Peter Rabbit" is not a book that can be read by primary students without assistance although the interest value of a story is a more important factor than its readability. "The Tale of Peter Rabbit" is a book that has been used for reading aloud to small children. It may have special appeal to children because of its being a visual and active story. However, its vocabulary consists of many words visually unrecognizable by children. Because the story, appealing to the young, contains difficult words, it becomes an excellent choice for a computer-assisted

independent reading book for primary students. They can enjoy the story, listen to the music, sound effects and the reading, recognize many of the simpler words and obtain help for words they do not recognize or understand.

Insert Table 1 here

The speed at which the speaker reads a sentence can also be too fast for many young primary readers who wish to follow along with the words while the sentence is being read. Several sentences were timed to count the number of words being read per minute. According to McMahon (1983), as previously mentioned, primary children can read comfortably at about 39 words per minute in grade 1 and 96 words per minute in grade three; table 2 shows the number of words per minute for selected sentences.

Insert Table 2 here

All sentences of 25 or more words are included as short sentences do not present the same difficulty to students who are trying to follow along. Sentence pace was measured with a stop watch to the nearest quarter-second. The average pace of these nine sentences is 153 words per minute. This would make "The Tale of Peter Rabbit" a talking book rather than a taped book, according to Gamby's distinction.

Most children cannot follow along with the words at this average reading pace of 153 wpm. In order to alleviate this difficulty, there is an option built into the sentence speakers of the Discis Book (see Figure G-14 in Appendix G) to allow parents or teachers to customize the length of 0 to 4 seconds for phrase pauses. This would change the category of the Discis Book from talking book to taped book.

Table 1 - Readability Measurements of selected passages of "The Tale of Peter Rabbit"

Description	Passage 1	Passage 2	Passage 3	Totals
Number of sentences	9.0	9.0	12.0	30.0
Number of words	147.0	188.0	211.0	546.0
Number of syllables	196.0	248.0	268.0	712.0
words with 6+ letters	35.0	40.0	35.0	110.0
words with 3+ syllables	6.0	10.0	8.0	24.0
% of words with 3+ syllables	4.1	5.3	3.8	4.4
Average sentence length	16.3	20.9	17.6	18.2
Average letters per word	4.3	4.3	3.9	4.1
Average syllables per word	1.3	1.3	1.3	1.3
Spache grade level	3.8	n/a (4+)	3.7	4.0
Dale-Chall grade level	5 - 6	5 - 6	5 - 6	5 - 6
Fry grade level	7.0	7.0	7.0	7.0
Raygor grade level	7.0	7.0	6.0	7.0
Flesch grade level	7.0	8.0	7.0	7.0
Gunning-Fog grade level	8.2	10.5	8.5	9.0

Table 2 - Reading pace of longer sentences (25+ words) in "The Tale of Peter Rabbit"

Sentence	Seconds	Words	Words/min
3	16.00	41	153
13	10.50	28	160
16	13.25	41	186
18	14.50	32	132
19	10.75	29	162
29	11.00	25	136
32	8.25	25	182
39	14.25	28	118
46	10.00	25	150

In the demonstration disc, the phrase pause option was enabled only for page 2 but in the release versions this option will be enabled for every page. On the other hand, children have several options to minimize the reading rate difficulty if the phrasing pause has not been activated. They can click on the sentence speaker a second time or they can finish reading the sentence silently at their own pace. The book will wait for their next interaction. They can click on individual words to check words they heard but did not see while the reader was speaking. The fact that the children can control the interaction makes the unconfigured sentence reading speed less of a problem than it could otherwise be.

Features in Discis Books

When children begin a session with a Discis Book, the title page is displayed on the screen. (See Appendix G, figure G-1). The name of the book and a picture of Peter Rabbit in a book format attract children's attention and provide instant access to the book.

Children may click on a picture, a sentence symbol (amplifier), a word or the page turn in one of three ways to receive information. These alternative ways of clicking (click, double-click, press-and-hold) can have different effects depending on the way the book has been customized. The Discis Knowledge Research Inc. have set up a certain default configuration but parents, teachers and/or knowledgeable children can customize these features as desired. (See Appendix G for sample screens for configuring options).

For clicking on pictures, options are: show words, pronunciation, syllables, definitions, Japanese and Spanish. The inclusion of Japanese and Spanish on the demonstration disc was made in order to demonstrate the language learning potential of this product. The Discis Knowledge Research Inc. default for clicking on pictures is "show words and pronunciation." This default configuration was used without change in this study.

When students click on pictures, the object on which they click is named both visually and aurally. This joining of the picture labels to the sound reinforces the same words found in the text. The illustrations in the Discis Books are not mere appendages but add to the educational value of the whole.

For clicking on sentence speakers, the only option given is to say the sentence.

For clicking on words, options are: pronunciation, syllables, definitions, Japanese, Spanish and add the word to the recall list. The Discis Knowledge Research Inc. defaults are: for click and press-and-hold,"pronunciation and add the word to the recall list" while double-click has "pronunciation, syllables and add the word to the recall list." These defaults were used for the study as well, as it was noticed that some young children had difficulty differentiating 'click' and 'press-and-hold' so that when definitions were joined to the 'press-and-hold' mouse action in the pilot study, one student got definitions on most of her 'clicks'. The "add the word to the recall list" is an option which allows children to quickly review any difficult word previously questioned.

For clicking on the page corners, the options are: show page turns, music & effects, pictures, and read the next page. The Discis Knowledge Research In. defaults are: on the click and double-click "show page turns, music & effects, pictures" and the press-and-hold adds "read next page." Because of student difficulty with differentiating mouse actions and the desire to observe the children's reactions with a similar configuration, it was decided to use only click defaults for all mouse actions in first-time use.

Additional features of the Discis Books are the options to set font type, style and size, to set the volume control and to go quickly to another section of the book by dragging a slider along the side of the book with the mouse. The default font is New York, size 18 and plain style. Changing the font size will change the number of pages. (See Figures G-17 and G-18 in Appendix G). The default font was used for grades K to two but the size was changed from 18 to

14 for grade three students so that they would not need to use as many page turns and it was felt that that size would be more suitable.

Another feature of the Discis Book which can be set is the ability to finish reading the book automatically from any point. This would be especially useful for children who would like to have the book read to them but have difficulty turning the pages. However, it may introduce problems in children's giving meaningful attention to an automatically read book, as was seen with taped books.

As the Discis Books keep the same illustration with a certain section of text, the Discis Knowledge Research Inc. uses numbered paragraphs rather than numbered pages. As the slider on the right side of the book is moved, paragraph numbers appear beside the slider to indicate the new position in the book. In this study, pages were numbered according to the illustrations for record keeping in the observation tool. (See Appendix H for the numbered pages of the complete story).

Discis Books and CAI

None of the computer programs discussed in Chapter 2 have the scope and the number of features of the Discis Books. Many of the microcomputer programs, those found in the MECC software for example, have different objectives and methods. They aim at reviewing or drilling a concept and so must keep track of student responses and give suitable reinforcement. Most of them are at the letter or word level. Customization is generally minimal, however some programs, MISSING LINKS and STORY WRITER in KIDSTIME for example, allow teachers to edit word lists or enter stories.

In previous research, Olson, Foltz and Wise (1986), although recognizing that speech feedback is a primary factor for improving word recognition, used synthesized speech because of computer storage limitations. This is the case in most CAI programs in which there is audio

feedback. STORY WRITER is an excellent program which uses synthesized speech. This is useful because it allows the computer to read stories created by the students. However, there are many instances when these words are mispronounced because the program cannot allow for all exceptions.

On the other hand, Discis Books, with its CD-ROM disc, can present digitized natural speech. This means that children can hear well-modeled speech and hear the intonation used when words are read in meaningful phrases. Since the sentences are in a story-context, they can be read with heightened dramatic impact.

The PERC *Talking Page,* very similar in concept to the Discis Books, required a mainframe computer with an expensive touch-screen. The speech production device used was only minimally reliable. Discis Books makes use of newer technology with its use of a mouse to replace a touch-sensitive screen and a CD-ROM drive. The books, besides having the same ability to read sentences or individual words aloud to children that the *Talking Page* had, add: syllabication, definitions and explanations of individual words or phrases, foreign language translations for individual words or phrases, music and sound effects on page turns, animation of page turns, and two levels of embedded information in the pictures. One advantage of both the PERC project and STORY WRITER which is lacking in Discis Books is the provision of a method to insert stories dictated to the teacher by the children. CD-ROM discs, once made, cannot be altered.

Discis Books and Talking Books

Talking books provide an inexpensive way of presenting a story in audio format. Children can listen to a cassette tape while they follow along in the written version. Two difficulties that can crop up with talking books are the possible inattention of children during their listening to the tape and a reading pace which is too fast for the children. Discis Books minimizes

these two difficulties by requiring children to click on each sentence that they wish to hear. This engages their attention while allowing them to repeat sentences read faster than their reading speed. This control also encourages them to focus their attention on the story as no more than one sentence is read at a time and they must click on the next sentence. The control also encourages repeating a word or sentence as often as is needed as well as going back to a previous page to check a forgotten fact.

Discis Books have a greater depth and control of information than do talking books. Not only is the story read but individual words can be checked, thus reinforcing the match between a word and its sound in the children's minds. As well, there are the other features mentioned above: definitions, syllabication, foreign language translations, music, and information embedded in illustrations. The computer is being used to provide this greater depth and control, a task for which it is well suited.

Research Design

The study is composed of two parts: case studies of students interacting with the computer and interviews of adults involved with reading education after they experience the computer materials.

In this study, children from kindergarten to grade three were observed in order to provide observations over a full range of literacy levels. Grade three was chosen as the cut-off point because during grade four, children generally change to a more fluent stage of reading in which they are reading for content rather than for developing reading skills. Three boys and three girls were used from each grade level in order to allow for individual differences and to provide some basis for extrapolating the initial impact of these materials. Two schools, one rural and one urban, were used in order to minimize the effects of locale and environment on children's reading skills.

Two schools were approached in October 1989 for permission to observe students and teachers using the Discis Books after they had seen or heard about the study. Once the schools returned their acceptance, the investigator sent information and consent sheets to the schools, along with a list of students chosen to participate. This list was determined by having the computer generate random numbers using the numbers of boys and girls in each of the classes involved. Although only three boys and three girls would be chosen out of each class, five random numbers were generated in order to allow for parental refusals or child absenteeism.

Case Studies of Students

Because of research and development delays, observations could not begin until February 1990. Once the final version of the Macintosh program was received, the researcher spent several days in each school. Children came individually for their session with the Discis Books.

They were shown how to interact with the Discis Books and some of the choices available to them. They were taught how to use the mouse and given practice on the title page in listening to a sentence, in clicking on a word to hear the pronunciation, in clicking on a picture to see and hear the picture's name, in turning the page. This order of introducing the options was kept constant for all students. They were not shown other choices such as reviewing words in the recall list so as to lessen the number of items to remember.

Once children understood the program and had practiced making these choices, they were left alone with the computer while the researcher worked at a table about six feet away to the side and slightly behind them. This distancing was done in order to minimize the effect of having an adult stranger present while the child explored and experienced the book.

An observation tool, refined through use in a pilot study, was used by the researcher as students worked through the computerized book. (See Appendix D). This tool was employed to note student attending behaviours, student comments, the book features they used and the length

of time during which they appeared to be captivated by the new experience. Of particular interest were: 1) the effects of music and illustrations on the children as shown by their comments or behaviour, 2) their clicking pattern, and 3) the length of time they worked with the book.

Students used the computerized book as long as they liked. After they stopped, they were asked to bring up their chair to the desk for a closing interview. (See Appendix C for the interview questions). These questions focused primarily on the children's affective response to reading and to the use of Discis Books. The questions were deliberately designed to be open-ended so that the books could be assessed from the child's point of view and non-conventional responses could be collected as well as the more expected ones.

Children came to these observation sessions with differing reading abilities and attitudes, so the questions as well were meant to provide background information on those factors which would influence their observed behaviours. The same questions were asked of all children interviewed so that responses within grades could be compared.

Extra Student Observations

Because observations of only first-time use would be severely skewed by the novelty and unfamiliarity factors, accommodations for additional observations were put into the research design. These entail repeated use, either on need or volunteer basis.

Two students from each grade level from the Vancouver school were given the opportunity for repeated use. These students were chosen by the teachers in order to observe the effect of the Discis Books on students who experience reading difficulties. It was felt that the additional practice in reading would be of benefit to the students at the same time as giving the researcher additional observations. As well, these students were chosen because hardware and time constraints will likely orient school use of Discis Books to those students who need more reading practice.

These observations become very important in the context of this study as it is the students repeating their experience who can give a truer indication of the interest factor of the Discis Books. The repeated use of the Discis Books also increases their comfort level with this technology; children can concentrate on content rather than on method of presentation. As a result their actions can be assumed to be more self-determined than accidental.

"The Tale of Peter Rabbit" was used again as it was the prototype and the only one available. To give the children greater control during their second session over the book's presentation, the children were shown how to get definitions (press-and-hold). The option for turning the page silently had been planned but students had so much difficulty turning the page that this option was dropped for this short term use. It could be used with students more experienced with the mouse.

These observations of repeated use aimed at determining the increase or decrease in interest in computerized books, the purposeful interactions with the same book, and the relative frequency of use of the different features as students became more accustomed to this reading medium.

Observations of Discis Book use in leisure time (noon hour) were also made in order to determine the quantity and quality of independent use and the appeal of the Discis Books outside of the researcher-determined experience. The grade level of the returning students, the time they devoted to the book and their pattern of interactions in the self-initiated experience were noted. There were no restrictions or expectations placed on the children's use of the books for leisure time use nor were there interviews conducted after this use. This was done in order to create a freer atmosphere for self-motivated discovery.

Because the observations were made on the basis of one-time use by randomly chosen students or on repeated use by students with special needs, these observations are important in assessing the ability of the books to captivate interest at all early reading levels. The interactivity

with the Discis Books during the leisure time use could be assumed to be more self-motivated than possibly accidental interactivity of unfamiliar users.

Data Collection

Student data came from two sources: the observed behaviour of the children during their interaction with the computer and the answers to the interview questions. The answers would indicate their affective response and attitudes to reading and the use of the Discis Books while the children's behaviour would be an outward manifestation of the same interior realities. The behavioural data increases the validity of the children's expressed views about the Discis Books as it gives an objective measure. Their responses during the interview portion of the case study could be influenced by several factors, such as a desire to please an adult stranger, discomfort in being alone with a stranger and fear or shyness before that stranger.

Adult Interviews

Although it is the children's interaction with and learning through using the Discis Books that is the primary focus of this study, it was felt that adults engaged in Language Arts or parents of the children learning to read could provide valuable insights in how books in this medium can be utilized effectively. Their observed reactions while they used the Discis Books could also give the company valuable information in designing future books.

Two members of the Education Faculty, primary teachers, school librarians, and parents of kindergarten to grade three students were approached by the researcher to participate in this study. The faculty members and the school librarian of each school were included in the study because of their knowledge and experience of children's literary interests.

Each adult received the same instruction in using the Discis Books as the children had, but he/she also received instruction in configuring the book before he/she started. The adult was told

he/she could quit the book at any time but that the researcher would be very interested in his/her oral comments while the book was being examined. These comments were then noted.

After the adults had experienced as much of the book as they wished, they were invited to answer interview questions (See Appendix C). As with the children's interview questions, these questions were left open-ended in order to permit novel and unexpected responses. The questions about how the books can be used in the classroom and how teachers can incorporate it in their teaching were asked in order to provide recommendations to teachers for potential uses in a classroom setting.

Limitations of the Study

Although Discis Books can provide a great variety of features, these choices were not all presented to the children because it was felt that too many features might have confused them when they were unfamiliar with the book. The Discis Books provide three ways of clicking the mouse on any object. However, it was decided to keep the instructions very simple on the first exposure to the book by configuring all mouse choices to have the same result. This would allow a focus on the length of time that the book sustained their interest, the purposefulness of their clicking patterns, and the effect of music and illustrations. Of course, different instructions in introducing the book and the use of alternate configurations would give different results.

Children from only two schools were used. Since both schools are very interested in computer technology, conclusions drawn from this study may not apply to other schools without that interest.

Chapter 4

Observations and Discussion of Results

Observation Conditions

School A, a rural school, set up the computer in the library for the study. Students came to the library for their work on the computer and the interview questions. The computer was set up near a corner wall with the student facing the center of the library so that the screen could not be seen by other students.

The researcher stayed in this school for three full days, Tuesday, February 13 to Thursday, February 15. The fourth day's observations were cancelled because a heavy snow fall made the presence of the three remaining students doubtful.

Because of the computer's placement in the library, the computer was visible and easily accessible by students in their free time. The researcher remained during the noon hours to observe leisure use of the Discis Book. Even though the Wednesday noon hour was filled with Valentine's Day parties, students came to use the computer for part of the noon hour.

The snow fall of the third day prevented many students from attending the school so observations of special-needs students were arranged during this day and their parents' permissions were obtained.

School B, the urban school, set up the computer in the computer lab during the first week and the new library during the second week. These rooms were kept locked during noon hours. Students came to the room for the study and their interview. The library had library aides working on shelving the books during the observation. Large panels were placed behind and to the side of the computer to provide some privacy.

The researcher went Tuesday and Wednesday (February 20-21) during the first week and for four mornings (Monday, Feb. 26 - Thursday, Mar. 1) of the second week. During the second

week, the students who had been chosen by their teachers for extra practice were observed over a period of three consecutive days for repeated experiences of the Discis Book.

As can be seen from tables 3 and 4, there are occasionally more girls than boys chosen from a class even though the schools had been asked to select three boys and girls from each class. In one case, the boy who had been chosen was absent and a girl whose parents had given their permission was substituted. Since extra observations would be conducted in school B, it was felt that the lack of an even match between genders would not be problematic.

One Time Use by Randomly Chosen Students

As students worked through the Discis Book, the researcher noted their pattern of interaction with the book, the time they spent on each page, on what they clicked for each page, and their behaviour. If they seemed to lose interest, they were asked if they wished to stop. However, if they desired to continue they were allowed to do so. When they finished the book or decided to stop, they answered the interview questions and were thanked for their participation.

To preserve student anonymity, observations were coded with pseudonyms. School A student names start with A to D, School B student names begin with letters E to J. The names of the students using the Discis Book for several sessions begin with the letter P.

Table 3 is a compilation of student total time in minutes, the last page they worked on, their relative percentage of time using Discis features (sentences - S, words - W or pictures - P), special strengths in them or in their attentiveness to the book, problems they had with the mouse or with their reading, and visible learning experiences with using the book or with their reading.

Insert Table 3 here

Table 3 - Randomly Chosen Students

Name	Grade	Gender	Total time	End page	Features - % S	W	P	Strength	Weakness	Improved
Adam	K	M	2	2	20	40	40		rev. order	
Alex	K	M	11	6		100			mouse	word order
Angela	K	F	10	7	35	30	35		mouse	word order
Alice	K	F	28	19	75	25		music	mouse	
Earl	K	M	35	11	35	45	20	music	rev. order	finds word
Eric	K	M	6	2			100			
Ernest	K	M	6	9	80		20	pic/word		
Eve	K	F	14	4	10	40	50	pictures	skip 2 pgs.	
Erin	K	F	25	15		90	10			guess wds.
Ethel	K	F	47	27	70	20	10	music		guess wds.
Bob	1	M	9	21	60	40			skip 13 pgs.	
Brian	1	M	18	25	60	40			skip 3 pgs.	
Barry	1	M	40	27	50	40	10	tracking		page turns
Betty	1	F	33	27	80	20		tracking		page turns
Barb	1	F	29	20	80	20		music	skip 2 pgs.	
Bev	1	F	43	27	65	10	25	music	skip 2 pgs.	
Fred	1	M	22	14	10	80	10	music	rev. order	
Frank	1	M	38	1	20	40	40			saying wds.
Floyd	1	M	53	27	30	40	30	oral pract.		vocabulary
Fran	1	F	20	27	90		10	tracking		
Faye	1	F	45	20		90	10			mouth wds.
Flora	1	F	30	27	40	10	50	tracking	skip 5 pgs.	mouth wds.

Name	Level	Gender	Total Time	End Page	Features - % S	W	P	Strength	Weakness	Improved
Carl	2	M	44	27	30	60	10	tracking		
Cindy	2	F	25	27	75	10	15	music		
Charlotte	2	F	10	27	90	5	5		skip 5 pgs.	
Candy	2	F	7	27		5		silent rdg.		
Christine	2	F	20	27	80	10	10	music		page turns
Gary	2	M	25	22	10	50	40		mouse	word order
Greg	2	M	12	21	80	20		tracking		
Gina	2	F	21	27	80	20		tracking		
Grace	2	F	28	21	85	10	5		mouse	page turns
Gertrude	2	F	16	27	85	10	5	tracking	mouse	page turns
Gretel	2	F	26	27	5	30	15	silent rdg.	mouse	
David	3	M	14	27	100					page turns
Don	3	M	18	27	80		20			page turns
Dennis	3	M	14	27	85	5	10	tracking	skip 1 pg.	page turns
Donna	3	F	9	27				silent rdg.		
Dawn	3	F	19	27	65	15	20	music		page turns
John	3	M	14	27		10	10	silent rdg.		
Jim	3	M	20	27	40		60	involved		page turns
Jean	3	F	20	27	50	10	40	tracking		page turns
Jill	3	F	13	27				silent rdg.		
Joan	3	F	35	27	50	10	40			diffic. wds.

Table 4 - Answers to Interview Questions for Randomly Chosen Students

Student	Grade	Listening	Reading	Pref.	Reason	Another?
Adam	K	Y - pictures, excit.		Both	neat	N
Alex	K	Y - pictures		Discis	sound	Y
Angela	K	Y - new words		Book	new words	Y
Alice	K	Y - fun		Both	like to listen	Y
Earl	K	Y - fun, pictures		Both	reading, mouse	Y
Eric	K	Y - liked story		Discis	like computer	Y
Ernest	K	Y - fun, nice		Book	easier, know wds.	N
Eve	K	Y		Discis	pictures	Y
Erin	K	Y - pictures		Discis	says wds.	Y
Ethel	K	Y - pleasure		Discis	alone	Y
Bob	1	Y - interesting	Y - fun	Discis	story, pictures	Y
Brian	1	Y - learn, relax	Y - need	Book	need to learn	Y
Barry	1	Y - neat	Y - fun	Discis	listen, pictures	Y
Betty	1	Y	Y	Book	put finger on wds.	Y
Barb	1	Y	Y	Book		Y
Bev	1	Y - nice		Discis	music, reads	Y
Fred	1	Y - interesting	N - repeating	Discis		Y
Frank	1	Y - rabbits	Y - fun	Discis	lots of words	Y
Floyd	1	Y - interesting	Y - interesting	Discis	reads for you	Y
Fran	1	Y - learn, inter.	Y - fun	Discis	move stuff around	Y
Faye	1	Y - fun, excit.	Y - good	Discis	turns pages, fun	Y
Flora	1	Y	Y	Discis		Y

Student	Grade	Listening	Reading	Pref.	Reason	Another?
Carl	2	Y - activity	N - too hard	Discis	reads, words read	Y
Cindy	2	Y - nice	N - lack practice	Discis	listen	Y
Charlotte	2	Y - fun, advent.	Y - neat stories	Book	turn pages, skipped	Y
Candy	2	Y	Y - pictures	Book	screen hurts eyes	Y
Christine	2	Y - fun, neat	Y - fun, predict	Discis	music, pictures	Y
Gary	2	Y	Y - learn	Discis	pictures	Y
Greg	2	Y - adventures	N - boring	Discis	reads	Y
Gina	2	Y - pictures	Y - funny	Discis	clicking	Y
Grace	2	Y	Y - fun	Discis	sentences read	Y
Gertrude	2	Y - nice	N	Discis	more fun	Y
Gretel	2	Y	Y - learn	Discis	don't have to hold	Y
David	3	if good ones	Y - can predict	Book	turn pages, read	Y
Don	3	Y - fun	depends on bk.	Both	music, reading	Y
Dennis	3	Y	Y - learn	Discis	reading	Y
Donna	3	Y - music	Y - neat, mystery	Discis	music, page turned	Y
Dawn	3	Y - interesting	Y - fun	Book	longer, read over time	Y
John	3	Y - fun, exciting	Y - learn	Discis	music, wds. read	Y
Jim	3	Y - activity, fun	Y - fun	Discis	pictures, wds. read	Y
Jean	3	Y - ideas	Y	Discis	pictures	Y
Jill	3	Y - surprises	Y - fun	Both	clicking	Y
Joan	3	Y - pics.,chars.	Y - excit.,learn	Discis	reads	Y
Dan (esl)	4	Y - listen	Y - most bks.	Discis	didn't have to read	Y

Table 4 is a compilation of their answers to the interview questions. Full answers as well as a short descriptive summary of each child's interaction with the Discis Book can be found in Appendix I.

Insert Table 4 here

Discussion of Results of Randomly Chosen Students

Learning seemed to be occurring on the part of most children who stayed with the Discis Book. Even a kindergarten child who clicked only on the picture (Eric) might learn that text and sound were related because of the picture labels that appeared. Ernest clicked on a picture and then found the same word in the text. Earl began to recognize a particular word in the text. Erin and Ethel began to guess at words that they had met previously in the story.

Grade one students sometimes used the book to practise their reading. Alex and Erin clicked mostly on words, saying some before clicking. Faye and Flora mouthed the words of the text as they followed the reader. Frank said words both from the text and from the picture. Floyd used the book to practice oral reading, clicking on unknown words. The number of words he needed to check decreased during his session as he became a bit more fluent.

Eleven students from grades one to three learned to turn the page with the reader. This learning is in getting used to the program or learning the 'rules' of this environment.

Joan (grade 3) clicked on difficult words. For her, using the book would improve her vocabulary.

The difficulties that the 43 children had with the Discis Book can be divided into two parts: problems with book use and reading difficulties. There were seven children who had difficulty moving the mouse and another eight who skipped pages because of clicking too many times on

the page corner. This does not include the students who skipped pages and returned. The problem is that continuing pages (those with the same illustration) turn quickly while new pages do not. Children seem to think the computer has not accepted their click and so click again. A possible improvement in the program would be to show them that they simply need to wait for the CD-ROM disc to be accessed by highlighting the page corner when it is clicked. Otherwise, both these problems can disappear with practice and improved motor skills or hand-eye coordination. Some students began to wait after clicking on a page corner. Another student, Grace, held down the mouse on a page corner until the page turned.

Children also had difficulty in their reading skills. Two kindergarten children (Adam and Earl) and one grade one child (Fred) clicked on words in reverse order and did not improve during their session while two other kindergarten children (Alex and Angela) did improve.

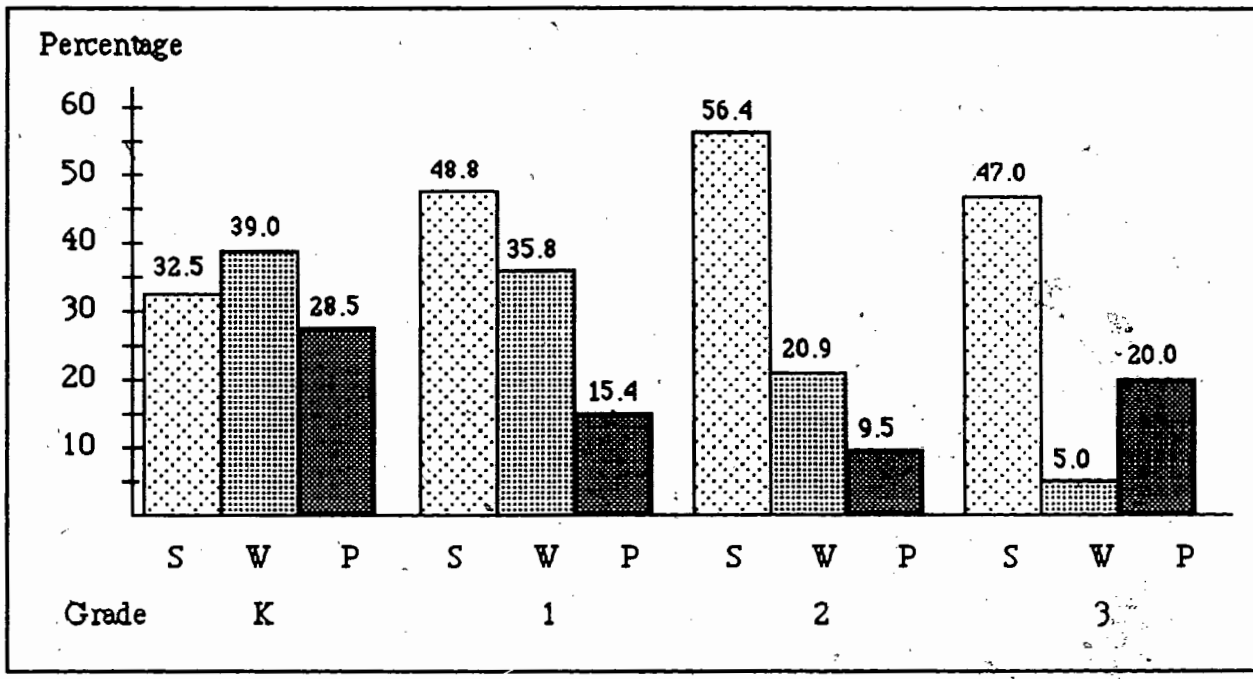
The two main points that the research focused on were the length of time that the children were interested in the book and the pattern of their interactions. Because most children stopped working with the book when they reached its end, Table 5 shows the mean number of pages read by students of that grade and the number of children who finished the book.

Table 5 - Time and Pages Read of the Discis Book by Randomly Chosen Children

Grade	Number	Mean time (min.)	Mean number of pages	Number finishing
K	10	18.4	10.8	1
1	12	31.7	11.5	6
2	11	21.3	25.5	8
3	10	17.6	27.0	10

The pattern of the children's interactions with the Discis Book are shown in Figure 1 as a mean percentage of the interactions that children had with the book (See Table 4). The results were separated into grade levels in order to observe differences between the grades.

Figure 1 - Mean percentage of book features used by randomly chosen children



The percentage of sentence clicks increases over the first three grades while the percentage of word clicks and picture clicks decreases. For grades two and three, the time spent in silent reading makes it impossible to know which feature might have been larger. The percentages in these two grades for silent reading were: 13.2% for grade 2 and 28% for grade 3.

Taking the means for a pattern of interaction does not give as accurate a picture of interesting possibilities as by looking at individual cases. Some students were unique in their use of the book.

In kindergarten, Alex clicked his way through six pages on words only. Alice clicked on sentences and a few words. Eric clicked on two pictures only while Ernest clicked on sentences and a few pictures. Erin clicked on words and a few pictures.

There were also special cases in grade one. Fred, as already mentioned, stayed almost exclusively with words and clicked on them randomly or in reverse order. Floyd read the story aloud for the first ten pages, clicking on the words he needed. Fran spent most of her time clicking sentences; Faye spent most of her time clicking words. Frank spent all his considerable time (38 minutes) on one page, alternating between sentences, words and pictures.

In grade two, Candy read silently, clicking on only a few words while Gretel, who also read silently, clicked occasionally on sentences, words and pictures. David, in grade three, clicked on sentence speakers; Jim, on sentence speakers and pictures. Donna, John and Jill read silently; only John clicking occasionally on a word or picture.

One Time Use by Special-Needs Students

In School A, teachers requested that three special-needs students be given the opportunity to work with the Discis Book. Parental approval was requested and obtained. Three students, a hearing impaired student in grade one, a learning-disabled student in grade two and an immigrant student in grade four worked through the Discis Book under the same conditions as had the randomly chosen students except for the presence of teacher aides in the first two cases. The observations for these students are compiled in Table 6 (See Appendix J for the recording of the full observations). As Dan was the only one able to answer interview questions, there is no separate table for his answer. Instead, they have been included in Table 4.

Insert Table 6 here

Table 6 - School A Special-Needs Students

Name	Grade	Gender	Total Time	End Page	Features - % S	W	P	Strength	Weakness	Improved
Bea (hi)	1	F	3	1	5				choices	
Cathy (ld)	2	F	33	12	30	70		music	skip pgs.	verbalizing
Dan (esl)	4	M	8	13	70	25	5		lacks interest	

hi - hearing impaired ld - learning-disabled esl - English second language

Discussion of Special-Needs Students for One-Time Use

Of the three students using the Discis Book for this one-time use, only Cathy seemed to benefit from it, staying for an extended period of time. She enjoyed the music and used the book to repeat words to her teacher aide. The teacher aide had to respond. At one point shortly after Cathy started, the teacher aide left for a few minutes and Cathy repeated a word until the researcher repeated it back to her. Then Cathy went on to the next word. It became an occasion for Cathy to say the word correctly as the repetition seemed to reassure her. When she said a word incorrectly and the teacher aide said it correctly, she repeated it correctly. She would also make motions to explain the word, such as straight or underneath. Occasionally the teacher aide would say it in a sentence, taking the place of the definition and example feature of the book.

Other discussion on the time and patterns of these children will be incorporated with the discussion for the results from the other school's teacher-designated students. There are learning-disabled students and ESL students in the second school as well who used the Discis Book.

Repeated Use by Teacher-Designated Students

The longer time period in School B allowed for repeated use of the Discis Books by two children each from grades one to three chosen by the teachers for extra reading practice.

These students were given the same instructions during their first session with the book as the randomly chosen students. On their second session with the book, they were shown how to click on a word so that it gave a definition and example (press-and-hold). Practice sessions were held on three consecutive days except for Patrick who had a day between the first and second sessions and Patty who had her three sessions on the last two days, two of them on the last day, one at 8:40 and the other at 11:40.

Observation results for these students are compiled in Table 7. The percentage of Discis Features used is a measure of the relative time of the student's using it. Besides sentences (S), words (W) and pictures (P), definitions (D), a feature shown to them the second practice time, has been added.

Table 7 - School B Teacher-Designated Students

Name	Grade	Gender	Total Time	End Page	Features - % S	W	P	D	Behavioral changes
Patrick	1	M	17	11	50	30	20		interested,involved 1st time
			16	19	40	20	5		plays with menus after few
			12	21	30	10			minutes and skips pages both second and third times
Patty (ld)	1	F	20	1	10	70	20		poor clicking, coordination
			20	6	40	50	10		aimed at sentences
			15	9	50	50			clicking getting better
Paul	2	M	36	27	50	30	20		involved, clicks many words
			23	27	70	5	10	15	occasionally read with/before
			21	27	85		5	10	more s. with/before speaker
Peggy	2	F	33	27	50	20	30		involved, says some words
			21	27	60	20		20	tracking lines with mouse
			16	27	90			10	attentive, enjoys sounds
Peter (esl)	3	M	32	27	50	5	45		involved, wants definitions
			27	27	55	5	30	10	tracking, says picture labels
			30	27	65		25	10	second and third times
Philip (ld)	3	M	32	12	5	65	30		poor coordination, random w.
			16	20	20	80			bottom-up left-right w. order
			15	6	30	40	30		some words in order

The teacher-designated students were asked the same questions after their first experience of the Discis Books as the other students. These answers are compiled in Table 8. (See Appendix K for full answers).

Table 8 - School B Teacher-Designated Student Answers to First Interview Questions

Student	Grade	Listening	Reading	Pref.	Reason	Another?
Patrick	1	Y - like story	N - hard	Discis	like computers	Y
Patty	1	Y - fun		Discis		Y
Paul	2	Y - fun, happy end	Y - good to read	Discis	don't have to turn page	Y
Peggy	2	Y - fun	Y - fun, learn	Discis	interesting	Y
Peter	3	Y - characters	Y - fun, quiet	same	using mouse	Y
Philip	3	Y		Discis		Y

After their third experience with the Discis Books, they were asked questions about the Discis Book, what they liked, if they learned anything, and what they found difficult with it. The purpose of these questions was to get student evaluation of the book by students who had a more prolonged exposure to it. The answers to these questions are compiled in Table 9. (See Appendix K for full answers).

Table 9 - School B Teacher-Designated Student Answers to Ending Interview Questions

Student	Grade	Like about Discis	Learn	Suggestions for Developer
Patrick	1	story, fun	words	like to type, have keyboard
Patty	1	pictures, music	bunny	
Paul	2	pictures, words, mouse	story, computer	change story
Peggy	2	funny	reading, words	
Peter	3	music, story, computer	English words	moving the mouse
Philip	3	bird singing, story	story	

Discussion of Repeating Students' Use of the Discis Book

The teacher-designated students of School B were varied. In grades 1 and 3 there were learning-disabled students. In grade 3 there was an ESL student as well. The other students in grades 1 and 2 were low level readers. Table 10 shows the mean times and number of pages read per grade. The two students are averaged so that the mean times can be compared to the averages for the randomly chosen students. Students generally worked through the book more quickly with repeated use.

Table 10 - Mean Time and Mean Pages Read for Students Repeating Use of the Discis Book

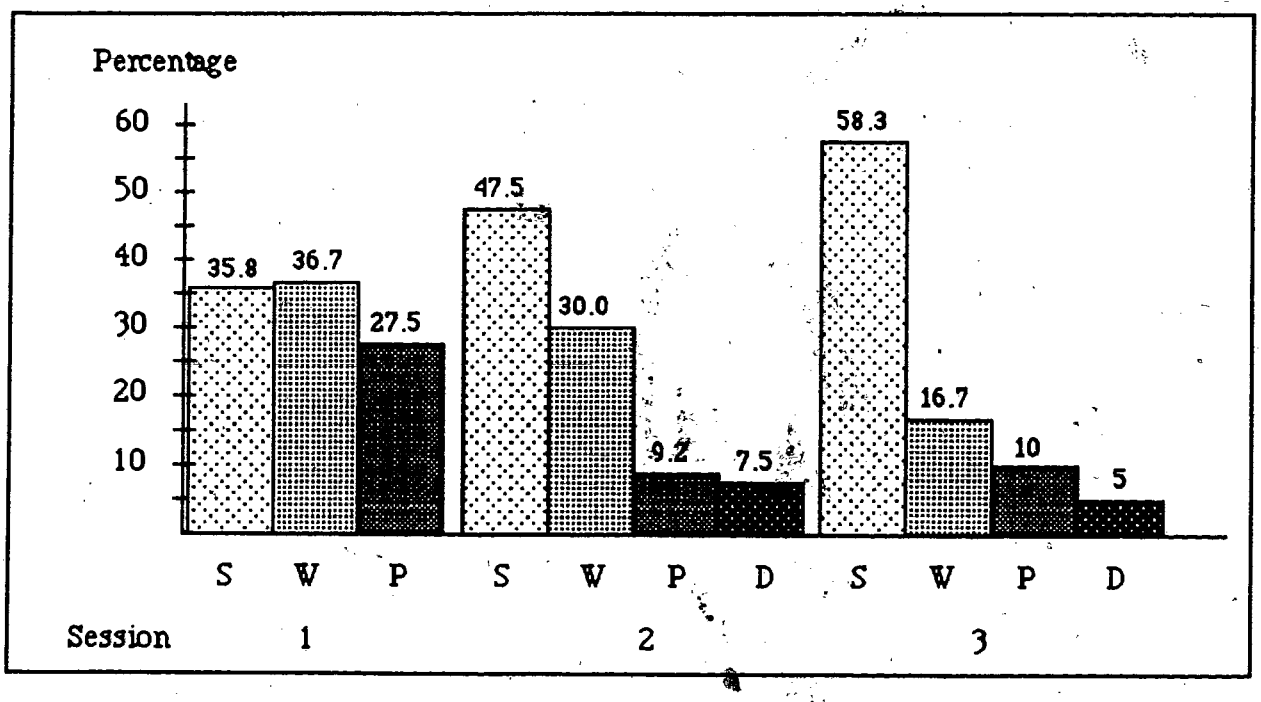
Grade		Mean Time (min.)	Mean Page
1	First	18.5	6.0
	Second	18.0	7.0
	Third	13.5	7.0
2	First	34.5	27.0
	Second	22.0	27.0
	Third	18.5	27.0
3	First	32.0	19.0
	Second	21.5	21.5
	Third	22.5	16.5

The ESL student in this school worked for a long period of time each time. He and the two grade two students spent most of the time on sentences and some on definitions. They spent less time on pictures each time and none on words the last time.

The learning-disabled students in grades one and three spent more time on sentences and less time on words as time went on but while one decreased on clicking on pictures, the other spent as much time the third time as the first. It is these learning-disabled students and the other grade one boy who spent more time on the settings for the Discis Book that lower the mean pages read in grades one and three.

Figure 2 shows the change in mean pattern of interaction over repeated use of the Discis Book by the six children. The percentage of time spent by Patrick on book settings has not been included. These were 5.8% in session two and 10.0% in session three.

Figure 2 - Mean percentage of book features used by repeating children over sessions



As can be seen in Figure 2, sentence clicks increase while word and picture clicks decrease. Definitions were enabled for the second and third times except for the grade one students. This decision was made because of Patty who had a great deal of difficulty handling the mouse and could cope only with clicks.

Again, mean percentages do not show the individual flavor of the student's unique patterns of interaction. Patrick, a very active grade one student, worked very closely with the

book the first time he met it but on second and third encounters, he concentrated less on the story and more on the book settings. He learned something during his sessions but not necessarily in Language Arts. Patty, the other grade one, learned how to use the mouse and worked hard to move it to where she wanted. She started with a low percentage of time on sentences and a high percentage on words and ended with both equal by the third time.

Paul and Peggy, the grade two students, increased to a high percentage of sentence clicks, spending the rest of the time on definitions or a few pictures. Both of them used the book to practise reading, saying words and even sentences with or before the speaker.

Peter, the grade three ESL student, wanted definitions from the very first time. He made good use of them when they were enabled, clicking on the ones he had asked the researcher the previous session. Philip, on the other hand, had poor coordination, straining with the effort of moving the mouse to click on words. Yet he would click on every word, including 'a'. He began with clicking on words in bottom-up left-right order but by the third time, he was beginning to click them in order. He also increased slightly on sentence clicks.

These students, although some had learning disabilities, did not have the difficulty of Bea, the hearing-impaired child of school A. They were able to make choices and work with the book. There may have been other factors affecting Bea as well, such as the presence of three adults: her teacher aide, the librarian and the researcher.

Discussion of Results of All Interviewed Students Using the Discis Book

Of the 52 students participating in the study, many displayed a keen interest in the Discis Book. Of the 50 students who were able to answer the interview questions, 35 said they preferred the Discis Book to ordinary books, six said they liked them equally while nine preferred books. Forty-eight of the 50 students said they would like to work with another Discis Book.

Table 11 - Children's Levels of Interest in Reading with the Discis Book

Grade	Number of students	Times used	Interest
K	2 [a]	1	Low
1 special needs	1 [b]	1	Low
4 ESL	1 [c]	1	Low
K	4 [d]	1	Medium
1	2 [e]	1	Medium
1	1 [f]	3	Medium
2	3 [g]	1	Medium
3	2 [h]	1	Medium
K	4	1	High
1	10	1	High
1 special needs	1 [i]	3	High
2 special needs	1 [j]	1	High
2	8	1	High
2	2	3	High
3	8	1	High
3 special needs, ESL	2 [k]	3	High

[a] Adam and Ernest
[b] Bea
[c] Dan
[d] Alex, Angela, Eric and Ernest
[e] Bob and Brian
[f] Patrick
[g] Charlotte, Candy and Greg
[h] David and Dawn
[i] Patty
[j] Cathy
[k] Peter and Philip

Table 11 lists the children by groups giving grade, number of times they used the book and their assumed interest. Low is given for using the book for a very short time, a stated preference for books and/or a disinterest in using another Discis Book. Medium is given for using the book for a short time, having a desire to do another one and the observed interest during their session. High is given for working with the book a long time or finishing it, expressing the desire to do another one and the observed interest during their session.

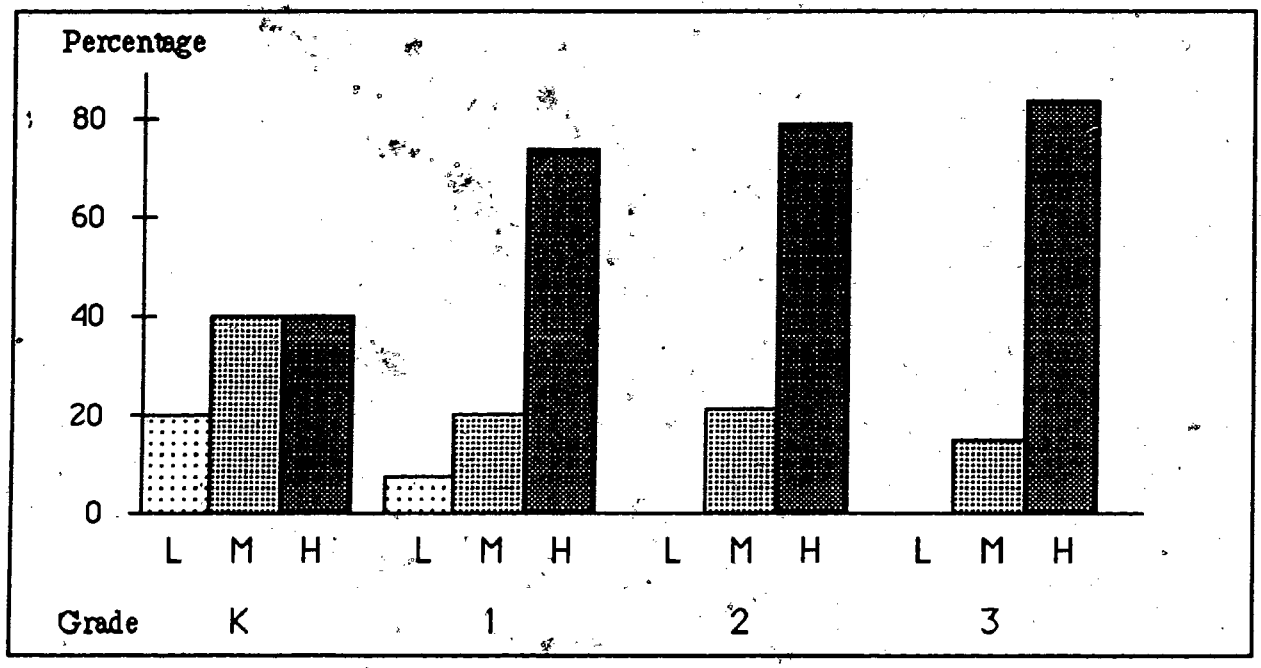
Insert Table 11 here

It is interesting to note that five out of the six students repeating their experience of the Discis Book demonstrated a high interest level. Another interesting fact is that four of the six special-needs children were in the high interest group, two of them being also in the repeating group.

Putting the number of students per grade per interest level can also be quite instructive. Figure 3 shows that information. The grade four student, being alone in his grade, has been omitted. As can be seen from the figure, low and medium interest percentages decrease over the grades while the percentage of high interest increases.

Insert Figure 3 here

Figure 3 - Interest levels in the Discis Book per grade



Leisure Time Use

In School A, the computer was left set up during the noon hour; any student requesting to view the Discis Book was allowed access. This occurred during three noon hours.

Students coming during the first noon hour consisted of older students who had been in the library during the morning and were curious about the program.

The first group using the Discis Book went through the story and then went back over special sounds and the pronunciation of some words after which they would giggle together. The mouse was controlled by the oldest girl of the group. There were two chairs so two stood behind the chairs.

Two of the younger members of the first group stayed for an extended time to have their turn controlling the mouse. Again, one member controlled the mouse. They went back over the story, clicking on words, sentences and pictures. They imitated the male voice's pronunciation and on page 16, they said a sentence as well with the reader.

A new girl came in near the end of the noon hour. She clicked on sentences and words. She was joined by a friend who giggled with her over special word pronunciation.

Comments during the first day: "I like the sound effects" by a member of the first group and "This is fun" by a member of the second group.

The second noon hour students were some who had watched for a short time during the first noon hour but had not had a chance for personal experimentation. The mouse was controlled by the first person who arrived while her friend watched. Sentences, pictures and occasional words were clicked. The first girl stayed for the full half hour session while her friend left after 20 minutes.

The third noon hour students included two grade three students (Dawn and Don) who had been randomly chosen to use the Discis Book once and wished to try it again. They were both excellent readers.

Dawn demonstrated the book to other members of the group and controlled the mouse until members of the group asked to share it. Three shared it but they complained when they felt their pages had less sentence speakers. Clicking was mainly on the sentence speakers.

Don watched a group, showing them how to work the scroll bar and taking over after the group finished. Don clicked on sentences, words and pictures. He also experimented with clicking words faster than the computer could keep up with highlighting.

Table 12 summarizes the number of students in a group, how long they stayed, their grade level, the makeup of the group, and their general clicking patterns.

Insert Table 12 here

Discussion of the Use of the Discis Book in Leisure Time

All the students coming to experiment with the Discis Book were from grades three to seven. The two grade three students were among the ones randomly chosen to use the Discis Book.

During multiple group work, there was a tendency to click on words and giggle with the pronunciation or go to pages for which there were special effects.

Mouse control was assumed by one member or when shared, could become a contentious issue. In one case, the oldest member of the group controlled the mouse. In others, the first member arriving took control. Some group members remained after others left, restarting the book so that they could control the mouse and experiment on their own. In the case of shared

Table 12 - Noon Hour Observations

Day	Number	Min. Stayed	Grades	Gender	Patterns
1	4	15	4-7	3 F/1 M	sentences, commenting on music
	2 [a]	30	4-5	F	word, sentence, pictures
	2	10	5	F	sentences, words
2	2	20	4	F	sentences, pictures, words
	1 [b]	10	4	F	sentences
3	2	5	6	M	exploring features
	3 [c]	30	3	F	words, sentences, pictures
	1 [d]	10	3	M	sentences, pictures, words

[a] two members of first group restarting book

[b] one girl continuing through the half hour

[c] includes Dawn, a randomly chosen student

[d] Don, a randomly chosen student

control, group members asked for control of the mouse. When a rotation pattern was decided upon, members counted the number of sentences on their allotted page and complained if they felt cheated.

When new members joined a group, they were usually integrated into the continuing experimentation or observed over the shoulders of the others. In two cases, the book was started again when a friend joined the group.

There was a tendency for students who had only observed the first time to return to take control. These students then demonstrated the program to their friends.

Groups usually stayed for an extended period, some leaving only at the bell. Individuals within a group watched during one pass through the book and took over control for another so their actual time was extended over two groups. The full time for these individuals was used in calculating the mean working and/or observing time for group members.

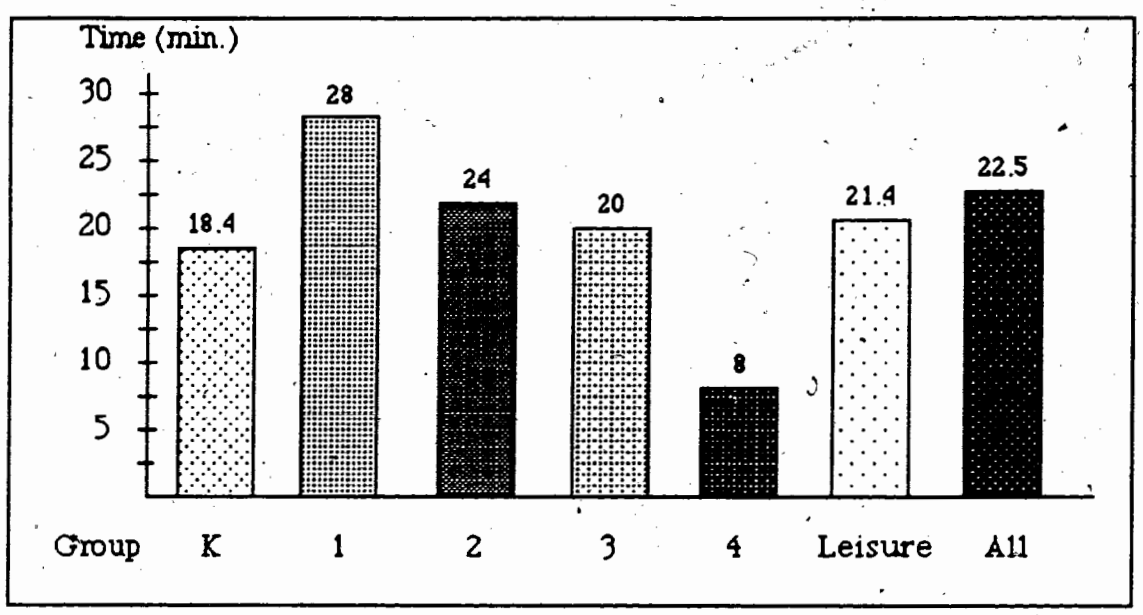
Two members of the first group of the first day stayed a total of 45 minutes while one member of the first group of the second day stayed for 30 minutes. The total time was calculated by multiplying the number of people in a group by the time they stayed. The average time for the 14 individuals who used the Discis Book during the noon hour was 21.4 minutes.

Time Spent by Children on the Discis Book in Their Initial Experience

Since the ability of the Discis Book to attract children can be measured partially by the time spent on it, the time of all 56 children who participated as well as the 14 who used it during leisure time was totalled to give a mean time per child. Other factors could also account for time spent on the computer, such as novelty in first time use, interest in computers and interest in stories. The decrease of time over sessions by repeating students point to the existence of such factors. This mean time demonstrates the power of the Discis Book to attract on initial impact at this time in children's experience of computers.

In order to observe grade differences, the means were calculated by grade as well. Figure 4 displays the mean time by grade, by leisure time users and for the total population observed.

Figure 4 - Mean time of Discis Book use by all students in their first session



One interesting result in this figure is that students who came during their leisure stayed almost as long as the mean of the total population. There was no pressure or interest in their being there except by self-initiated choice. For whatever purpose they came, the book kept their interest in their initial experience with it.

The highest mean time was spent by the grade one's, grade two being second. This may in large part be due to the eight grade two's and all the grade three's finishing the book. Most students stopped at the end of the book, only Grace in grade two and Don in grade three continuing. Leisure time users spent more time than the grade three students because they did go back over the book to repeat special sound effects or word pronunciations.

Interviews with Adults

A variety of parents and teachers as well as two school librarians and two Education Faculty members involved in Reading Instruction were approached to view the Discis Book and

comment on its use for Language Arts and Reading Instruction. The teachers chosen were the primary teachers in the two schools involved in the study. The parents were taken from those available, either working in the school library or coming to collect their child after school.

The sixteen adults were given the same instructions as the children with the addition of how the book could be customized for individual needs or for more in-depth study of the text. They were then invited to work through the book for as long as they wished. This time varied from ten minutes to one hour. They then answered the interview questions.

These questions related to the use of the Discis Book as a manner of presenting literature in Language Arts instruction. The adults were asked about the positive and the negative aspects of the book that they had perceived. They were asked their opinion as to how it could be best utilized in the school and which students would best benefit from it. The adults were then invited to suggest ways of incorporating it into the Language Arts program.

Positive Comments about the Discis Book by Adults

In their comments about the Discis Book (see Appendix L for a full report of their comments and answers), adults described the book as great, wonderful, delightful, cute, innovative, stimulating, exciting, excellent, creative, motivating and intriguing.

There were many positive comments about the Discis Book features. Three commented on the variety of presentation: picture, text, reading of words and sentences, definitions, music and sound. Several commented on the ways children can learn in the program: pictures that can present text as well as sound, highlighting of phrases to show reading direction and to allow children to match words with sound, definitions and examples to explain the words used in the story. Some commented on the possible involvement of the children through their ability to interact with the book in an independent manner, controlling the book to access what they wish and need as active learners. Many commented on the natural quality of the sound and voices.

The music was well chosen, both male and female voices are used to present good pronunciation and diction and the story is rendered in a dramatic fashion. Several adults appreciated the ability to customize fonts and possible second languages for ESL students. Table 13 presents a simplified list of the possible or actual aspects of the Discis Books that the interviewed adults appreciated. The list is clustered about four areas: variety and learning aids, student actions, sound and customization.

Insert Table 13 here

Negative Comments and Suggestions by Adults

The sixteen adults had negative comments and suggestions for possible improvements of the book. During their use of the Discis Book, several noted that the reading of the sentences ran on past the words shown on the screen. Though some of these mentioned the importance of the mapping of words to sound, only three people repeated this criticism during their interview. Other criticisms of the book repeated by three people included some definitions being either out of context or poor (see Appendix M for sample definitions), mouse movement being difficult for beginning readers and pictures being black and white.

Other criticisms expressed of the book were that this book was too long and the speaking speed was too fast for grade one, the music was too long and there was no creativity allowed for within the structure of the program. A criticism expressed of the technology was that the page turns were too slow.

Several expressed fears about misuses of the Discis Book. Children may become dependent on this manner of reading, teachers may use the book as the only way of teaching

Table 13 - Number of Adults Referring to Positive Aspects of the Discis Books

Aspect	Number
Variety of presentation modes	3
Possibility of learning	8
Highlighting of phrases	5
Visual-auditory mapping	6
Picture label-auditory mapping	3
Definitions and examples	3
Interaction or involvement	4
Student control	3
Independence	3
Sound effects and music	6
Naturalness of voices	1
Excellence of voices	2
Dramatic reading	1
Customizing fonts	3
Choice of second language for ESL students	2

Table 14 - Interviewed Adults' Criticisms and Suggested Improvements

Comment	Number
Reading of sentence words on next page[a]	3
Definitions out of context, poor examples[a]	2
No creativity allowed by book's structure	1
Book too long for grade 1[a]	2
Reading speed too fast for grade 1 to follow[a]	2
Music too long, interrupting flow of the story[a]	1
Mouse movement difficult	3
Black and white pictures[a]	3
Page turns too slow[a]	1
Children become dependent on book aid	1
Used as primary teaching method, sight vocabulary stressed	3
Bright children play with menus	1
Special-needs children have difficulty with choosing	1
Readability level too high for special-needs children	1
Option to have two reading speeds[a]	1
Automatic page turns with sentences[a]	1
Limit customizing of font styles for bold highlighting	1
Chunk highlighting as done on second text page[a]	2

[a] Concerns addressed by the company and improved in the release versions

reading and not teach phonics, and bright children will play with the program rather than read the story. Some expressed cautions that the Discis Book not replace listening to adults or replace group reading which include human interactions and input by the child. Other fears expressed were that special-needs children would have difficulty with the choices, the readability level and the motor skills and hand-eye coordination required for the mouse movements.

Suggestions for improving the program included making shorter stories for grade one, having two reading speeds which can be chosen as options, turning the pages automatically with the sentence being read and limiting customizing of font styles so that highlighting can be done in bold for these sentences. Suggestions for using the program included keeping the choices simple for grade one and providing an exploration and training period so that students can become comfortable with the program before they work on the Discis Book on their own.

Table 14 shows the number of teachers making each criticism and suggestion. They are clustered about pedagogical considerations, programming difficulties and decisions, fears about misuse and difficulties and suggested changes. Some of these criticisms and suggestions have been addressed in the release versions.

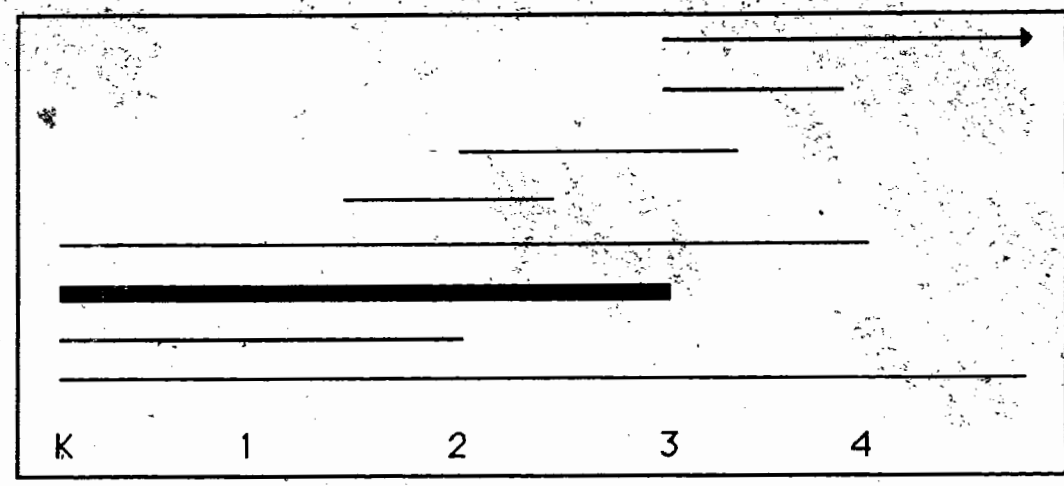
Insert Table 14 here

Reading and Grade Levels Which could Benefit

The adults were varied in placing the reading and grade levels which could make the most effective use of the books. Six suggested it be used throughout the primary grades. Others suggested kindergarten to grade two or grade four, late grade one to early grade two, grade two or slow grade three, slow grade three, and grade three up only. The latter was suggested because it was felt that the Discis Book emphasizes sight vocabulary and children should be finished their

phonics instruction before using the Discis Book. Figure 5 shows the grade levels chosen. The thick line represents the choice of six of the adults ; the other lines represent single choices.

Figure 5 - Interviewed adults' choices of grade levels for the Discis Book



Three adults suggested that it be used especially with children having trouble reading while two suggested that it could be used with ESL students in upper grades as well. One suggested that adult illiterates could benefit from this technology if suitable stories were chosen for them.

Ways of Using the Discis Books

The adults were asked how the Discis Books could be used in the school. Answers stated where it could be used, its relationship to the Language Arts curriculum, how the teacher could use it in his/her teaching and how children should be directed in its use.

As to place, nine of the sixteen suggested that it be used as a learning station while one suggested a computer lab. Two said that it should be used individually while one suggested small groups and another allowed for individuals or groups.

Five adults stated that it should be used for a supplement to the Language Arts curriculum. Others wished to include it within the curriculum with the book being part of a unit with follow-up activities for the class or follow-up activities for individuals using it at a listening station.

There was divergence as to whether children should use the book for self-directed exploration or whether they should be directed to a specific goal. One felt that the book's use should be left as a choice by the child while another stated that children should use it regularly. Two suggested comprehension questions or discussions following its use while one was against any follow-up. Table 15 presents the number of teachers who commented on each of these viewpoints. The comments are clustered according to type: where and how the book is to be used, how it fits into Language Arts and how children are to use it.

Insert Table 15 here

Discussion of Adult Responses

Sixteen adults involved with primary children were interviewed. The adults generally enjoyed the Discis Book. They diverged considerably in suggesting grade levels for its use. Some suggested primary grades and older special-needs children; others suggested use even by intermediate grades. Table 16 shows which adults suggested each grade level. Some adults were both teachers and parents, so have been included twice because of their double perspective.

Insert Table 16 here

Several comments were about definitions. Some adults indicated that the definitions are helpful and one stated that while the presentation in the definitions of the one valid meaning for the context is excellent, some of the definitions are poor. Others felt that the examples should have used the word with story details. For example, the sentence using "underneath" in the definition

Table 15 - Adult Suggestions re the Use of Discis Books in the Classroom

Usage	Number
In a listening centre	9
In a computer lab	1
As individuals	2
As a group	2
Either individual or groups	1
As supplement to curriculum	5
Part of a unit with class activities	2
Individual follow-up activities	3
Comprehension questions or class discussion following	2
No follow-up, leave as exploration	2
Exploration by the child	4
Goal directives given to child	2
Its use left to child's choice	1
Children's use determined by teacher	1

Table 16 - Grades Suggested by Adults for Use of Discis Books

Adult Role	Suggested Grade Level
School A librarian	Late one and early two
School B librarian	K to four
Kindergarten teacher	-
Kindergarten teacher	All elementary
Kindergarten teacher	Two to slow three
Kindergarten parent	All elementary
Kindergarten parent	K to three, ESL
Grade one teacher	-
Grade one teacher	Slow three
Grade one parent	-
Grade two teacher	K to three
Grade two parent	All elementary
Grade three teacher	K to three
Grade three teacher	K to four
Grade three parent	K to three, ESL
Grade three parent	K to two
Grade Three parent	Three up
Grandmother	K to three, ESL
Education Faculty Member	All elementary
Education Faculty Member	K to two

(see Appendix M) could have referred to Peter Rabbit being underneath the root in the picture of page 1. However, the definitions are meant to be used by the program any time the word is used so it makes sense to use an example taken out of the child's experience rather than to use details specific only to that page. The word "underneath" is used again on pages 16, 19, 21, and 22.

Another problem with the definitions mentioned by adults was the use of difficult words: "A gooseberry net is made of knotted threads woven together". Most children would not be able to make sense out of that but they would out of the example: "Tom and John played hockey and used the gooseberry net as a goal." Difficult words are given as alternate words, such as "dank" for "damp" and "encounter" for "meet". The child would have a better chance of understanding the original word than the alternate word.

One suggestion about definitions in earlier pilot work was to have a child's voice saying the definition. There are only professional speakers throughout the disc and although it is important to have good pronunciation, there could have been a good child's voice as well.

Another problem that had come up in early pilot work that did not occur in the research was the use of esoteric words in the example. The definition for "fortnight" is "two weeks. Example: *We shall go to Timbuktu for a fortnight.*" The problem here is that the child asked the researcher where Timbuktu was; then upon being asked by his parent what fortnight meant, he responded that it meant going to a place far away. As the research did not study children's comprehension, this case did not come up again.

The adults occasionally had opposing viewpoints on student choice, responsibility for self-directed learning and the value of exploration. Some wished to use the book for teaching; others wished to let the children use it for learning. These questions will come up again in the next chapter in program evaluation and research implications.

Chapter 5

Program Evaluation, Conclusions, Implications and Directions for Future Research

Program Evaluation

The Discis Book does indeed offer a learning opportunity for exploration, for contextual practice in reading and for hearing good literature. It encourages children to have an active involvement in reading through their control of the computer program. It was interesting enough for 96% of the students interviewed that they would use another Discis Book. Purchase of CD-ROM drives and Discis Books have been budgeted by both schools for next year.

Pedagogical Evaluation

The book has been well planned so that students at different levels and of varying abilities can learn something from its use. Its varied use of media and possible choices appeal to different cognitive and personality styles. Although it is impossible in this study to demonstrate that children actually learned something transferable to other materials, there are some learning outcomes that could be achieved and were implied by the children's behaviour.

For children at a preliterate stage in which text has no meaning, pictures and music can hold their attention for a short span. Clicking on the illustrations provides a text name for the object at the same time as a spoken name. This can help them relate text and sounds. Clicking on text or sentence speakers provides them with spoken words or a sentence. Children could discover by this exploration that the words rather than the picture carry the meaning. Paul, one of the learning-disabled children, tried to click all over the page but only text words responded to his clicks. Only one child, Eric in kindergarten, paid attention solely to pictures and music, clicking exclusively on the illustrations.

At a slightly higher level, children can discover the correct word order through their exploration. The highlighting of phrase chunks on page two (which will be normal for all pages of the released books) and noticing the order of words in the spoken sentence after clicking on individual words of that sentence are two means to achieve this goal. Two kindergarten children, Alex and Angela, in this study demonstrated an improved order in clicking on individual words as they worked just once through the book while three, Adam and Earl in kindergarten and Fred in grade one, who worked just once did not. Philip, a grade three student who worked for three sessions, began to show some indications of using the correct order.

A next reading level of children can use the book to learn to recognize simple words by sight. One kindergarten child, Earl, was interested in finding the word "and".

A further level would be to learn new words. Another kindergarten child, Ethel, clicked on some new words at the beginning of the session that she was able to say before clicking later. Floyd, a grade one child who read the story out loud, did not have to click on words that he met a second time.

Since the readability level of "The Tale of Peter Rabbit" was relatively high, all the children in the study could learn new vocabulary by seeing the spoken words in their context, even those who read silently. John and Candy, two children reading silently who clicked only on difficult or unknown words, were able to skip those same words when they were repeated later in the story. For those who clicked on the sentence speakers, simultaneously seeing and hearing the words would help them retain these words.

Some children could learn how to pronounce the words through hearing them spoken. Patty, the grade two learning-disabled child, used the spoken words to practise verbalization. Peter, the grade three ESL student, said words quietly to himself before and during the reading.

Oral fluency can be another goal achieved by students exploring the Discis Book. Floyd, a grade one student, read the book out loud, checking those words he didn't know.

Another use of the Discis Book can be for feedback for beginning readers in the prediction of words. Erin and Ethel, kindergarten students, guessed words and then clicked on them. Paul and Patty, grade two students using the Discis Book for three sessions, said words and even sentences before the speaker.

All of these learning possibilities require that the program be well devised and that the children be attentive. The text-audio mapping of words, sentences and picture labels enhances the probability of children's remembering the words and during children's use of the book, their attention was remarkable. Part of this attention results from the novelty of the computer and the program. Part of this could also come from the task-orientation attitude which many of the children showed in the study sessions. This could have been because they were participating in a study and/or because of the researcher's presence. The leisure time users were much more relaxed and played more with the story and the text, repeating interesting sounds and word pronunciations. On the other hand, the latter were also more ready to repeat parts of the book rather than to stop at the end of the story. Their attention was remarkably high as well, though occasionally this attention was focused on their reaction to the speaker's pronunciation.

Technical Difficulties

The program is quite user friendly, easy to start and simple in basic choices. The main difficulty experienced by the primary children observed in the study was in the use of the mouse. Most of these children had never used the mouse or had used it on only one occasion. A few days' experience with the mouse would help many of these children.

However, some children had difficulty with hand-eye coordination and fine motor skills. These children would need extra practice with the mouse. This could be done by working with a program such as MOUSE PRACTICE in KIDSMATH by Great Waves Software. This program helps the child gain practice in using the mouse by clicking on rockets, stars and satellites in order

to make them take off, fall or explode respectively. Using this program may relieve the frustration in children poor both in motor skills and in Language Arts who are trying to explore a Discis Book.

Another difficulty that children had with the program was with page turns. This has since been improved for the release version. Page corners now show an immediate reaction so that children know that the click has been received. As well, a trap has been set up for extra mouse clicks on these corners.

The researcher thought that music might distract the children. However, most children learned that they could stop the music if they wished by clicking on any object of the page. The music did not seem to be intrusive. The release versions will have shorter musical excerpts and as well, the volume of music and sound effects will be subdued in relation to the reading of words and sentences. On the other hand, the music was appreciated by several children. It enhances the mood of the book.

Conclusions

Manner of Use

Perhaps because the adults saw the Discis Book used as a stand-alone station only, nine of the 16 suggested that it be used that way.

The Discis Book was used in individual mode only during the study but it was used by groups during the noon hours. From that experience, it can be seen that groups could benefit somewhat from group work, but children wanted to interact with the book. Sharing the mouse became a problem and observing while others controlled the mouse was only minimally acceptable. Some of these observers came back to have their own personal interaction.

From these cases, it seems that the best manner to use the Discis Book is for children to use it individually at a listening station. It would be good to allow any child access to these books during their leisure time so listening stations should be in an accessible place. This setting could provide a more relaxed place and time for children to explore and play with the text. Monitoring these stations should be minimal -- to protect the equipment only.

The students using the Discis Book who were advanced enough to read stories for content seemed to approach the book as story. The 18 grade two and three students who finished the book went through it quickly, 11 of whom had few observed interactions with words or pictures. If the book were used in conjunction with Language Arts as a follow-up for children interested in or needing further rereading of the previously read story, children may be more inclined to explore the text and make better use of word pronunciations and definitions.

Preferred Students for Discis Book Use

Depending on the interest level of the story, any student may be attracted to the Discis Book. However, time and money constraints may prevent widespread use of the book. In this case, it should be the poorer readers and learning-disabled students who should be given priority in scheduling the use of the equipment if the purpose of using the Discis Book is to provide a learning aid. Poor students who generally are encouraged to read for correct pronunciation would be given an opportunity to read for meaning. It may lower the gap between good and poor readers. It may be useful to students who are still learning to decode.

From this study's results, it is apparent that grade one and two students would benefit most from use of this particular book for learning reading. These students worked longest at the book, using it in diverse ways depending upon their needs. These students are at the decoding stage, learning to recognize words by sight and building their sight vocabulary. Some kindergarten children would benefit but can wait if there is too much demand on equipment.

Grade three children can read for enjoyment and at the same time, increase their vocabulary by seeing and hearing words in context. Because of their further development, these children may have benefitted most from the pleasure provided by using this medium.

Other students who should be considered in the priority list are the older learning-disabled and ESL students. These children need extra practice in hearing good pronunciation and the Discis Book can be a useful tool in the hands of the teacher for guided practice.

Children Needing Direction

Teachers must always be ready to guide the children in their use of the computer. Most children used the computer to work on particular needs in their Language Arts. However, this may be largely due to the presence of the researcher, as previously mentioned. Leisure time users were not as task-oriented although even these children generally worked through the book until the end of the story.

From this study, it is apparent that some children do need direction in making independent choices. It is not enough to place them before a computer and tell them to direct their own learning. This is a goal for all teaching but children from differing backgrounds, with poor self-motivation or with physical handicaps may require more help, as in Bea's case. It was also apparent that Michael might have concentrated more on exploring the book for Language Arts learning rather than on computer menus if he had been given a specific goal and required to do a certain task each day when he came to the computer. At this point he was more interested in exploring and controlling this new micro-world.

Length of Use

From the results, it was found that interest ranged from one (Bea) to 53 minutes (Floyd). With teacher choice and direction for those who are to use the Discis Book, there will not usually

be as many of the uninterested children using the book. For some children in kindergarten, a good time would be about 15 minutes. These children would have to be determined by the teacher. Most grade one and two children could be interested for about 20 to 25 minutes or until they finish the book. (See Figure 4). These times would be lowered for the repeated use of a book, since it would take less time to finish the book. It would be important not to force children to stay longer than their interest so that textual exploration in the Discis Book does not become another chore.

Discis Books and Language Arts Enhancement

The Discis Book is not meant to take the place of phonics instruction or of oral reading. It does not teach word-attack strategies. What it does offer is the presentation of a story in a form that can be used by any child who can follow a story and who desires to explore pictures or text for further information. It provides good pronunciation and definitions to enable children to understand the story better. Children did not usually make a choice to read out loud. Of the children observed in this study, only Floyd and Cathy used the story for oral practice. Some of the others mouthed or repeated words but did not concentrate on oral reading practice.

One of the questions of this study was to find out if children could be self-initiated learners, making choices that would help them learn. All the children observed, except Bea, were able to make choices between clicking on sentences, words and pictures. For these children, exploration of the Discis Book could become a powerful manner of learning. They could discover principles through text-word mapping and through observing word progression in sentence highlighting. New words could be learned in context and the ease of reading for meaning could enable poor readers to get past the decoding stage. Good pronunciation and prosodic reading could help them visualize text in phrases and see sentences in the context of a whole story.

The interviewed adults had suggestions for ways to direct children's use of the Discis Book. This may have been because of the interview question that asked them how teachers could incorporate it in their teaching. Using the book in a directed fashion for all students may have the effect of minimizing the learning experience through the exploration of the book. Children in the study used the book in such diverse ways that teachers may suggest ways not beneficial for that child. Direction may be best kept only for those children who need it for a time.

Implications

Repeated reading and audio feedback were described as two methods which could help children who were poor in reading. If the Discis Books are accepted by teachers and children and are used to help poorer readers to improve while they are still in the primary grades, there may be far reaching benefits. Reading is such an important skill. However, the Discis Book is one means out of many and only further research will show if the book continues to interest children so that there are measurable benefits.

If children increase in their ability to become independent learners through the use of Discis Books among other means, education may change somewhat. Children lose interest in school for many reasons. If having the possibility of making choices and becoming independent learners helps them maintain some of that interest, there may be more invigorating classrooms in the future. Having the Discis Book provide poorer readers and special-needs children with extra reading practice may also lessen some of the teachers' burdens.

Directions for Future Research

This study is just a beginning in observing the interaction of children with computerized books. As primary children become more accustomed to computers and to computerized books, numerous other avenues can open for future research.

Measuring Time on Task

The children seemed very attentive to the screen, occasionally being distracted by movement around them but returning their eyes very quickly to the screen. Paul, who had a little car in his hand, spent very little time playing with it. Even Ethel, the kindergarten child who asked for automatic reading, looked away from the screen during the music but focused on the screen during the sentence reading. If an important element in learning is the length of time spent on the material, then it would be informative to measure the percentage of time on task children exhibit when exploring text with the Discis Book.

Level Benefitting Most From the Discis Books

Because of time and money constraints, not every child can use the Discis Book during the school day. The study observed different types of students from K to grade 3 and of different reading ability. However, it would be important to observe students in the classroom setting for learning and affective gains after having used the Discis Book as part of their Language Arts work. Does use of the book encourage children to read more? Are their vocabulary and reading skills -- both oral and silent -- improved?

The particular book used in the study appealed mainly to young children. Could books with stories interesting to other groups benefit from them as well? ESL students, poor readers of the intermediate grades, adult illiterates?

Longitudinal Studies

This study was of short duration, observing the initial impact of the Discis Book on children having only one session with the book and six students having three sessions. Longitudinal studies could extend this research for changes in patterns of interaction over a longer

period of time. Other longitudinal studies could check for an increase in reading motivation or reading achievement in students who have used the Discis Books for a year or two.

Use of Discis Books by Children with Different Learning Styles or Personality Types

This study observed all children who used the book without reference to their learning style or their personality type. The PLATO project discussed in Chapter 2 offered a wide range of learning modes in different CAI programs in order to appeal to different cognitive styles. The Discis Book seems to offer a wide range of learning modes in one book. Further studies could investigate the correlation of the preferred learning mode of each child with his/her cognitive style. One child clicks on words; another clicks on sentences. Some listen to music; others don't. Some children click on pictures, sentences and words; others read silently. Which type of interaction is a function of learning style? Is there a relationship?

The PLATO project designers found that children's behaviour fell into four categories: active non-conventional, active conventional, passive conventional, and passive non-conventional. Do the children using the Discis Book fall into the same four categories? If they do, how do the different children explore the book? Is there a group that needs direction and goals in the book's use?

Further observations with the Discis Book in these areas may provide insight in student motivation and student choices in self-initiated learning.

The Effect of Providing Goals or Directions in Using the Discis Book

This study observed only exploration of the Discis Book. What effect would there be if some children were directed while some were allowed to explore? Would there be an effect on children's motivation and enjoyment of the book with different goals?

Choice of Discis Books

Only one book was used in this study. What effect could there have been in students repeating sessions using a different book each time? What effect could there have been if students had been allowed a choice of book? Would there have been more interest in kindergarten children if they had used an extremely simple book, for example, going over the alphabet? Would a story suitable to intermediate students have attracted more children during leisure time or have encouraged students to go over parts of the book rather than stopping at the end of the story? Could intermediate students benefit from the Discis Books as well? What would the effect of increased interactivity, for example, the ability to enter comments, have on older students' use of the books?

A limitation in using only the one book in this study is that children's interactions were observed using a book in a story format only. What difference in their interactions with the text would occur if children were using a Discis Book of poetry? Many of the children, especially grade three students, went through the story quickly. If they were working with poems or with very short stories, would they be more inclined to play with the text after reading each poem or short story?

Discis Books Using Newer Media

One of the media presented but not yet on the market is the CD-WO (Compact Disc - Write Once. See Appendix F). As further new erasable media enter the market, changes will occur quickly. Teachers and parents will be able to record their stories or the children's stories. What effect would this writeable media have on Discis Book use at adult levels? College students studying medicine, for example, could store lecture notes and comments along with illustrations and textual information. Would students at this level make use of Discis Books?

The study of the Discis Books has been very stimulating at this time when there is a literature focus in Language Arts teaching, when computer use in the schools is evolving to greater user control and a content orientation and when the United Nations has declared 1990 an International Literacy Year. Teachers involved in Language Arts have become excited by the potential they perceive in this new media. Computerized books may become a powerful tool for literacy in children's hands.

Appendix A

Letter to Adult Subjects

Evaluating the Interaction of Primary Students with Computerized Books

Information for Subjects

You will be asked to work with a computerized book on a Macintosh computer. The different options available to a child using the program will be shown to you at that time.

You may examine the program in any manner. During this time, I will be noting down your comments as the reaction of a reading professional to a child's book in this form.

After working with the program for the amount of time you wish, I will ask you a few questions about your views on this type of program and how it can be used in a school setting.

No names will be used in the study. However, I will ask for a short biography re your experience with children's books so as to give a background for your comments and observations.

Your time involvement should be from 20 to 40 minutes, depending on how much of the book you wish to view.

If you have further questions about the research or the materials, please feel free to contact the researcher, Sister Georgette Lamy, at 435-5911 (home) or 291-3615 (University).

If you have any complaints about the research please contact the Director of Graduate Programs, Robin Barrow at 291-4255.

Thank you for your cooperation.

Yours sincerely,

Sister Georgette Lamy

SFU graduate student

Informed Consent by Subjects to Participate in a Research Project

Having been asked by Sister Georgette Lamy of the Education Faculty of Simon Fraser University to participate in a research project experiement, I have read the procedures specified in the document entitled:

Evaluating the Interaction of Primary Students with Computerized Books: Information for Subjects.

I understand the procedures to be used on this experiment and the personal risks to me in taking part.I understand that I may withdraw my participation in this experiment at any time. I also understand that I may register any complaint I might have about the experiment with Sister Georgette Lamy or with Robin Barrow, Director of Graduate Programs, Simon Fraser University. Copies of the results of this study, upon its completion, may be obtained by contacting Sister Georgette Lamy. I agree to participate by working with the computerized book on the Macintosh computer, commenting on its value as I'm interacting with it, and then answering the questions about my reactions to this type of computer use in primary reading. I realize that this will take one session of from 20 - 40 minutes during December, 1989 at a convenient time and place mutually arranged by Sister Georgette and me.

NAME (Please print):_____

ADDRESS:_____

_____

SIGNATURE:_____ WITNESS:_____

DATE:_____

Once signed, a copy of this consent form and a subject feedback form should be provided to you.

Appendix B

Letter to Parents

Dear Parent/Guardian:

Your child will be asked to work with a computerized book on a Macintosh computer. The different options available to a child using the program will be shown to them at that time. The child may ask the computer to read a sentence to him/her, a word or the definition of a word. The book is illustrated and each page turn signals the computer to play appropriate music.

They may use the program freely. During this time, I will be noting down their comments and reactions to a child's book in this form.

After working with the program for the amount of time they wish, I will ask them a few questions about their views on this type of program and whether they like to read a book in this manner.

No names will be used in the study. However, I will ask the teacher for her/his perception of your child's reading ability and reading interest to correlate with the answers and reactions for the later compilation.

Their time involvement may be from 30 to 60 minutes, depending on how much of the book they wish to view. They will be given freedom to stop at any time. After working with the book, I will ask them four questions about their interest in listening to stories, to reading, and to this manner of reading.

The observations and answers will be compiled as part of my master's research thesis on evaluating this type of use of computer technology to help children practice reading. University policy requires that any such research be done with informed consent. Whether you do or do not wish to allow your child to participate in the study, please return the attached permission form to the school by November 24, 1989.

If you have further questions about the research or the materials, please feel free to contact the researcher, Sister Georgette Lamy, at 435-5911 (home) or 291-3615 (University).

If you have any complaints about the research please contact the Director of Graduate Programs, Robin Barrow at 291-4255.

Thank you for your cooperation.

Yours sincerely,

Sister Georgette Lamy

SFU graduate student

Consent for a Minor Participating in Research

As Parent/Guardian of _____

I consent to my child (named above) participating in the Computerized Books research project as described in the attached document.

I understand that my child can ask to stop at any time with no adverse reactions from the observer and that his/her answers to the questions can be freely given without pressure or bias from the observer.

_____ _____

(Signature of Parent/Guardian) (Date)

Appendix C

Interview Questions

For Children with Single Use - First Interview

1. Do you like listening to stories? What do (don't) you like about it?
2. Do you like reading? What do (don't) you like about it?
3. Which way do you like reading better? this way or with a book?

(If this way - What did you like about it?)

4. Would you like to read a book like this again if they made another one?

For Children with Repeated Use - End Interview

1. Did you like the Book? What did you like about it?
2. What do you think you can learn from a Book like this?
3. What suggestions would you have for the one who made the Book about things you didn't like about the Book or that you had trouble with?

For Adults

1. How do you feel about this manner of presenting literature?
2. What do you see as positive aspects of this computer use?
3. What do you see as negative aspects?
4. How would you see it best used in a school situation? (or home, library, ...)
5. Which level of readers would best benefit from it?
6. How could teachers incorporate it in their teaching?

Appendix D

Observation Tool

Name_____ Gr._____Sex____Date_____Start _____ End_____

Page#	Time	Clicking pattern/choices	Comments/Behaviour

Page#	Time	Clicking pattern/choices	Comments/Behaviour

Appendix E

B. C. Teachers' 1989 Research and Development Projects

(Compiled from Moran, 1989)

Telecommunications	Level	Subject Area	Computer	Software
Student Use of Information Networks	Elementary	Humanities	Apple IIGS	Proterm
Electronic Mail Telecommunications	Elementary	Humanities/Science	Mac/Apple IIGS	Point-to-Point, MS Works
Computer Telecomm. for School Use	Secondary	All	Apple IIGS	Point-to-Point
Teachers' Telecommunications Manual	Teachers	All		
International Online Research	Secondary	Humanities, Science	MS-DOS/Mac	Procomm, Red Ryder, PC Write, MiniWriter
Computer Pals	4	Humanities	Apple IIc	Point-to-Point
Communications Across the Miles	4-10	Humanities, Science	Apple IIGS	Point-to-Point
Computer Pals Via CNCP's Dialçom	4-7	Humanities	Apple IIGS	Point-to-Point, AppleWorks
Interprovincial Bilingual Exchange	9-10	Humanities (French)	MS-DOSMac	Red Ryder
District Telecommunications	All	Humanities, Science	MS-DOS/Apple IIe	RBBS, Netmaster, MS Works
Cooperative Classroom	All	All	Mac	MS Word, PageMaker, MS Works, Red Ryder
Victoria to Amsterdam Via Telematics	8-9	Humanities (French)	Mac	MS Works
Team Teaching of CS 12, Using a Modem	12	Science	MS-DOS	First Choice
Isolated Rural School Communication	Elementary	All	FAX machines	
Accessing the District Resource Centre	Teachers	All	MS-DOS	Eloquent Lib. Remote Booking Module Carbon Copy Plus

Art and Music	Level	Subject Area	Computer	Software
Princess Margaret MIDI Music	8-10	Fine Arts	Mac	Professional Performer/Composer, HyperCard
MIDI Music Composition	4-12	Fine Arts	Mac	Finale
Computers in the Art Room	8-12	Fine Arts	MS-DOS	Deluxe Paint II
Animation with Video Works II	Secondary	Fine Arts	Mac	VideoWorks II, HyperCard
Music and Technology	All	Fine Arts	Mac	Deluxe Music Construction Set
Recording and Printing Music	Secondary	Fine Arts	Mac	Professional Performer/Composer
Enhanced Digital Art	Secondary	Fine Arts	Amiga 500	Deluxe Paint II, Deluxe Video Aegis (Video Titler, Sonix, Animator)
An Introduction to Music Composition	Secondary	Fine Arts	Apple IIGS	Music Construction Set, MECC Music Theory Program
Music and Computers for Elementary School	Elementary	Fine Arts	Mac	Deluxe Music Construction Set, Passport Master Tracks Pro
Computer Assisted Drafting	Secondary	Practical Arts, Fine Arts	MS-DOS	AutoCAD
ScanArt, A Clip Art Library	Secondary	Fine Arts	Mac	AppleScan, MacPaint, MacDraw, Ready Set Go
Computer Artwork for Primary Grades	Primary	Fine Arts, Science	Apple IIe	Dazzledraw
Intermediate Music Composition Modules	6-7	Fine Arts	Mac	HyperCard

Technology Education	Level	Subject Area	Computer	Software
Robotic Design & Construction	Secondary	Practical Arts	Mac/Apple IIe	Works, AppleWorks, PrintShop, Robot Odyssey
Auto Mechanics Resource Bank	Secondary	Practical Arts	MS-DOS	Guide
AutoCAD On-Line Instruction	Secondary	Practical Arts	MS-DOS	AutoCAD
Computer Assisted Technology Instruction	Secondary	Practical Arts	Apple II	
Computer Interfacing/Robotics	Secondary	Practical Arts	Apple II/MS-DOS	
Developing a CAD-CAM Program	Secondary	Practical Arts	MS-DOS	AutoCAD, AutoSketch, Anicam
Practical Applications for CAD	Secondary	Practical Arts	MS-DOS	AutoCAD, Generic CADD Level Three, DOT Plot, Auto Dimensioning
Computer Aided Industrial Education	Secondary	Practical Arts	Apple IIe/Mac	Auto Mechanics Series, Machine Shop Equipment and Safety, Robotics Fund. Robotics, Woodwork Equip. & Safety, Welding Equip. & Safety, and others.
Revelstoke Technology Project	8-9	Practical Arts		
Computer Technology in Forestry Education	11	Practical Arts	Mac	MacDraft CAD
E.K.I. Electronics Kit Evaluation Project	10-12	Practical Arts		
Introducing CAD in a Junior Secondary	7-9	Practical Arts	Apple IIGS	DiscoverCAD
Introduction to Robotics	Secondary	Practical Arts	Apple IIe	
Introductory CAD	11-12	Practical Arts	MS-DOS	AutoSketch

Elementary Language Arts	Level	Subject Area	Computer	Software
Integration of Comp. Skills into L.A. & Art	Primary	French, Fine Arts	Apple IIGS	Megatexte
Enrichment Lessons Using Print Shop	Elementary	Humanities	Apple IIe	PrintShop, AppleWorks
Desktop Publishing in the Elementary Grades	6	Humanities	Apple IIGS/IIe	FrEdWriter, Publish-It! 2, Educational Graphics, Sensible Speller
Elementary Desktop Publishing and School Newspapers	4-7	Humanities	Apple IIe	AppleWorks, PaintWorks Plus, PrintShop, MECC Puzzles and Posters
Elementary School Newspaper	4	Humanities	Apple IIGS	MagicSlateII,PrintShop,PaintworksPlus MECC Puzzles and Posters, Publish-It!
A Whole Language Newspaper for Elementary School Children	Elementary	Humanities	Apple IIGS	Point-to-Point, Publish-It! 2
Gitksan-Wet'suwet'en Schools Link Up	Elementary	Humanities	Mac/Apple IIGS	AppleWorks, Point-to-Point MS Works
Desktop Publishing and Whole Language	Elementary	Humanities	Amiga 500	Scribble!, Deluxe Paint II, Pagesetter
Elementary Publishing of Student Work	7	Humanities	Apple IIe	Thunderscan, AppleWorks, Publish-It! 2
Newspaper Writing in the Elementary Grades	4	All	Commodore 64	GEOS
Enhancement of Desktop Publishing with Scanner	Elementary	Humanities	Mac	AppleScan, Works, Superpaint, PageMaker
K-7 Computer Usage - Scope and Sequence	Elementary	All	Apple IIe	Muppetville, Muppet Word Book, Teddy's Playground, Touch 'N Write, Type-to-Learn, LogoWriter, Mind Castle I & II, Story Writer, and others
District-wide Young Writers' Bulletin Bd.	All	Humanities	MS-DOS	RBBS-PC

Elementary Language Arts (cont.)	Level	Subject Area	Computer	Software
Native Curriculum Development Using Desktop Publishing	8-10	Humanities	Mac	PageMaker, MS Word
Book Making with Computers	5-6	Humanities	MS-DOS	Publish It, Deluxe Paint II
Desktop Publishing: Grades One through Seven	Elementary	Humanities	MS-DOS	Amy's First Primer, PC Paintbrush+, Kids' Word Processor, MS Works, All the Right Type, First Publisher Autosketch
Young Writers Telecommunications Network	3-7	Humanities	Apple IIGS	FrEdWriter, Point-to-Point
Computers, Curriculum and Whole Class Instruction	Elementary	Humanities, Science	Apple IIGS	MECC Graphing Primer, Patterns, Wood Car Rally, AppleWorks

Secondary Writing and Business Education	Level	Subject Area	Computer	Software
Desktop Publishing	Secondary	Humanities	MS-DOS	First Publisher
Desktop Publishing on the GS	8-10	Humanities	Apple IIGS	AppleWorks, GraphicWriter
Writer's Tools for English	8-10	Humanities	MS-DOS	Writer's Helper Stage II
Keyboarding for Low Achievers	Secondary	Humanities	MS-DOS	MS Works, Typing Tutor IV NewsMaster II, Grammatik III
A Hypermedia Approach to Canadian Literature	Secondary	Humanities	MS-DOS	LinkWay, MS Works, First Choice, dBase III, Pages, ClipArt, Bookshelf, Electronic Encyclopedia
Science Fiction Story Book	7-10	Humanities	MS-DOS	MS Works, Pages, ClipArt
Word Processing with Learning Disabled St.	Secondary	Humanities	Apple IIGS	AppleWorks, Pinpoint Starter Pak
Research Enterprise: Going Where No...	8	All	MS-DOS	Groliers' Electronic Encyclopedia
Pacific Rim Travel Project	12	Practical Arts	MS-DOS	MS Works
Solving Business Problems Using Microsoft Works	10-12	Practical Arts	Mac/MS-DOS	MS Works
OABUS Communication Project	11-12	Practical Arts	MS-DOS	OABUS
School Newspaper	11-12	Science	MS-DOS	Scanware, Publish It!
Computerized Grade 10 English Corres. Course	10	Humanities	MS-DOS	MS Works
From Data to Essay - Comp. Ass. Research...	8-10	Humanities	Mac	MS Works
School and Community Newspaper	All	Humanities	MS-DOS	SPC First Publisher and Graphics, MS Word, WordPerfect

Elementary Special Education	Level	Subject Area	Computer	Software
Accelerated Reading Readiness	K-1	Humanities	Apple IIGS	Muppets on Stage, Getting Ready to Read and Add, Muppet Slate
Computer Assisted Linguistics	1-4	Humanities	TRS-80, MS-DOS	
Integration Application	1-4	Humanities	Apple IIGS	Echo Speech Synthesizers, Keytalk
Computer-Based Possibilities for the Learning Disabled	Primary	Humanities	Apple II	Touch N'Write, MECC Writer, Muppet Word Book, Muppet Slate
Inservice for Using Computers in Integrated Classes	All	All	Apple IIGS	Primary Keyboard, Right of Way, First Letter Fun,Phonics Prime Time Vowels Phonics Prime Time Initial Consonants Fun from A-Z, Paint with Words, others
Cooperative Research and Telecomm.	4-5	Humanities	Apple IIGS	Point-to-Point, AppleWorks, FrEdWriter
Touch Screen for Multi-Handicapped Students	Primary	Humanities	Apple IIGS	Echo, Creative Antics, Creature Chorus, Talking Verbs and Talking Nouns, Balancing Bear, Touch 'N Write
HyperCard on the Macintosh for ESL St.	Elementary	Humanities	Mac	HyperCard, HyperSound
Use of Word Prediction and Spell. Correction	Elementary	Humanities	MS-DOS	MS Works, EZ Keys
Speed Reading in the Intermediate Grades	5-7	Humanities	Mac/Apple II	Speed Reader II
Augmented Communication Systems	Primary	Humanities	Apple IIe	Echo, Micro-Lads, Dr. Pet's TalkWriter, Interaction Games
HyperCard for Special Needs Students	All	All	Mac	Hyper(Card, Scan, Sound), SuperPaint
Special Education Problem Solving	4-6	Science	Apple II	Guiness World Record Problem Areas in Math

Special Education, Secondary	Level	Subject Area	Computer	Software
Cooperative Computers for Students with Learning Disabilities	8	Science	Apple IIGS	Mathematics Courseware Problem Solving Level 6, The Telex MagnaByte
Auditory Access for the Blind	11	Science	Mac	HyperCard, HyperSound
Vocational Assessment Unit Enhanced	Secondary	All	Apple IIGS	AppleWorks, MESA, ValGuide
Living and Working in Harmony	10-12	All	Mac/Apple IIe	KidsTime, Think, MacWrite, PrintShop AppleWorks, Easy Game Switch...
Success with Science and Social Studies	Jr. Sec.	Science	Apple IIe	Body in Focus, Animal Kingdom, Circulation Organs, Circulation System
Special Education HyperCard	Secondary	Humanities	Mac	HyperCard, Talking Tiles, HyperSound HyperAnimator
Field Testing and Evaluation of CAI Materials in Fractions	4-10	Science	Apple IIe	Math Tutor Fractions, Fraction Factory, Math Blaster, Fraction Fuel-up...
Special Education Diagnostic and Assessment Program	8-9	Humanities, Science	Apple II	Peabody Individualized Achievement Test, Woodcock Reading Mastery Tests
Reading Improvement Project	8	Humanities	Mac	MacPaint,Works,Type!, Speed Reader II
Mathematics 9A CAI	9	Science	Apple IIGS	Individual Computational Skills SemCalc: The Word Problem Solver, Tobbs Learns Algebra, Galaxy Math Facts, Fractions, Decimals and Percents

Social Studies	Level	Subject Area	Computer	Software
HyperCard Shell for Geog. 12 Map Skills	12	Humanities	Mac	HyperCard, MS Works, PageMaker
Using HyperCard in the Intermediate Curric.	7	Humanities	Mac	HyperCard
A HyperCard Database for Geography 12	11-12	Humanities	Mac	HyperCard, VideoWorks, TextPert
The Infinite Field Trip	Secondary	All	Mac	HyperCard, Video Voyager, MacPaint, Illustrator 88, PageMaker,CD Art, others
Test Banks: Elementary Social Studies	4-7	Humanities	Mac	LXR Test
Weather Information for Secondary Social St.	Secondary	Humanities	MS-DOS	PC PAKRATT, PK FAX
Two Aspects of the Research Process	4-7	Humanities, Science	MS-DOS	MemoryMate, Dr. Halo III, PC Paintbrush, Show Partner, others
HyperCard Stacks to Support Gr. 6 S. S.	6	Humanities	Mac	HyperCard, HyperSound
MS Works - A Tool to Teach Graphing in S.S.	Secondary	Humanities	Mac	MS Works, ScreenClip
Integrating the Comp. into the Research Proc.	4-7	Humanities, Science	Apple IIGS	Magic Slate, FrED Base, Project Zoo
Databases in Social Studies	3-9	Humanities	Apple IIGS	AppleWorks, MS Works
Building a Database	Elementary	All	Apple IIe	AppleWorks
Social Studies 11 Database Study	11	Humanities	Mac	MS Works
Quests	11-12	Humanities, Science	MS-DOS	Procomm Plus, File Express
Beyond the Textbook: Comparative Anal. ...	6	Humanities	Apple IIGS	AppleWorks, Point-to-Point
Explorations B.C.	4-7	Humanities	Apple IIe	AppleWorks

Mathematics and Science	Level	Subject Area	Computer	Software
Salmon Resource Database Using List Plus	9	Science	Apple IIGS	List Plus
Artificial Intelligence and Prolog	Secondary	Science	MS-DOS	Prolog
Canadian Academy of Student Science Researchers	11-12	Science	Mac	MS Word, Red Ryder, Calendar Maker, StatView 512+, Ready Set Go
The Computer: A Teaching and Learning Tool in Senior Mathematics	11-12	Science	MS-DOS	Mathematics Exploration Toolkit
Computer Augmented Mathematics	8-12	Science	MS-DOS	Eureka!, Green Globs and Graphing Equations, Master Grapher, Computer Applications of Finite Math, and others
NASA Spacelink: A Telecomm. Project	11	Science	MS-DOS	Telix 3.11
CD-ROM in the Senior Science Lab.	Secondary	Science	MS-DOS	Science and Technical Reference Set, The Electronic Encyclopedia
Use of Mathematical Projection Panel	10-11	Science	MS-DOS	Geometry One: Foundations and Mathematics Exploration Toolkit
Elementary Data Analysis Using MECC Graph	3-7	Science	Apple II	MECC Graph
Database Units in Science	4-7	Science	Mac/Apple II	MS Works, AppleWorks
The Microcomputer Based Laboratory Proj.	11-12	Science	Mac	custom software for DART by UBC
PC-LAN Graphics for Mathematics	Secondary	Science	MS-DOS	Plot it, Math Utilities
Videodisc Access for Jun. High Physical Sc.	Jr. Sec.	Science	Mac	HyperCard
Data Analysis Unit for Math 10	10	Science	Apple IIe	TimeOut Graph, AppleWorks, Works, PFS Graph

Library and Administration	Level	Subject Area	Computer	Software
Electronic Media Study and Research Skills	11-12	All	MS-DOS	New Electronic Encyclopedia
Remote Access to Local Area Networks	All	All	MS-DOS	Carbon Copy Plus
Jason HyperCard Project	All	Science	Mac	HyperCard
Interactive Test-Banking for Students & Teach.	8-12	Science	Mac	LXR Text, SuperPaint
Library Based Electronic Research	6	All	MS-DOS	Electronic Encyclopedia, PCStyle
CD-ROM in the Library	4-7	All	MS-DOS	Electronic Encyclopedia
CD-ROM Research Station	4-12	All	MS-DOS	PC-Write, PC-File, Elect. Encyc.
Electronic Information Retrieval	11-12	All	MS-DOS	Procomm Plus, ERIC, Elect. Encyc.
LXR Test Bank	7-11	Science	Mac	LXR Test, SuperPaint
Resource Centre Management Progam...	All	All	Mac	HyperCard, Reports!, TeachText
Theme-Based Bibliographies	All	All	Apple IIGS	Desktop Library, Library Edition
HyperCard Daily, Weekly, Monthly planner	All	All	Mac	HyperCard
CD-ROM Tech.in a Small Sec. Sch. Lib.	8-12	All	MS-DOS	Grolier's Electronic Encyclopedia
Computer Inservice for Educators	All	All	Mac	
Grade 12 Gov. Examinable Subjects Test Bank	12	All	Mac	LXR Test, SuperPaint
Interactive Video Survey	All	All	Mac/Acorn	HyperCard
Corrections Education Student File Transfer	All	All	Mac	MS Works

Miscellaneous	Level	Subject Area	Computer	Software
Diet Study and Nutrient Tally for Home Ec.	Secondary	Practical Arts	Mac	Dietician
Computers: Aid to Problem Solving	4-7	Science	Apple IIGS	Blockers and Finders, King's Rule, Building Perspectives, Puzzle Tanks, Missing Links, Tangram Puzzler, Paintworks Plus
Cross Curriculum Computer Resource Book	All	All		
LegoLogo Simple Machine Units	4-9	Science	Apple IIe	Lego TC Logo
Databases in the Secondary School	9-10	All	MS-DOS	MS Works
The Computer and Junior High French	8-10	Humanities	Apple II	Bataille de Mots
Lego TC Logo: A Fresh Way of Thinking	7	All	Apple IIe	Lego TC Logo
Surrey Lego TC Logo Project	All	Math, Science	Apple IIGS	Lego TC Logo
Unit Plan for Motorized Models	7	Science	Apple IIe	Lego TC Logo
Community, Past and Present	All	Humanities	Mac	HyperCard
Impact of Free Trade	10	Humanities	Mac	MS Works, Full Impact, TextPert

Summary

Table E-1 - B.C. Teachers' 1989 Research Projects in HyperCard, Speech or CD-ROM

Description	Number	Percentage
Number of projects using HyperCard	18	11.0%
Number of projects using CD-ROM (ERIC, Electronic Encyc....)	9	5.5%
Number of projects using speech (Echo, HyperSound, KidsTime)	9	5.5%
Total number of projects	156	100.0%

Appendix F
CD-ROM

Definition and makeup of CD-ROM

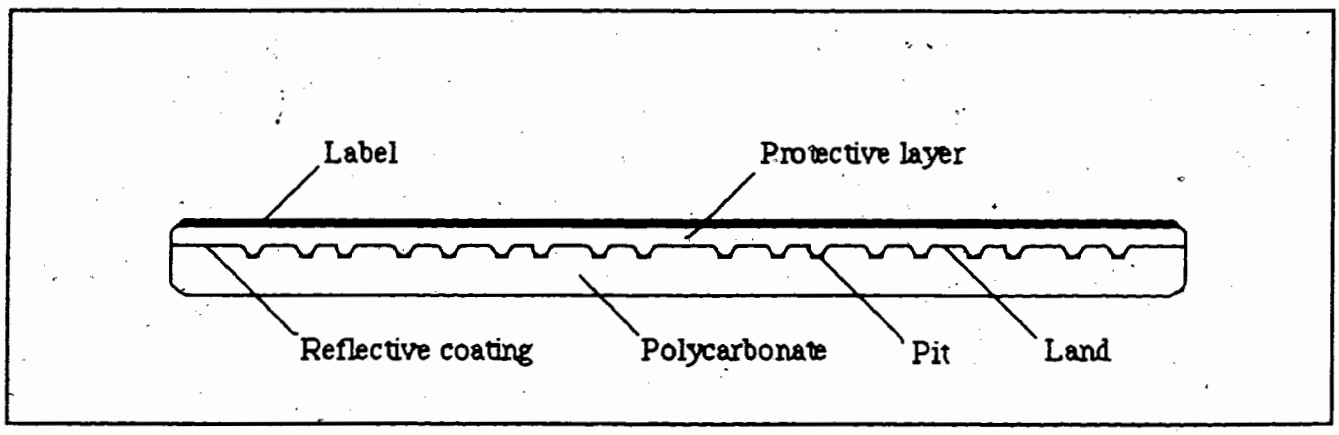
CD-ROM, an acronym for Compact Disc Read Only Memory, can store large quantities of binary data (553 - 682 megabytes or MB) on a 12 cm disc. The information, consisting of a spiral of small pits, is molded onto one surface which is then coated with a reflective metal layer (aluminum or gold) and a protective polycarbonate lacquer. The pits are read by collecting the reflection from a gallium arsenide laser beam. A photo detector then produces a current which is decoded to provide computer information. (Laub, 1986).

Audio CD, introduced into Japan in late 1983 and the rest of the world in early 1984, prepared the way for CD-ROM drives and several data bases released in 1985. A set of standards, the Yellow Book, developed jointly by Sony and Philips in the production of audio CD allowed for the interchangeability of a CD in any CD player. This CD standard specifies a data format, a basic channel and error correction coding, and the physical structure of the disc.

Disc Structure

The disc information is represented by a spiral of small pits which have been molded onto the polycarbonate layer. A metallic coating is then placed on the polycarbonate layer to reflect the laser beam from the CD. A protective lacquer covers the metallic coat and the label covers the top of the CD. The CD is read from the bottom of the disc through the transparent polycarbonate layer. Figure A-1 shows the relationship of the layers on a disc. The pits have sloping sides formed by the laser beam's action on the master.

Figure F-1 - A close-up of a short length of a CD track.



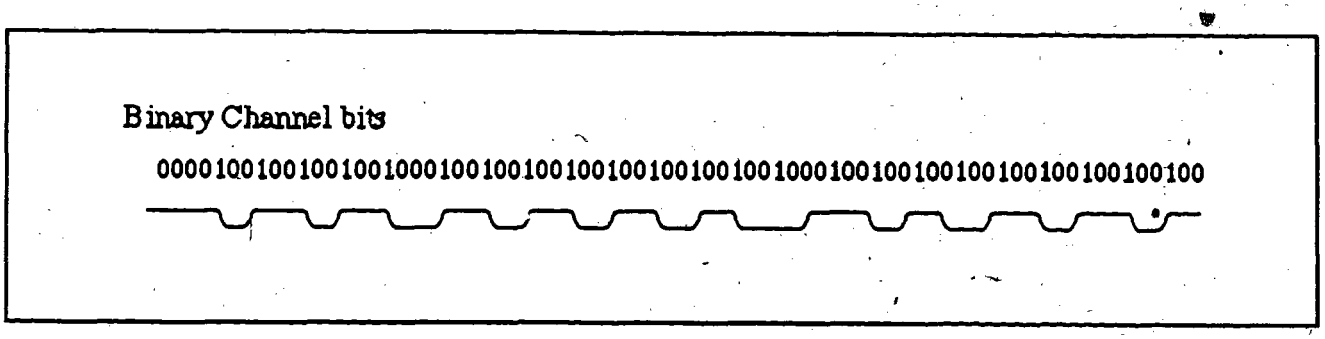
To store the information on the disc, magnetic tape information is used to control a fast shutter which in turn controls a short-wavelength laser beam which forms spots on a photoresist coating of a glass master disc. When the photoresist is developed, it turns the exposed regions into pits. That surface profile is copied onto a physical negative or "stamper". These "stampers" are then used to form the commercial discs by injection molding.

Reading the information on audio CD or CD-ROM

A gallium arsenide laser produces a short-wavelength beam which is focused into a small circular spot about 1 μm (1/25,000 inch) in diameter in order to read the pits on the disc. The amount of light reflected back into the objective lens is then measured. Light striking the sloping sides of a pit is scattered, while the light striking a flat section is reflected back into the lenses. The reflected light goes to a photo detector which produces a current proportional to the amount of light. This current thus changes each time the laser beam moves from a pit to land or back again. This modulated current is then decoded.

A binary channel code is used to represent the information on the disc. A "1" is assigned to a transition (the beginning and ending of a pit) while "0's" are used to fill in the length of the space between transitions.

Figure F-2 - A section of track showing the pits and lands (the spaces between pits)



The channel code for CD and CD-ROM is called EFM (eight-to-fourteen modulation) An EFM decoder in a CD-ROM drive converts the binary channel code to 8-bit computer data bytes. To represent 8-bit bytes and meet hardware requirements (self-clocking data which do not interfere with the servomechanisms), a minimum of 14 channel bits are required. Because sets of 14 channel bits cannot be placed immediately adjacent to each other, 3 more bits, called merge channelbits, are inserted. Thus each computer byte requires 17 channelbits.

On a CD, a set of 24 of these 17-bit symbols is combined with a sync pattern of 27 channel bits, a control and display symbol of 17 channel bits and eight error correction symbols of 17 channel bits each to form a frame with a total of 588 channel bits. A frame, the basic unit of information storage on a CD, contains 24 bytes of user data. Ninety-eight frames form a sector or block which contain 2452 bytes on an audio CD or 2048 bytes in the CD-ROM standard. The CD-ROM contains fewer bytes because it must carry extra error correction, sync and address bytes. The CD-ROM block thus contains 12 bytes of synchronization, 4 bytes of ID (minute, second, block, mode), 2048 user data bytes and 288 bytes of Layered Error Correction.

Storage Capacity of CD-ROM

A CD disc can hold up to 74 minutes of data but the last 14 minutes occupy the outer 5 mm of the disc. Since this is the hardest area to make well and keep clean, CD-ROM discs, up to now, use only 60 minutes of storage.

The 60 minutes available can store 270,000 blocks or 553 MB of information. If and when CD-ROM discs expand to occupy the full 74 minutes, a total of 682 MB of information can be achieved.

Present CD-ROM discs can hold the text content of 150,000 - 250,000 printed pages or the contents of 1200 to 1500 standard 5.25-inch floppy disks.

CD-ROM formats

The bit structure of CD-ROM discs is almost identical to the CD audio specification. The arrangement of these bits into frames and sectors has already been discussed. However, the arrangement of the sectors into logical blocks and the logical blocks into files has been left to application and retrieval software developers. This has resulted in the development of several formats.

High Sierra (ISO 9660) Format

The High Sierra Group, made up of representatives from Apple Corporation, Digital Equipment, Hitachi, LaserData, Microsoft, 3M, Philips, Reference Technology, TMS, VideoTools, Xebec and Yelick, met in November 1985 to define a further standard for CD-ROM. (Buddine and Young, 1987). The High Sierra specification defines the logical structure, the file structures and two standard record structures: fixed length and variable-length. It also allows access to multi-volume CD-ROM sets.

This standard, with minor changes, was formally approved by the International Standards Organization and renamed ISO 9660 (Bangasser, 1989). It is this standard that is used by the Discis Knowledge Research Inc. for their Discis Books.

CD-ROM XA (Extended Architecture)

This standard, announced jointly by Philips, Sony and Microsoft in August 1988, defines a format for storing compressed audio along with other data on a CD-ROM disc (Ropiequet, 1989; Sugiyama, 1989). It allows the interleaving of audio on the same track as image, text, and program data. The CD-ROM drive reads the data one sector at a time and allocates it to its assigned data transfer channels. There can be up to 16 channels for audio and 32 channels for data.

The number of audio channels is limited by the amount of data bandwidth each audio channel uses. While two channels of full-fidelity CD digital stereo audio fill up the entire bandwidth, the compressed audio signals of CD-ROM XA use up only one-fourth or one-eighth of the total bandwidth. The remaining transfer bandwidth can then be used for interleaving text and graphics information.

The CD-ROM XA controller sends the data portion of the file to system memory and the audio portion to an audio processor in the drive controller circuitry. This audio processor decompresses the audio signal and plays it back in an analog format.

CD-I (Compact Disc Interactive)

CD-I, announced in 1987, stores audio, video, text and data on the 12-cm CD-Audio format disc (Bastiaens, 1989; Ropiequet, 1989). In order to compress the space required for sound, it uses a new digital encoding technique called Adaptive Delta Pulse Code Modulation (ADPCM). Its highest quality sound (high-fidelity stereo sound) uses half the available disc space while the lowest (speech in mono sound) uses 6% of the disc. It also allows audio channels to be used in parallel which may be useful for different languages.

Video data is also being compressed with new digital encoding techniques. A full screen image of 300 KB can be compressed with Delta-YUV encoding to 108 KB while for full-motion cartoons, colour look-up tables and run-length encoding techniques allow an animated cartoon

image to be stored in only 5 to 10 KB. This will allow a CD-I disc to contain an hour's worth of continuous full-screen, full-motion animation with a sound track.

The CD-I disc player contains a 68000 micro-processor built in so it does not need to be hooked into a personal computer. It can be connected to a home T.V. and act much as the present VCR. However, it may suffer from the same problem as did the videodisc since it is read-only medium.

Industrial players should be available in 1990 and consumer players, in 1991. (Gilman, 1989).

DVI (Digital Video Interactive)

DVI can store 72 minutes of full-screen, full-motion digital video and audio on a standard CD-ROM and can be played back on a IBM computer equipped with DVI. (Stauffer, 1989). It was first announced in 1987 by General Electric and RCA. Intel Corporation bought the technology in October 1988 and will work on manufacturing DVI and building a standard.

DVI system software running in MS-DOS and authoring tools were placed in developers' hands in early 1988. The initial kit contained three basic boards with four piggyback boards that filled four slots in a PC/AT or compatible computer. According to Stauffer (1989) Intel planned to design a custom-designed VDP chip set during 1989 which would then be manufactured in volume in 1990. They expect that interactive video products will be ready to launch in 1990.

CD-WO (Compact Disc Write Once)

This disc for which specifications were released by Philips and Sony in February 1988, uses both CD-Audio and CD-ROM formats (Pohlmann, 1989). The disc is pre-grooved and may contain both user-recorded and prerecorded material. Prerecorded data is stored as CD pits while user data is stored as a change in reflectivity.

In any CD-WO disc, the first part of the structure is the TOC (table of contents) stored as pits. If there is prerecorded material, the next section is the prerecorded area also stored as pits. The next section is pre-grooved, starting with the UTOC (user table of contents) and following by the recordable user area. The final part, stored as pits, is the lead-out area.

Both CD-Audio and CD-ROM data can be recorded in one track on a CD-WO disc with a maximum of 99 tracks. A disc can be recorded discontinuously, new tracks starting at the end of previously recorded ones.

The CD-WO is seen as the first step towards a fully erasable and recordable CD.

Data Discman

According to a January 29, 1990 article in The Vancouver Sun, Sony executives the previous week displayed prototypes of a Data Discman which uses a 7.5 cm CD-ROM disc ("Sony Unveils," 1990). Weighing half a kilogram, it is meant to be a portable CD-ROM player. Sony needs to obtain international agreement to adopt the new 7.5 cm discs and its data recording format and has not yet introduced it formally.

CD-ROM Players

Apple introduced a CD-ROM player for the Macintosh in 1988 but now there are several more CD-ROM players that can be used with the Macintosh (Rizzo et al., 1990). Any one of them can play the Discis Book as well as CD-ROM discs containing Macintosh software. (For a comprehensive list of currently available CD-ROM discs, see Oberlin and Cox, 1989; for a list of the most popular, see Onosko, 1990).

However, drives do not all have the same merits. Speed is the most important factor to examine in buying a drive because CD-ROM drives are slow. Table F-1 shows the average access time for the six drives tested by the MacUser staff in their March, 1990 issue (Rizzo et al., 1990).

Table F-1 - Average Access Time for Six Macintosh-compatible CD-ROM Drives

Drive	Average access time (milliseconds)
AppleCD SC	550
CD Technology Porta-Drive	410
Denon DRD-253	920
NEC CDR-77	570
OMI ProCDP	575
Toshiba XM-3201 A1 MAC	410

The transfer rate of information from the CD-ROM drive to the Macintosh is limited by the Sony-Philips CD-ROM standard (the Red Book) to 153K per second. The CD Technology Porta-Drive, OMI ProCDP and Toshiba XM-3201 A1 MAC achieved this rate while the AppleCD SC and the NEC CDR-77 were a bit slower. However the Denon DRD-253 transferred data at only 86K per second.

Other factors that can affect the value of a CD-ROM drive are its automatic adjustment to differing power sources, its size, software and other considerations. The AppleCD SC can adjust to U.S. or European power and has excellent audio software but no AC fuse. The CD Technology Porta-Drive was given high points for having one of the fastest performances, being least expensive, smallest, lightest and being able to be set for U.S. or European power. However it has no audio software and no AC fuse. The Denon DRD-253 has an internal speaker and an internal AC fuse but is very slow, has only one SCSI connector and no audio software. The NEC CDR-77 has audio software and an internal AC fuse but is very slow. The OMI ProCDP has a very good overall speed, adjusts to U.S. European power and has an external AC fuse but it has slow access times, is the most expensive, largest and heaviest and has no audio software. The

Toshiba XM-3201 A1 MAC is the other one with the fastest performance, also adjusts to U.S. or European power, is compact and has an internal AC fuse but has no audio software.

Table F-2 shows their U. S. A. prices and their relative merits out of 5.0 as judged by the MacUser Staff, based on their speed and other factors.

Table F-2 - Relative Merits and Prices of Macintosh-compatible CD-ROM Drives

Drive	MacUser points	U. S. Price
AppleCD SC	4.0	$1,199.00 [a]
CD Technology Porta-Drive	4.5	$895.00
Denon DRD-253	2.5	$990.00
NEC CDR-77	2.5	$1,198.00 [b]
OMI ProCDP	4.0	$1,488.00
Toshiba XM-3201 A1 MAC	4.5	$970.00

[a] price change occurring (March 20)

[b] includes a $199.00 SCSI interface kit.

Appendix G

"The Tale of Peter Rabbit" Screen Samples

Figure G-1 - Title page with arrow cursor showing no mouse action possible

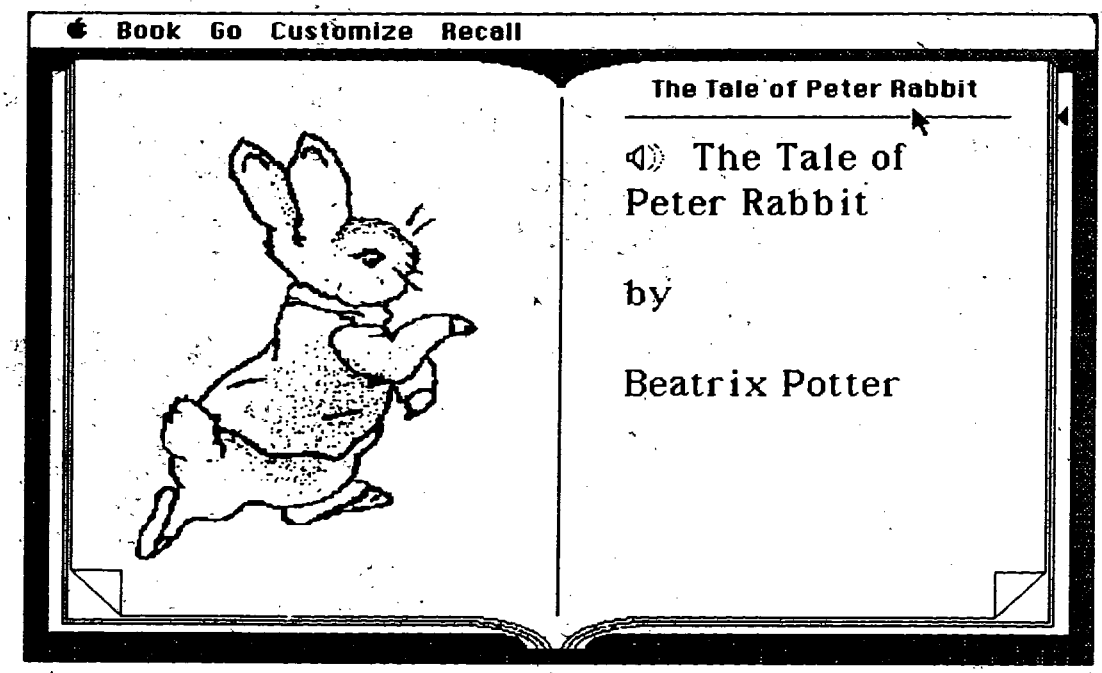


Figure G-2 - Title page with hand cursor showing mouse click on words possible

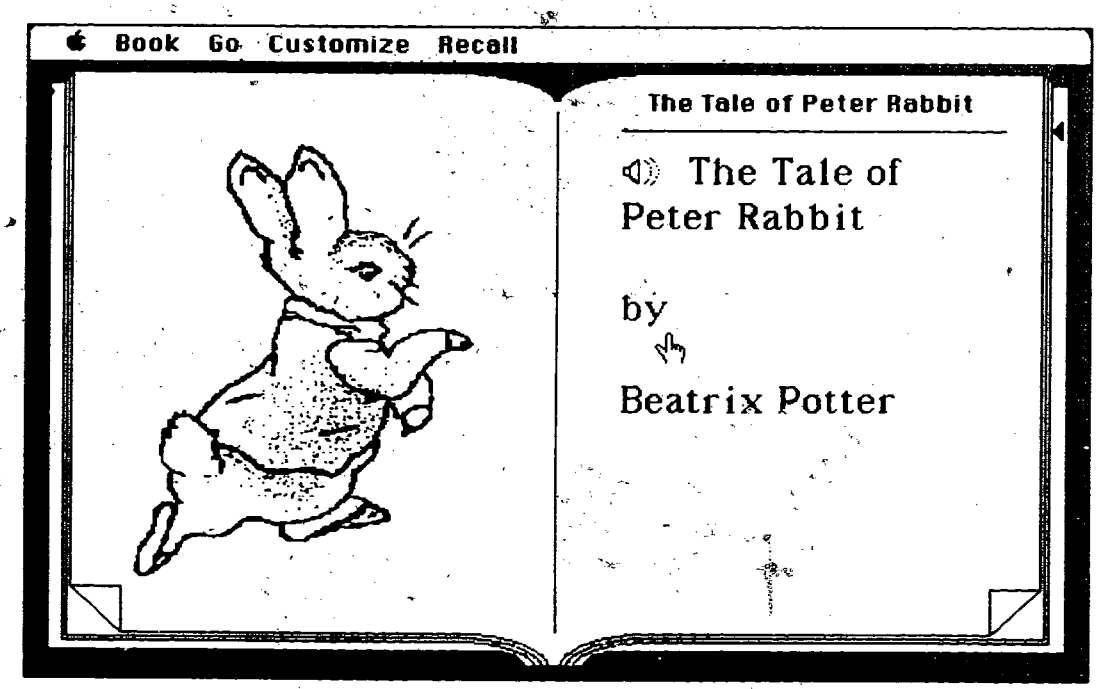


Figure G-3 - Clicking on a picture the first time giving the object's name

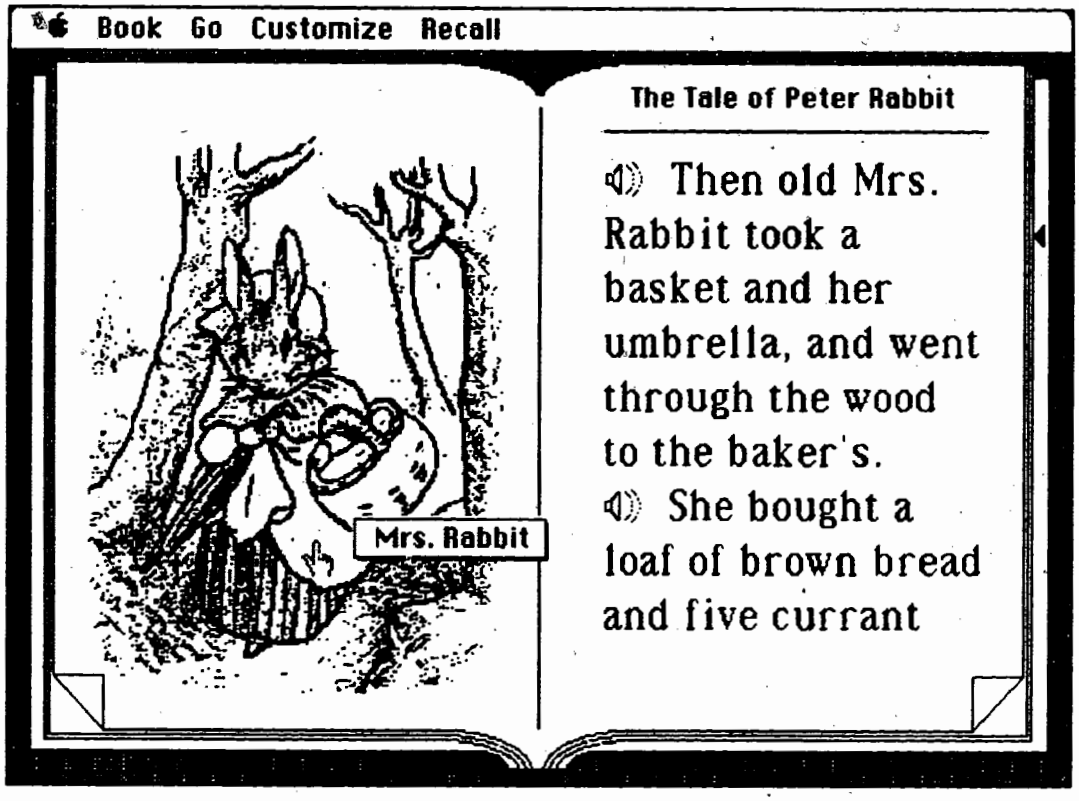


Figure G-4 - Clicking on the same object a second time giving a detail's name

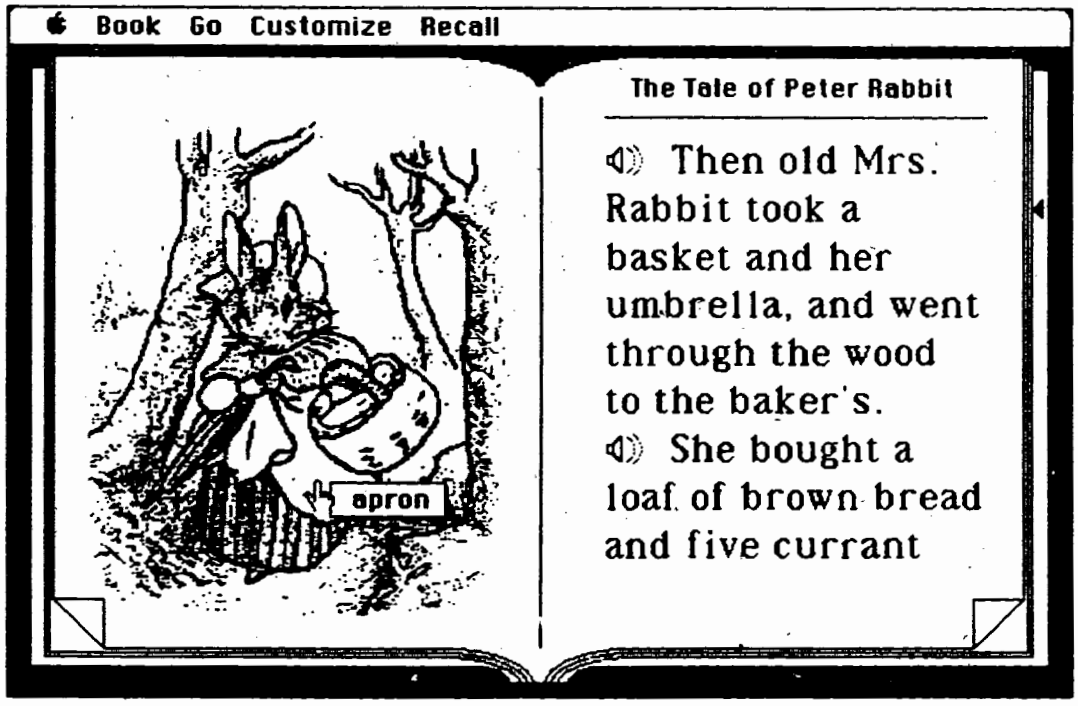


Figure G-5 - Customizing pictures for a mouse click

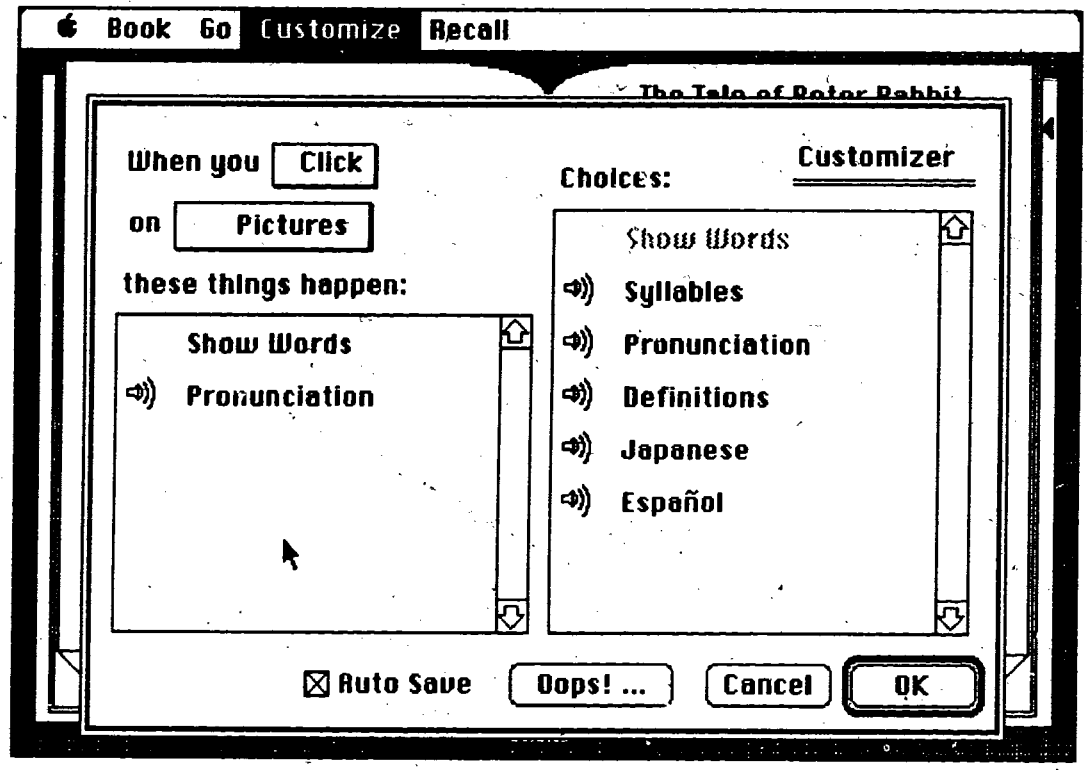


Figure G-6 - Customizing sentence speakers

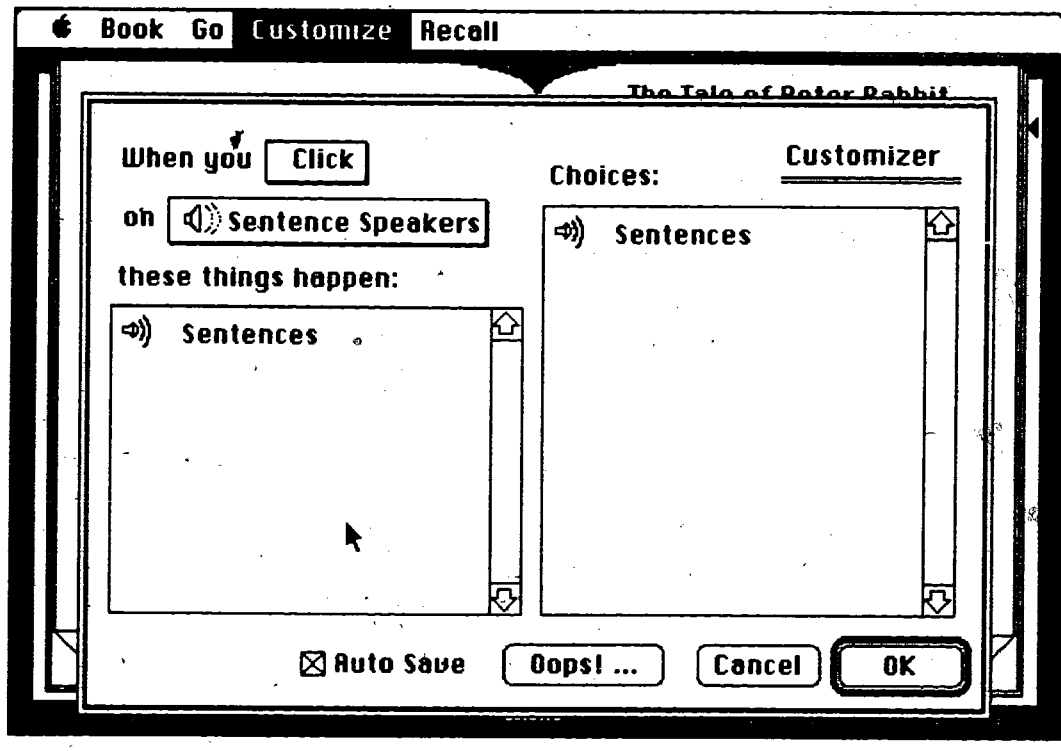


Figure G-7 - Customizing words for a mouse click

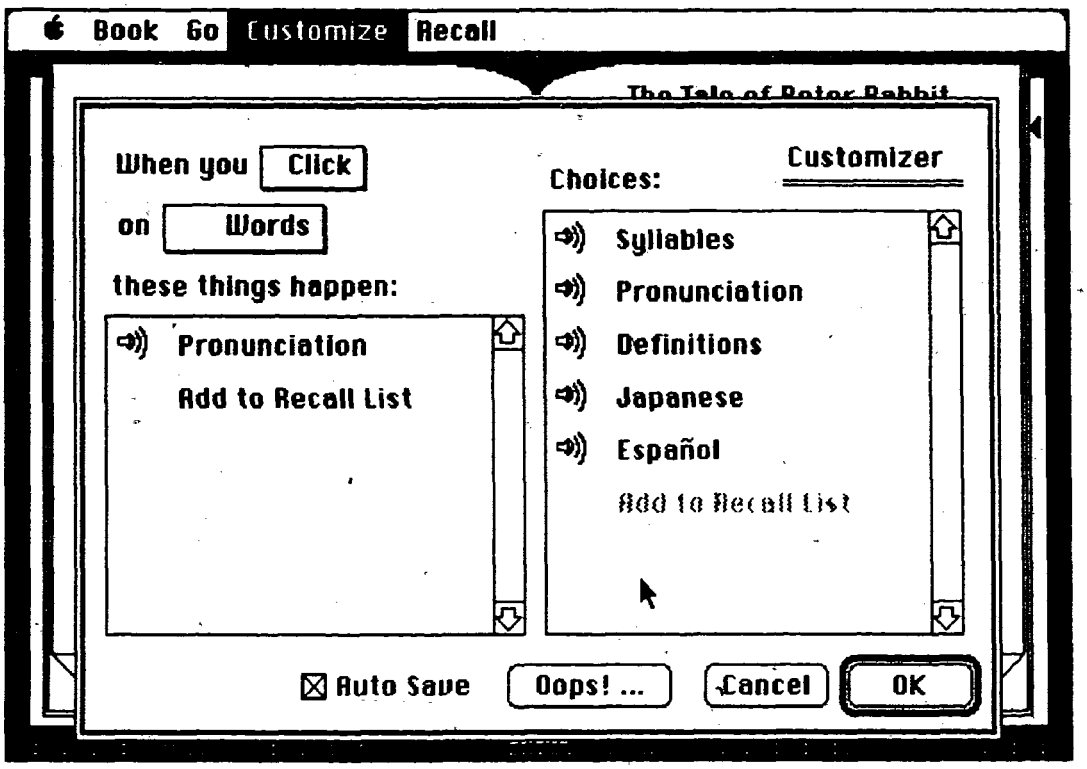


Figure G-8 - Customizing words for a double-click

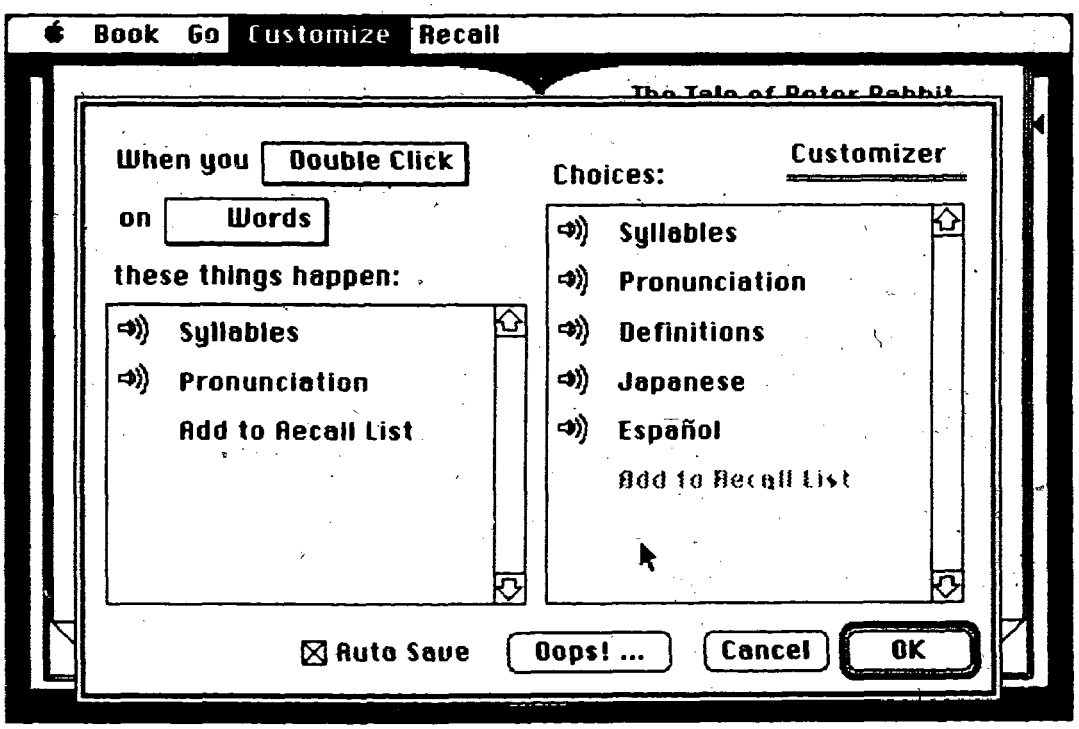


Figure G-9 - Customizing words for press and hold

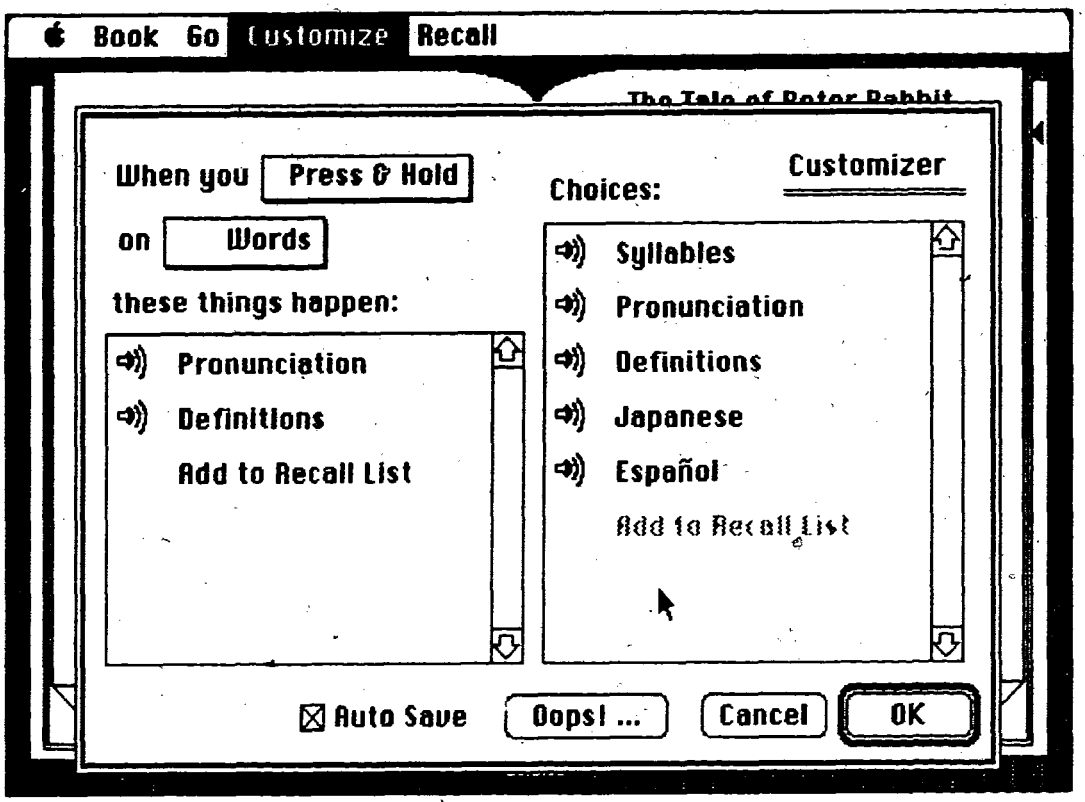
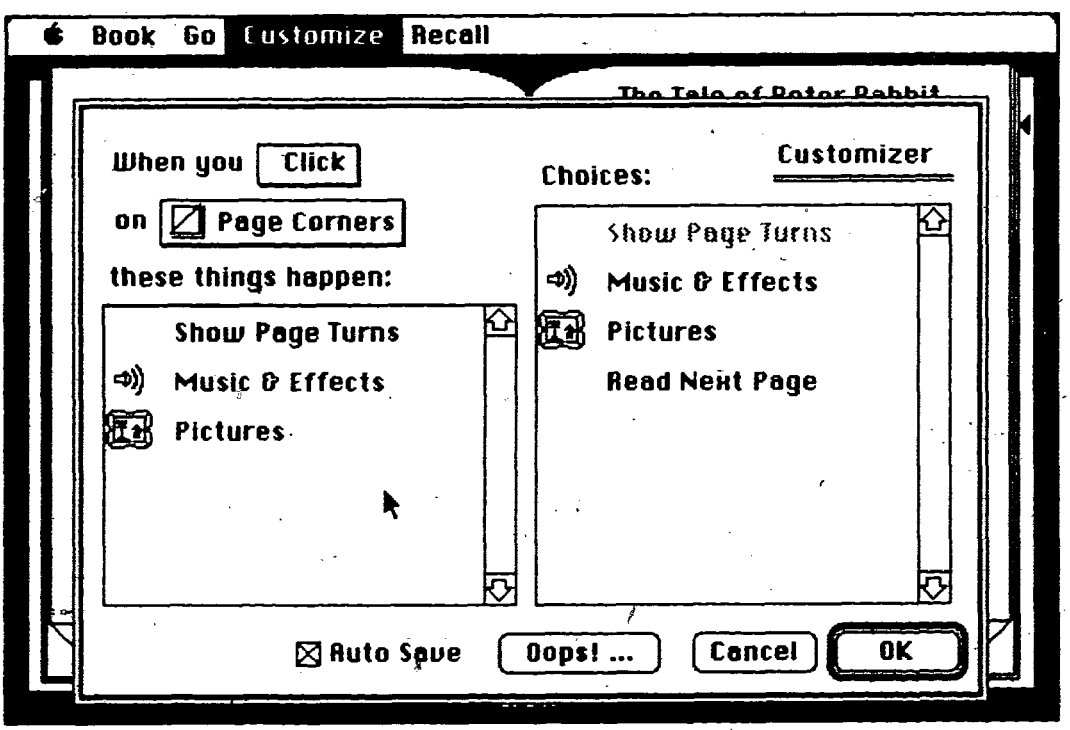


Figure G-10 - Customizing page corners for click



Fgure G-11 - Customizing page corners for double-click

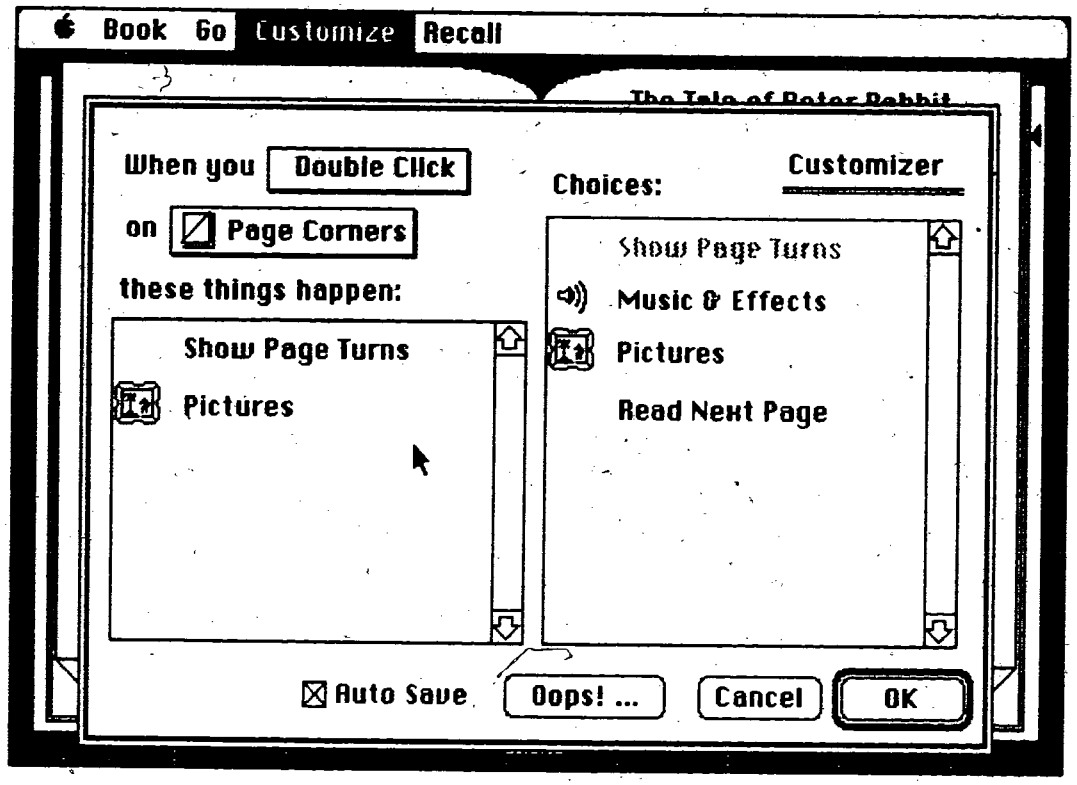


Figure G-12 - Customizing page corners for press and hold

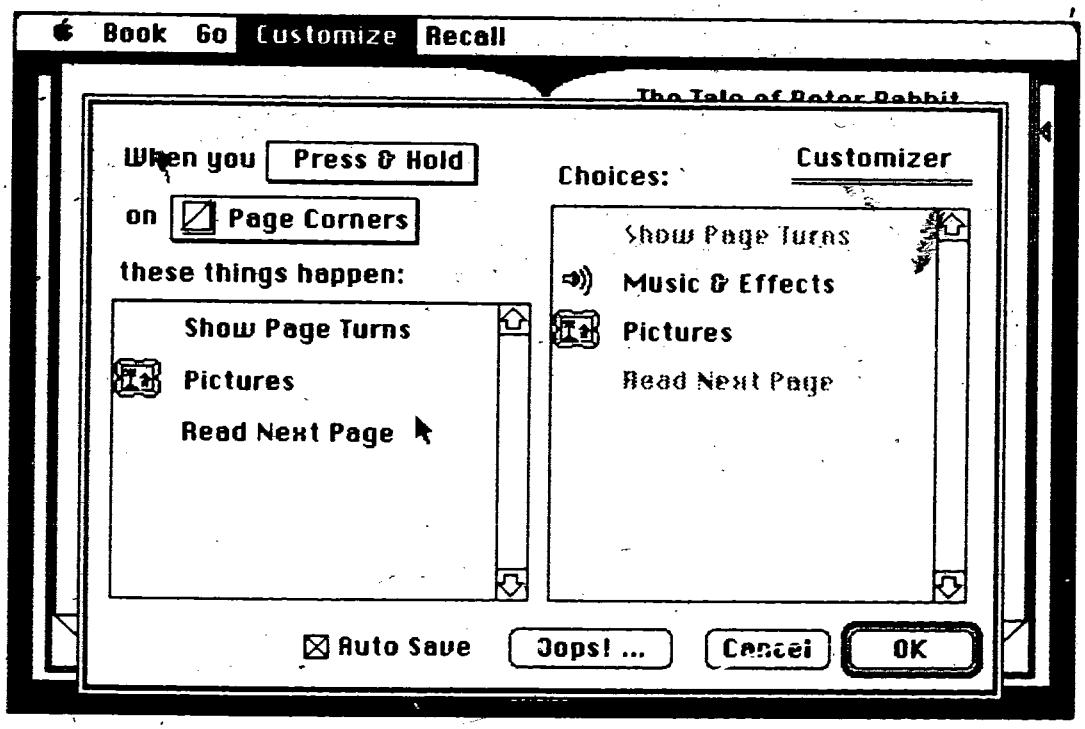


Figure G-13 - Setting sound volume

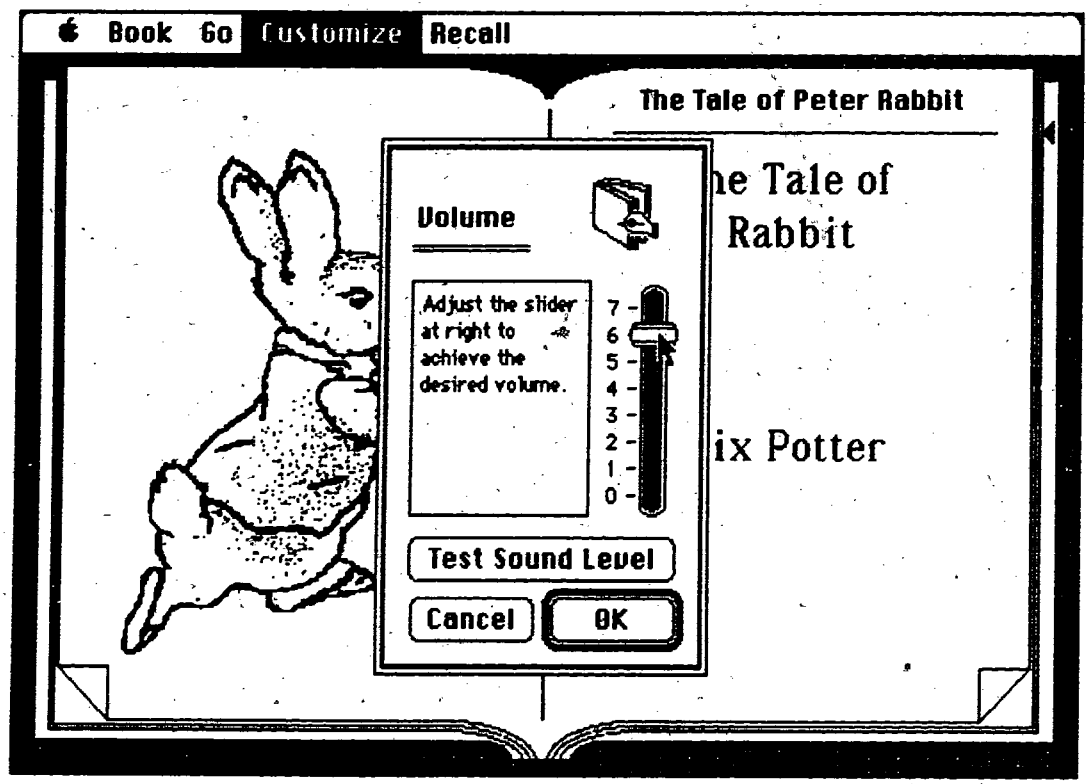


Figure G-14 - Setting the phrase pauses for page 2

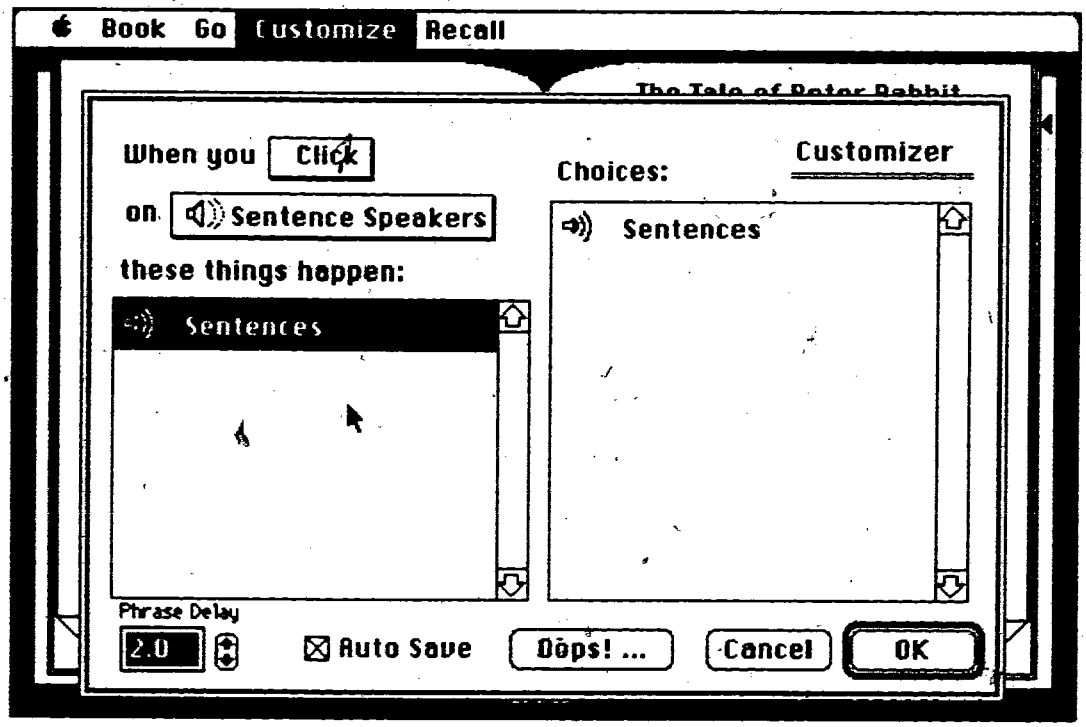


Figure G-15 - Default font: New York size 18

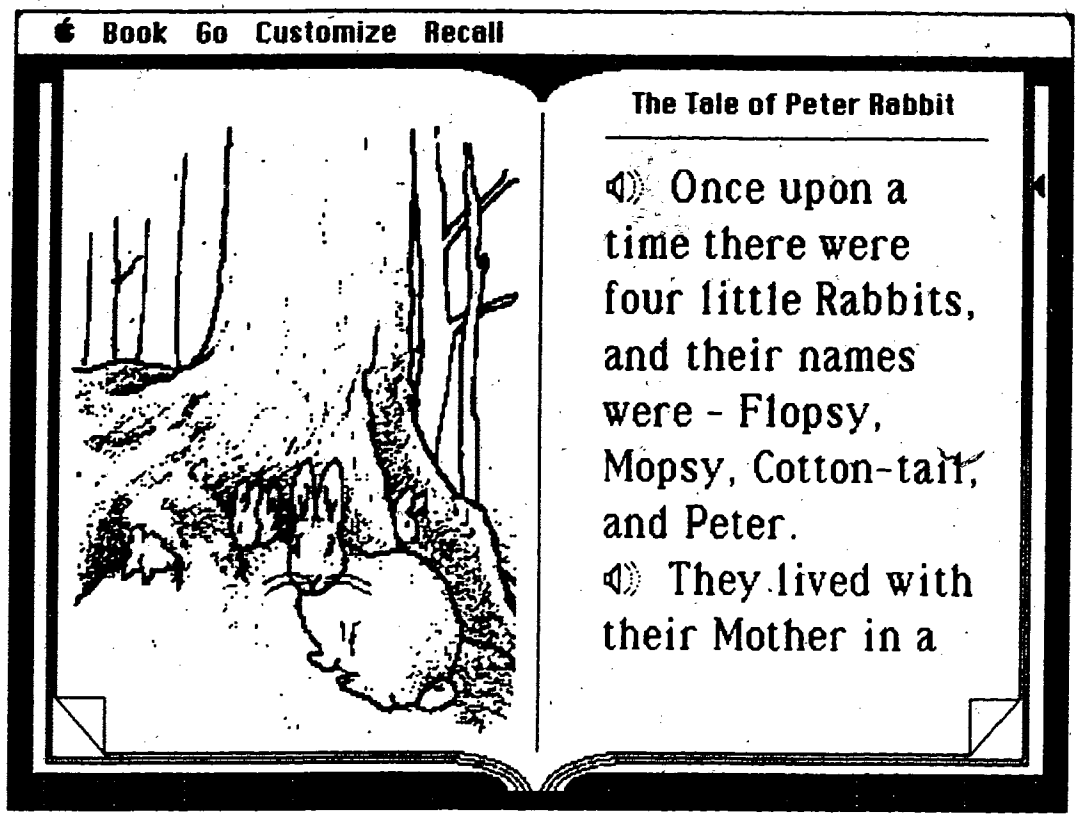
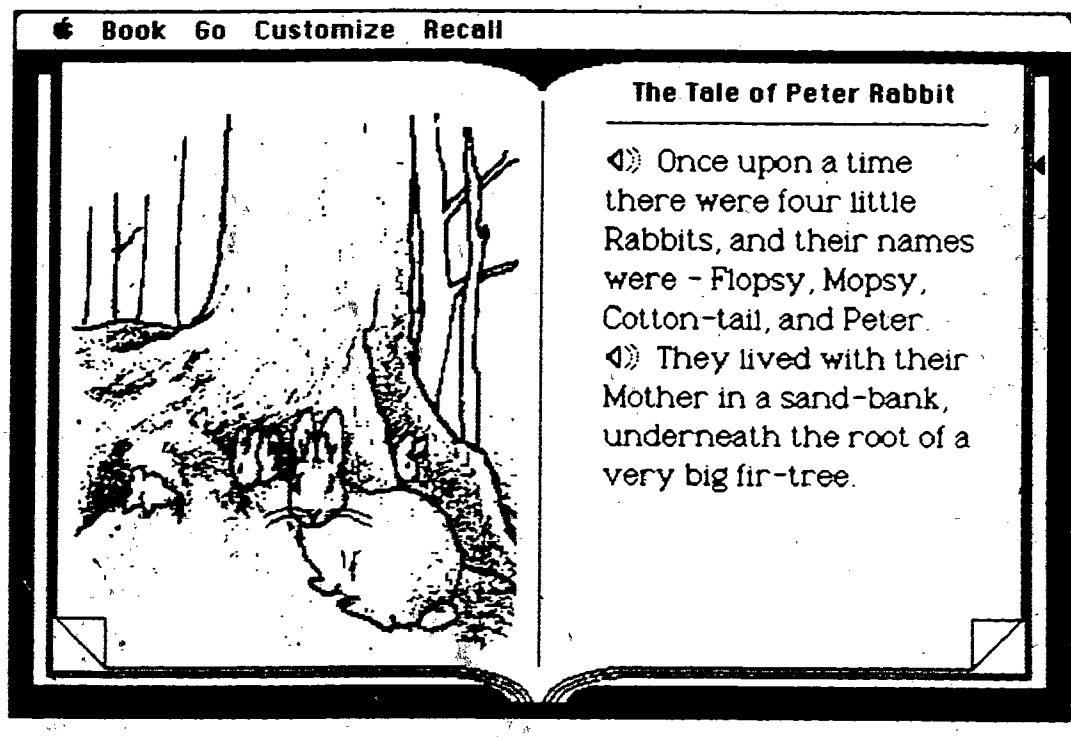


Figure G-16 - Font: New York size 14



Appendix H

"The Tale of Peter Rabbit"

Figure H-1 - page 0

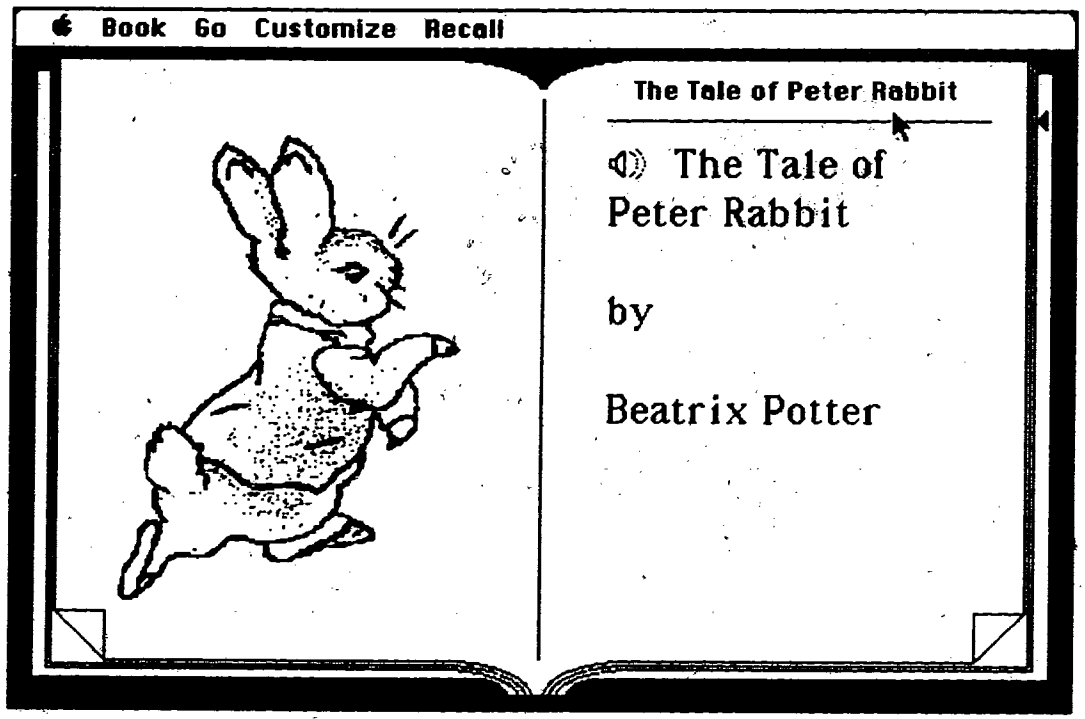


Figure H-2 - page 1

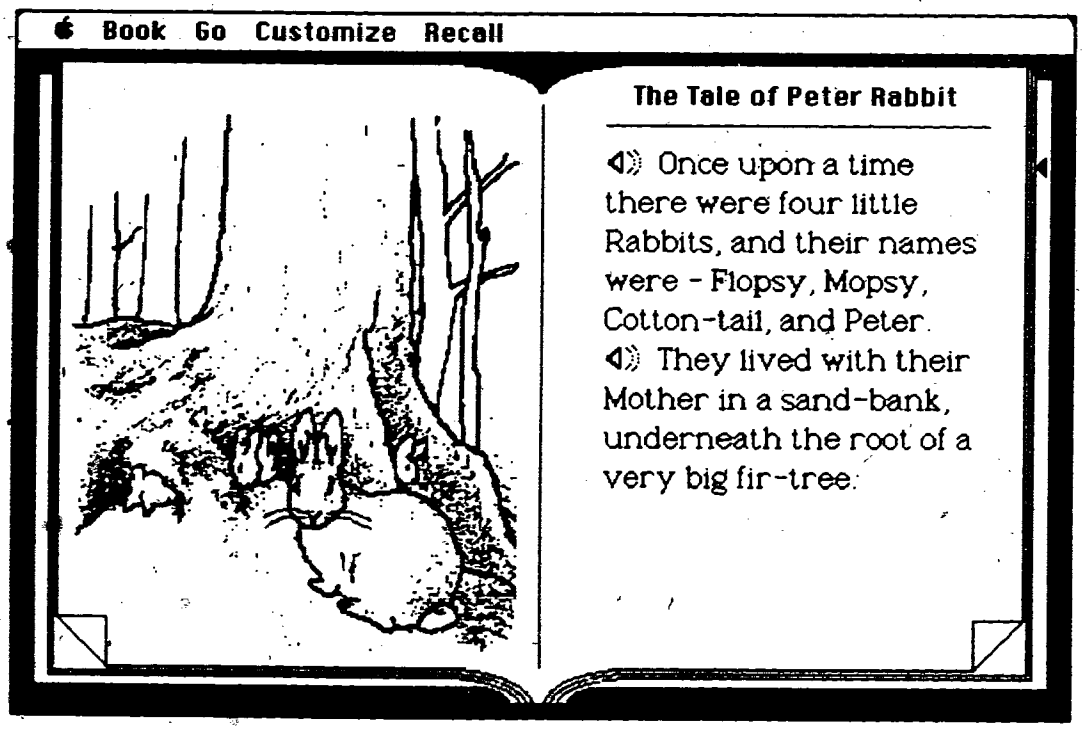


Figure H-3 - page 2

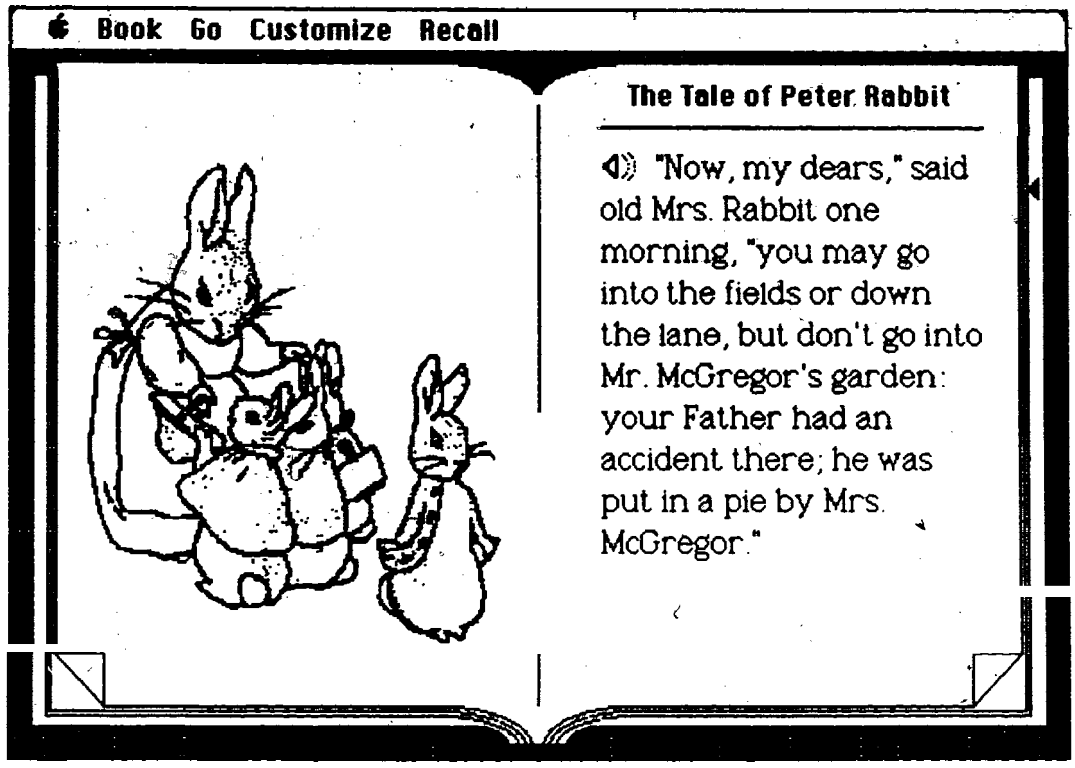


Figure H-4 - page 3

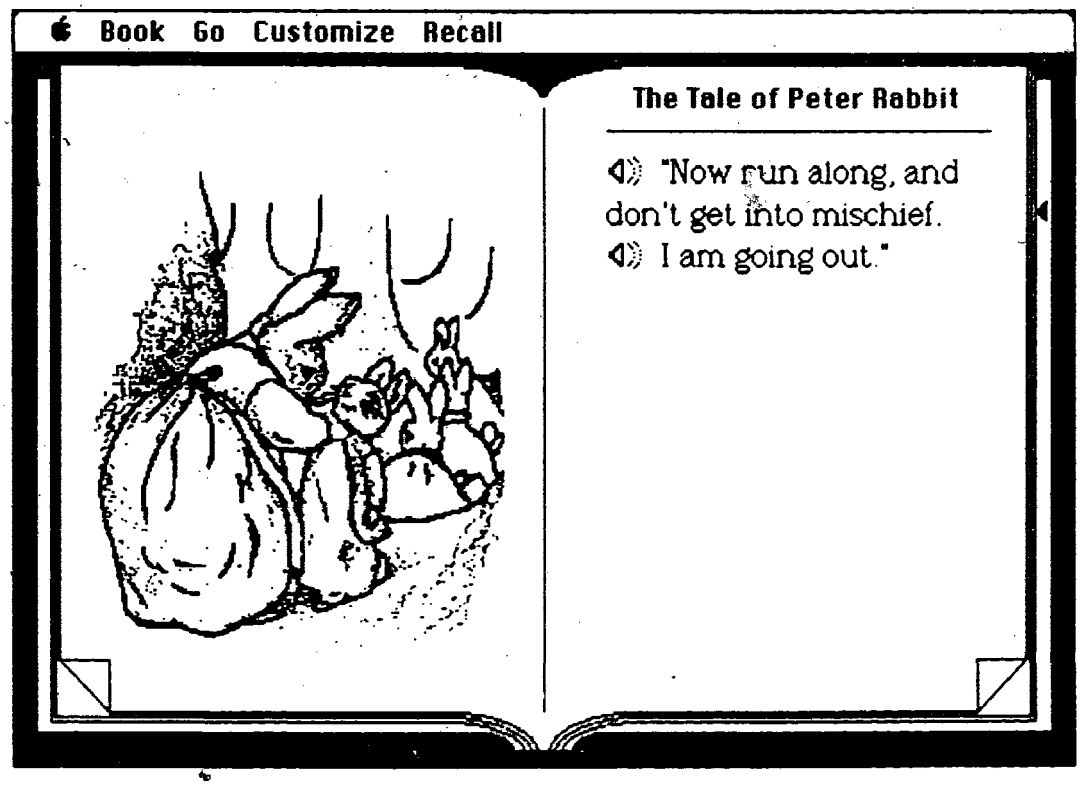


Figure H-5 - page 4

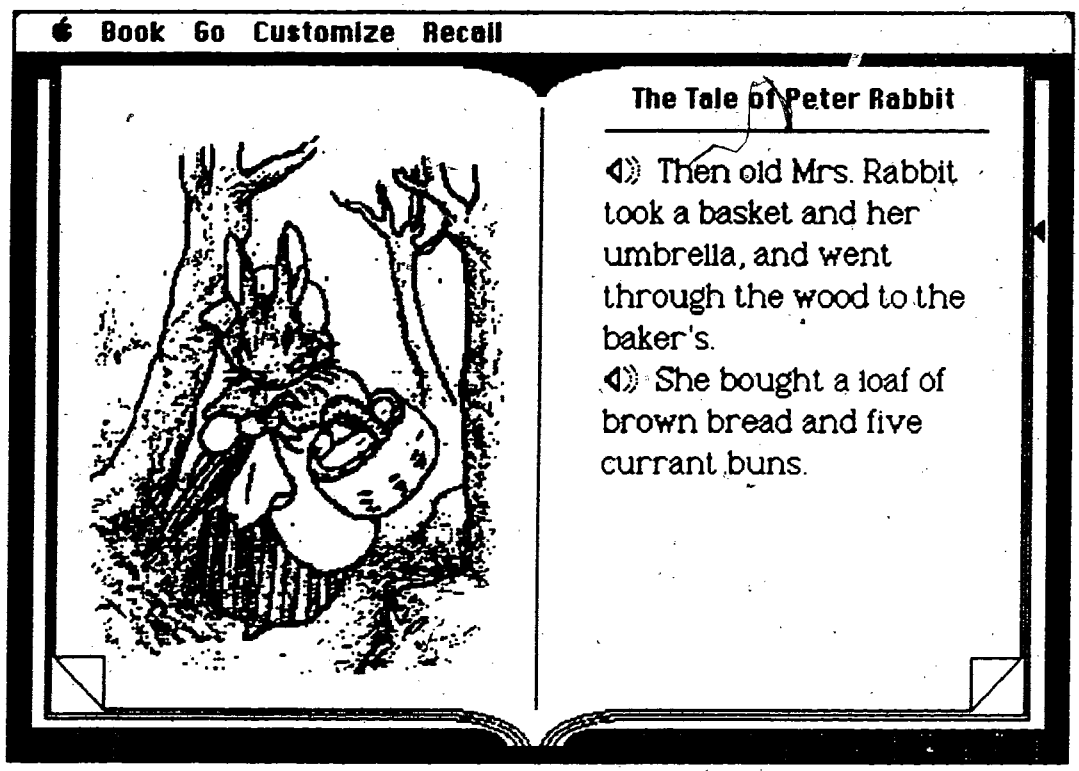


Figure H-6 - page 5

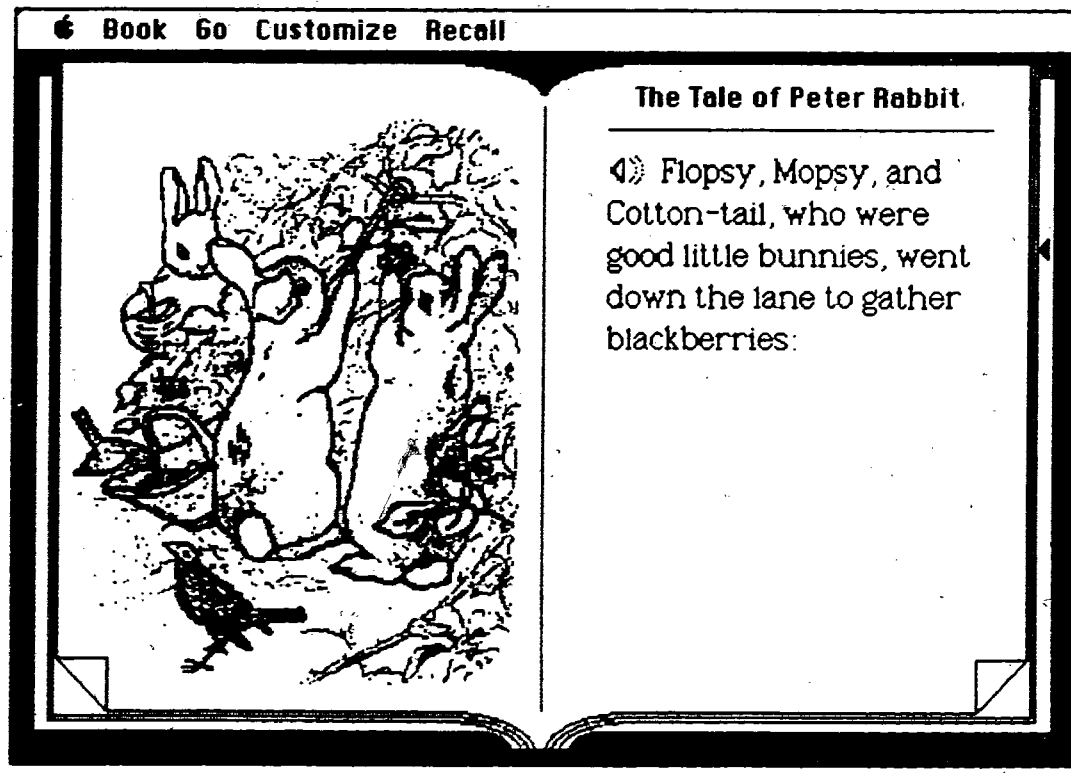


Figure H-7 - page 6

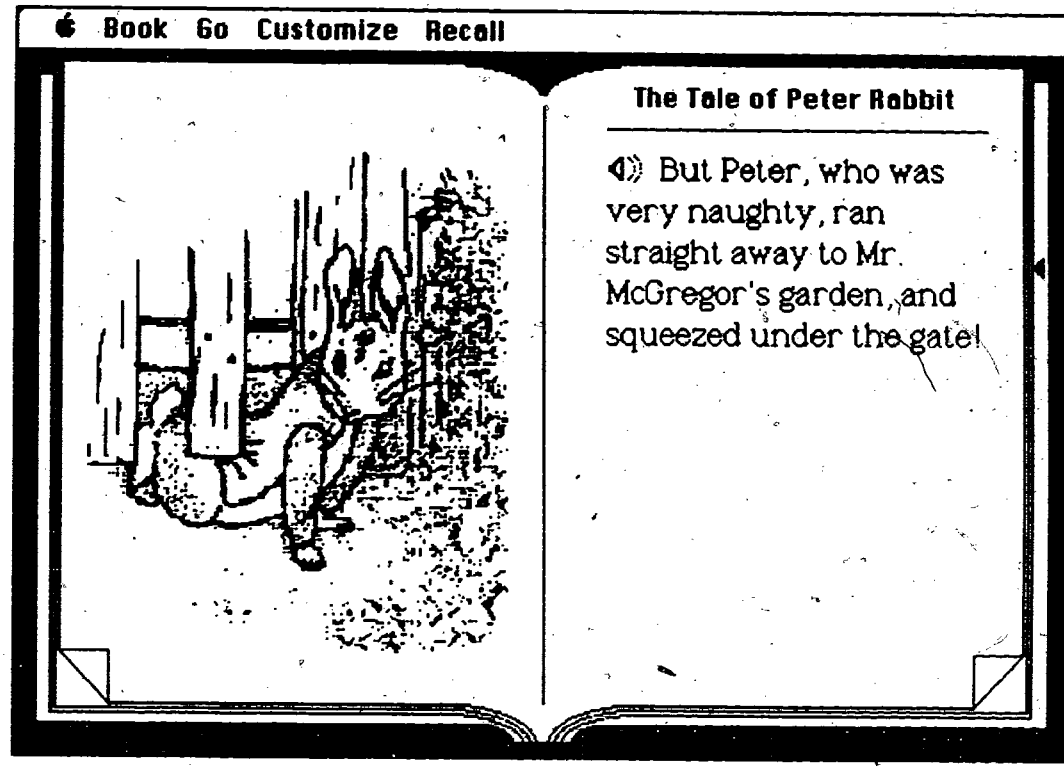


Figure H-8 - page 7

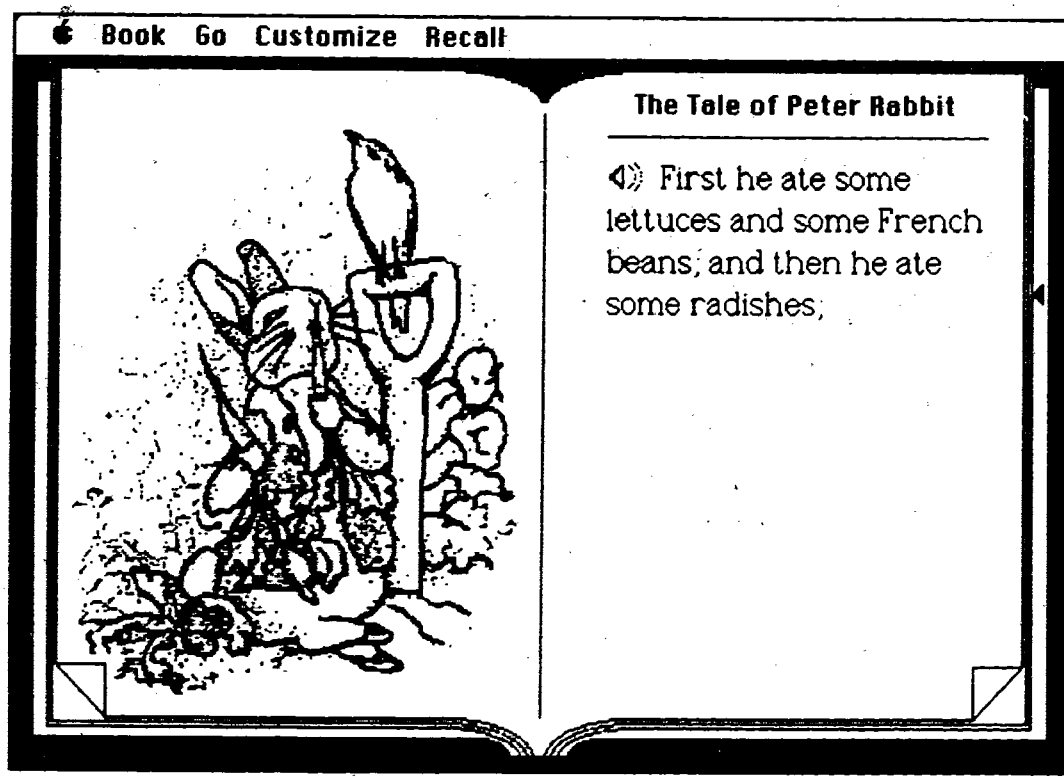


Figure H-9 - page 8

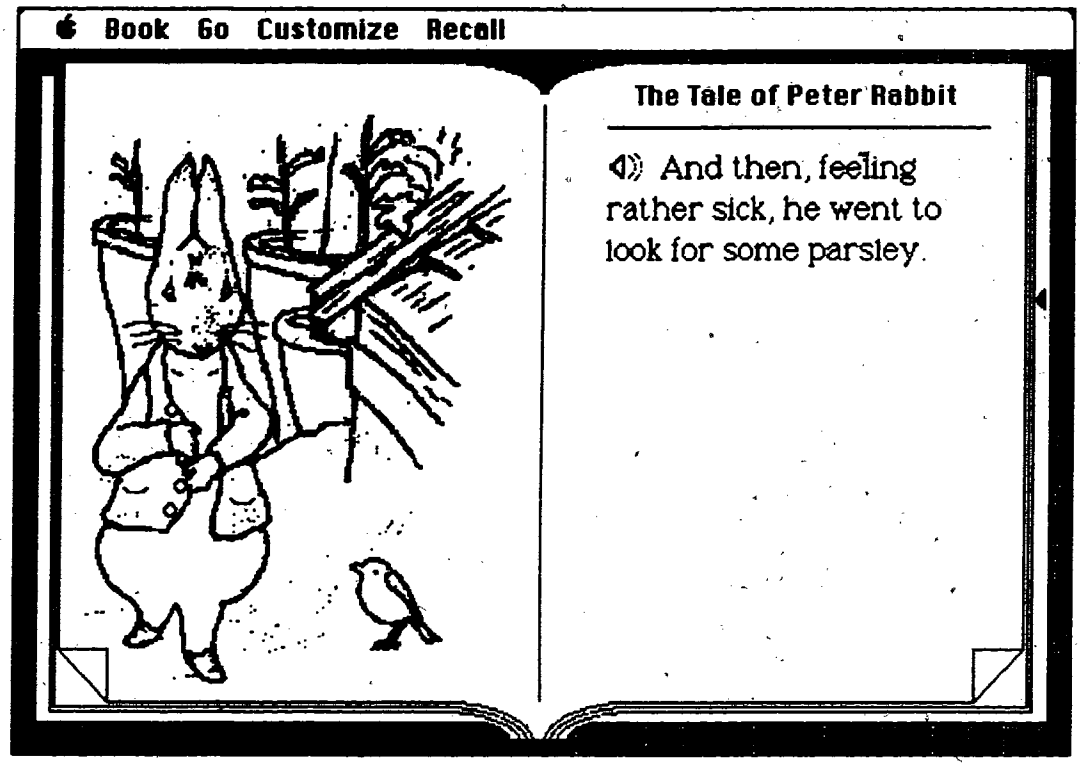


Figure H-10 - page 9

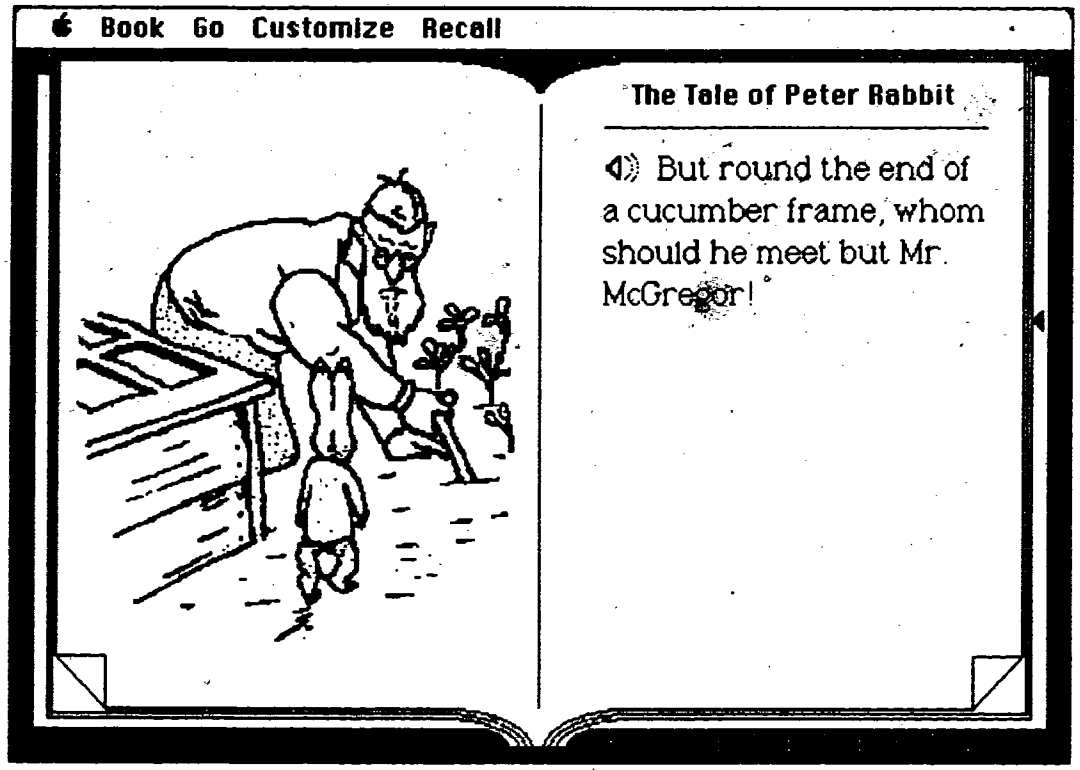


Figure H-11 - page 10

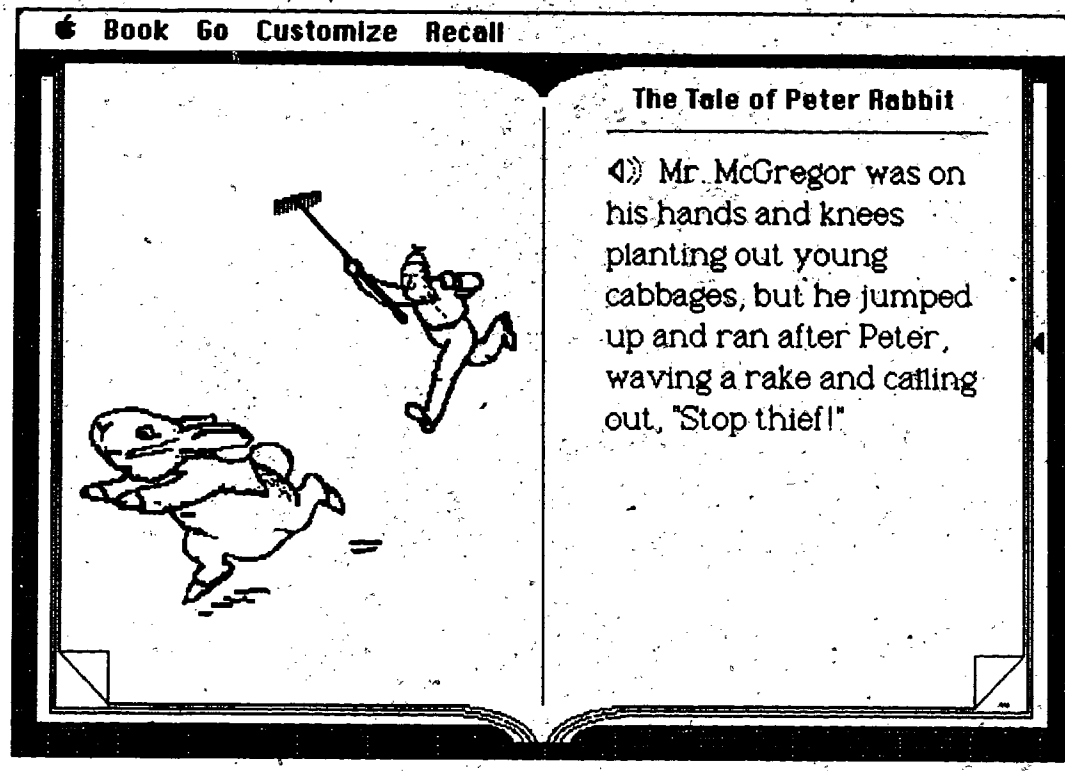


Figure H-12 - page 11

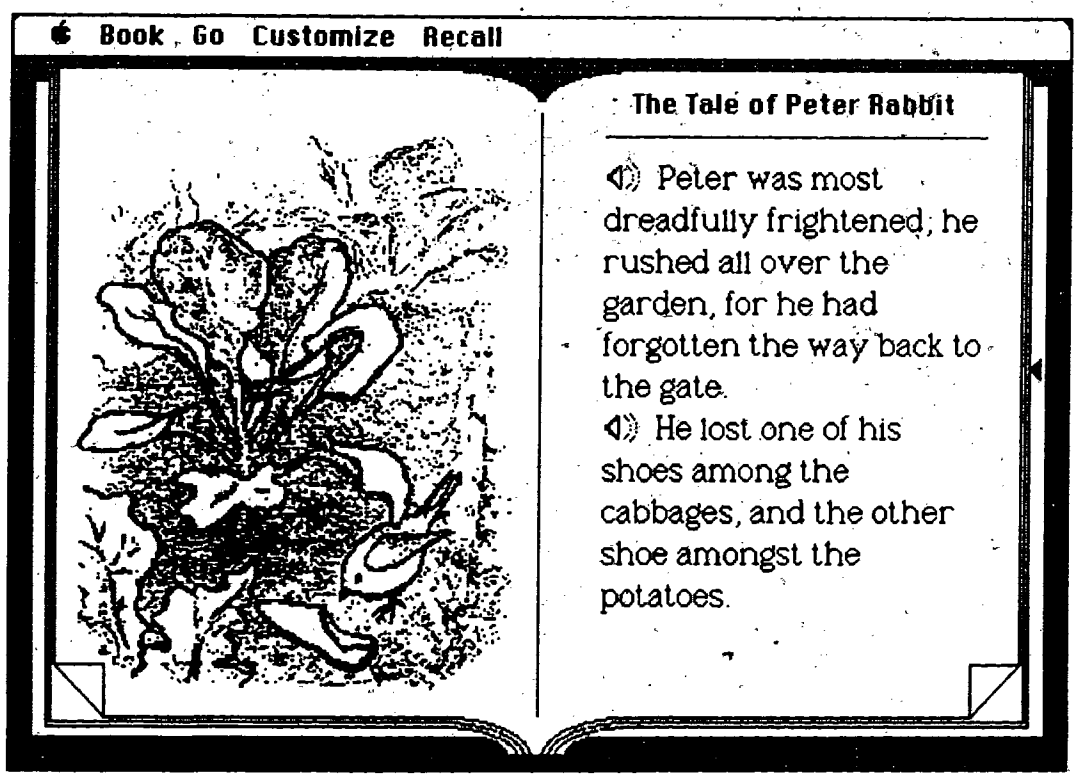


Figure H-13 - page 12

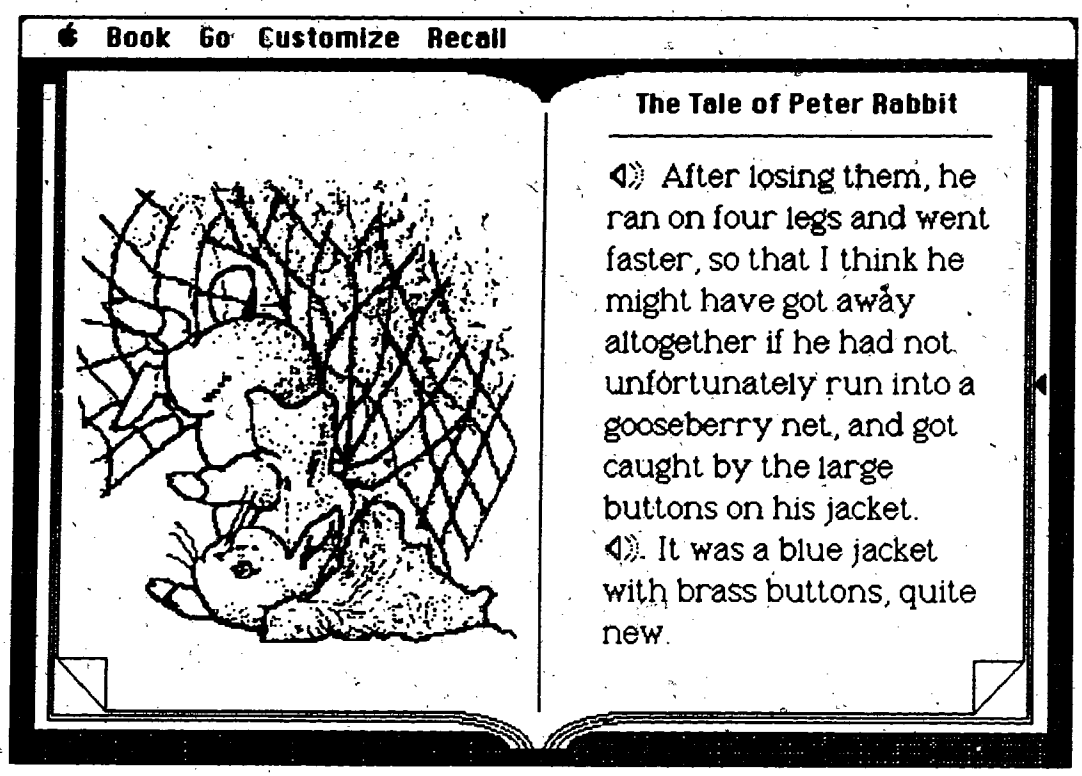


Figure H-14 - page 13

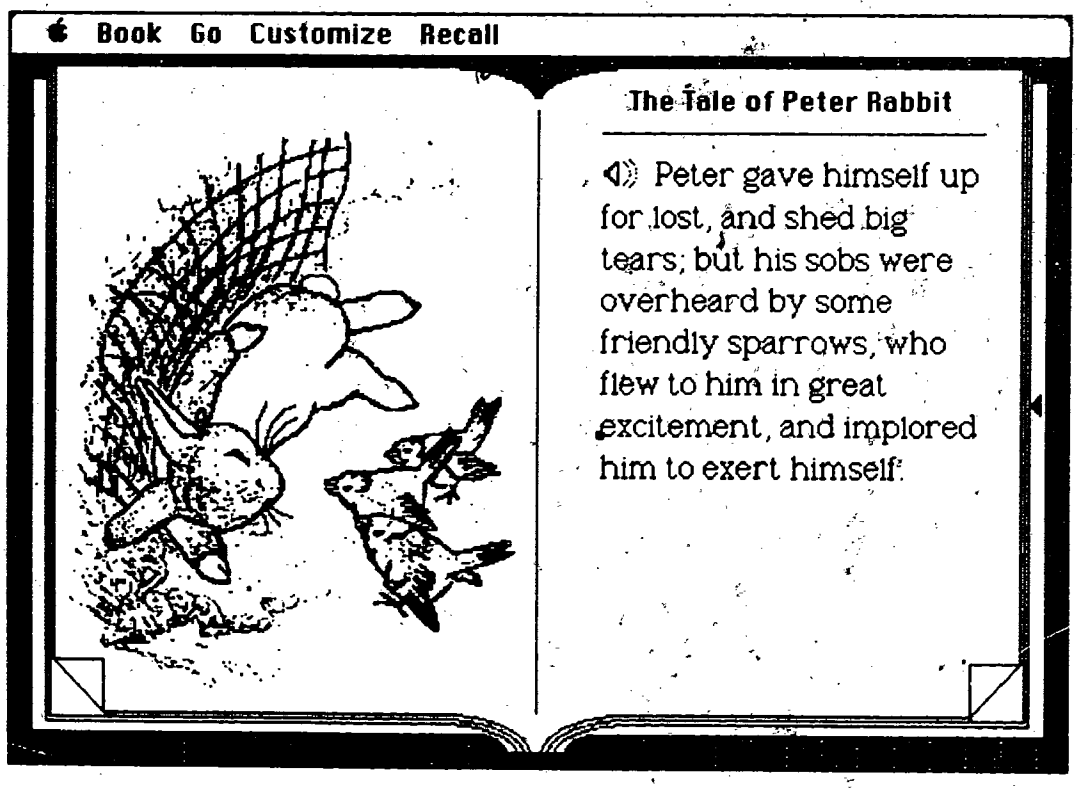


Figure H-15 - page 14

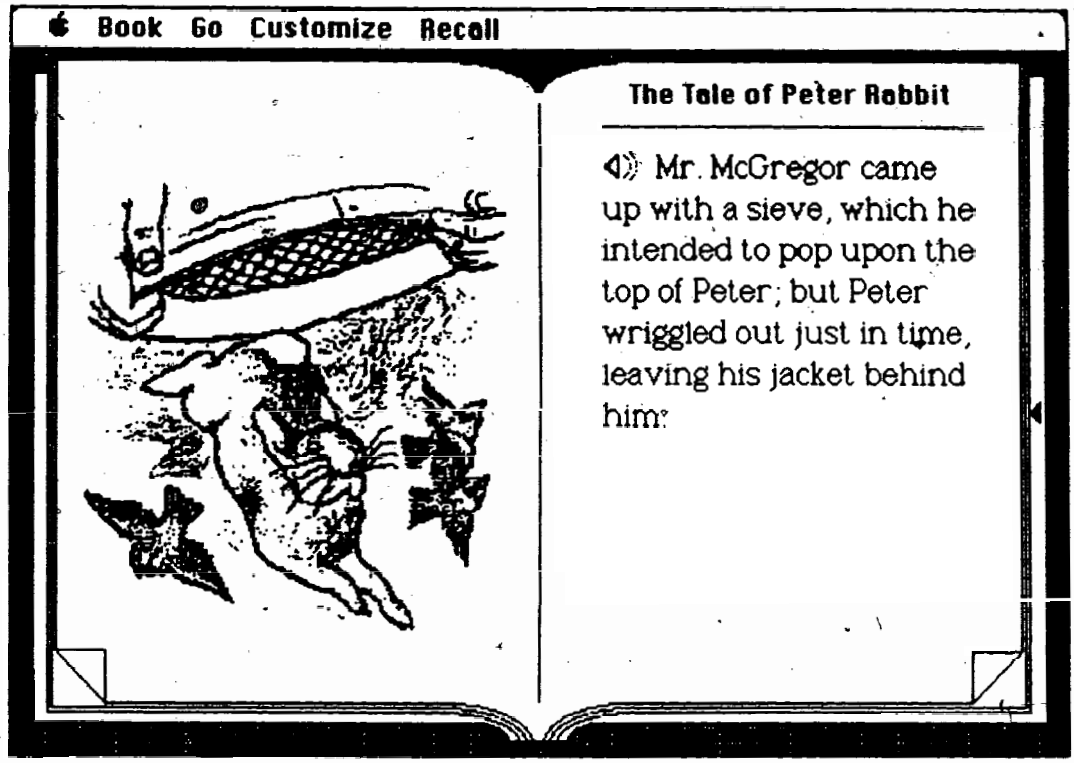


Figure H-16 - page 15

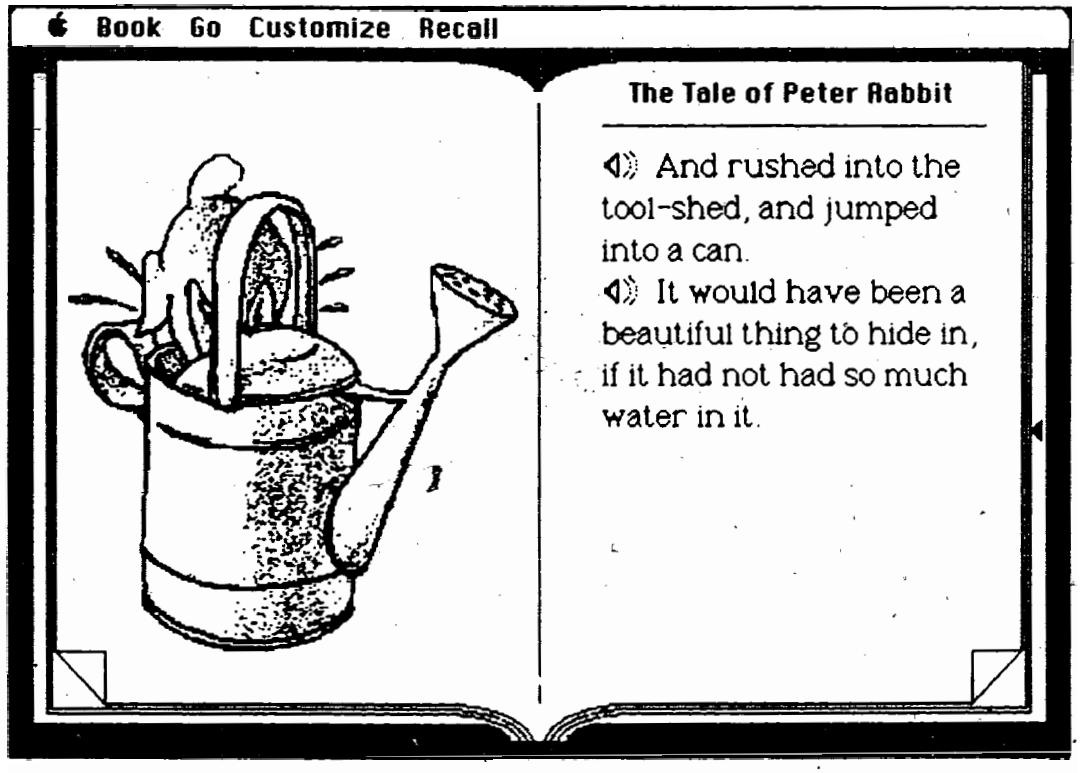


Figure H-17 - page 16a

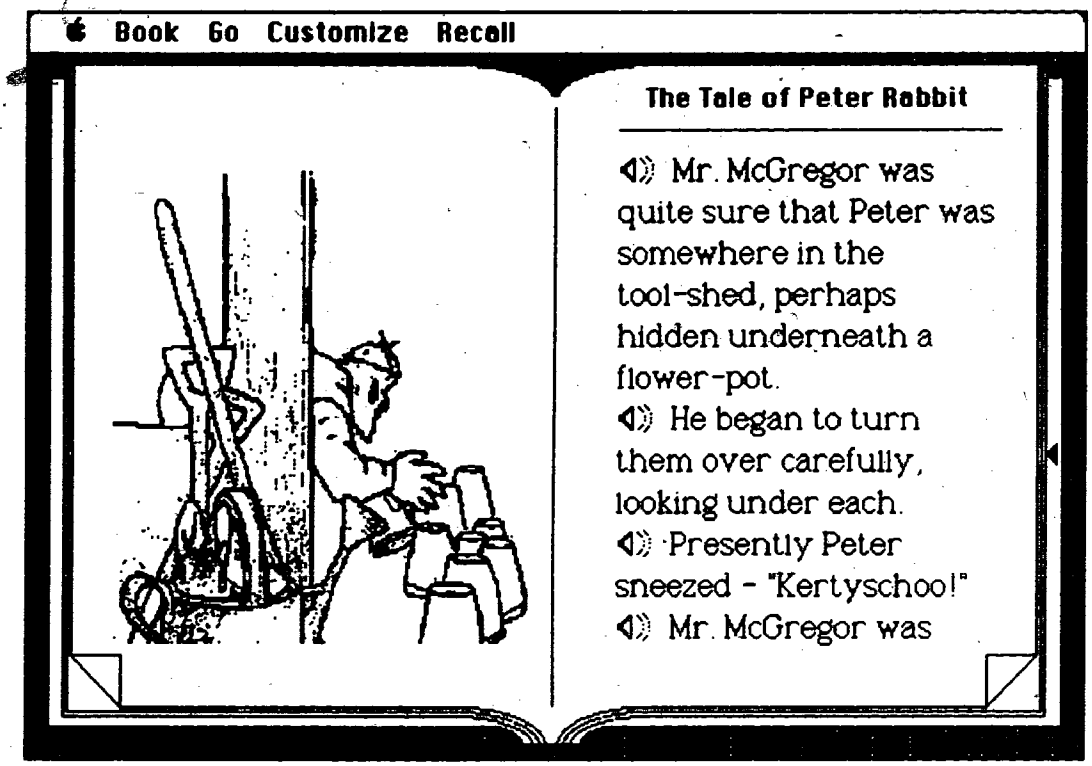


Figure H-18 - page 16b

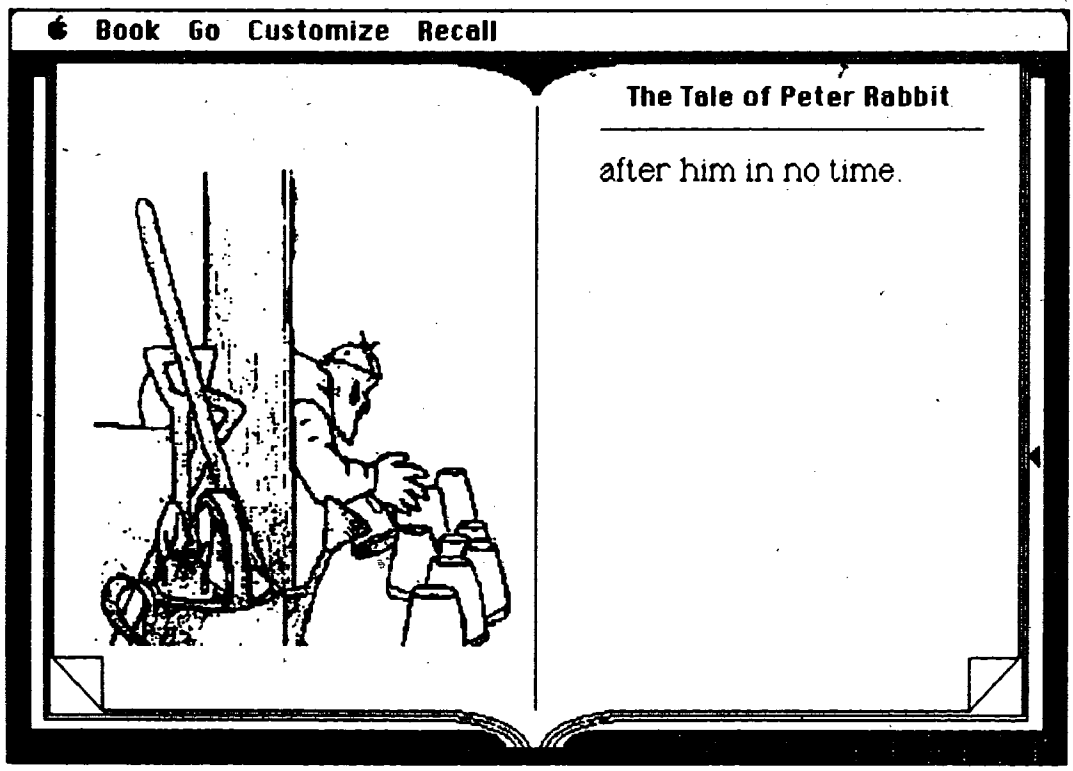


Figure H-19 - page 17

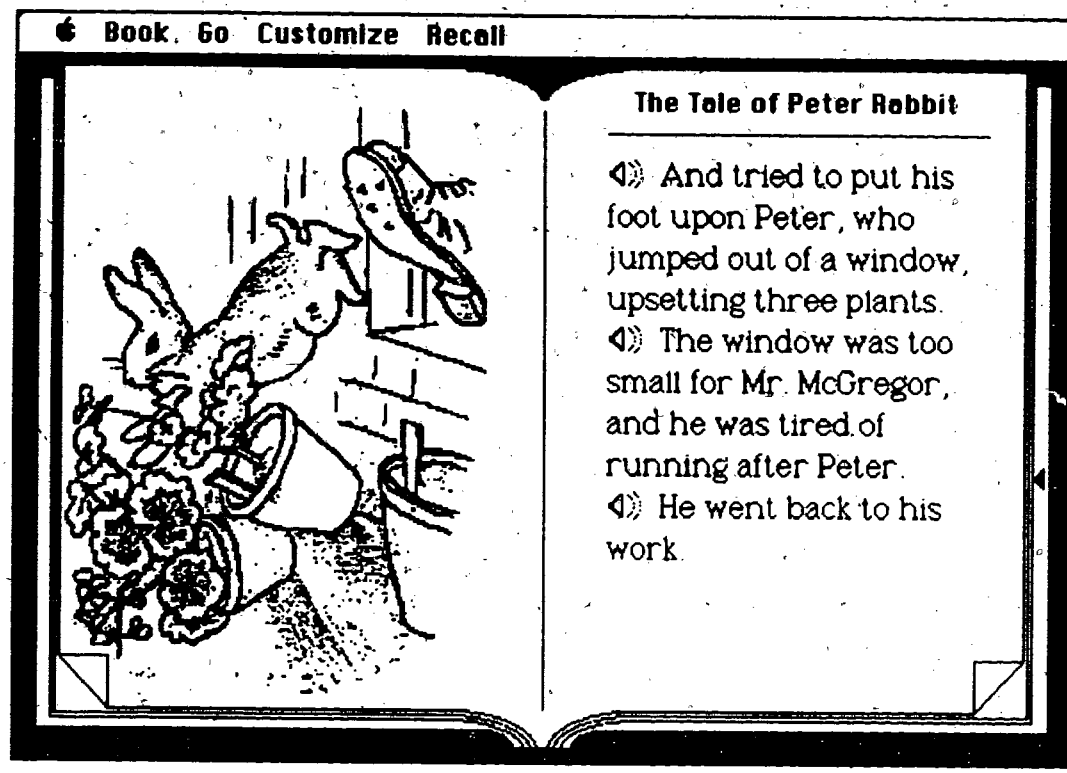


Figure H-20 - page 18a

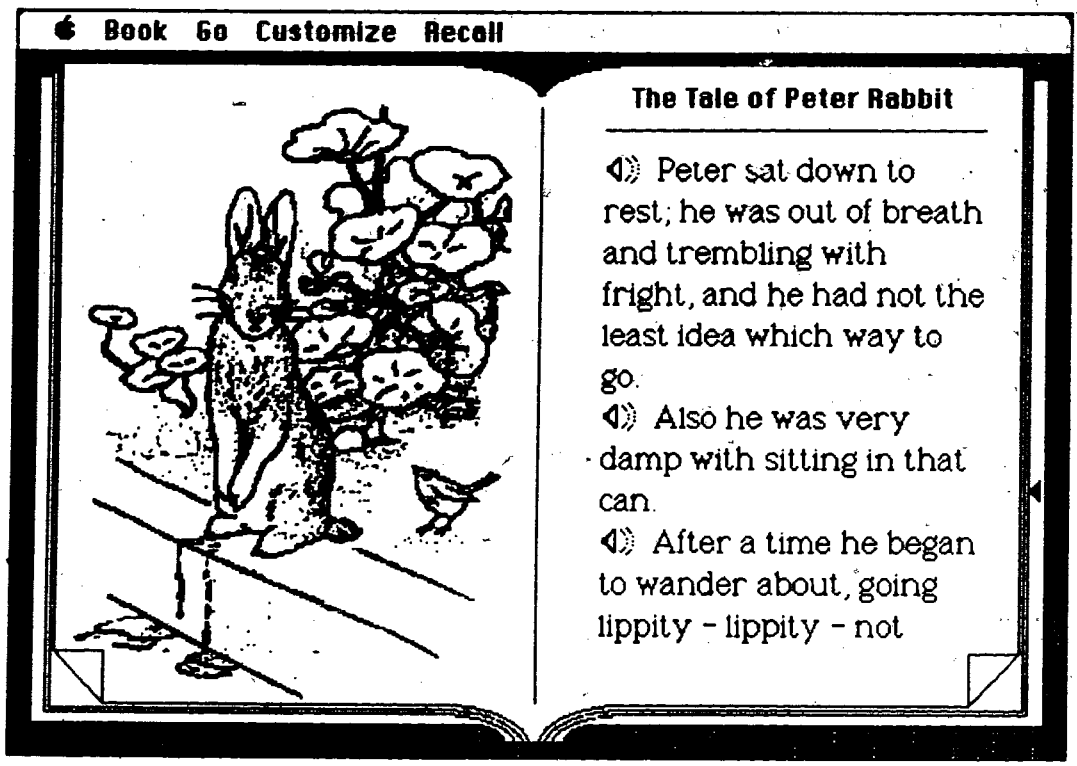


Figure H-21- page 18b

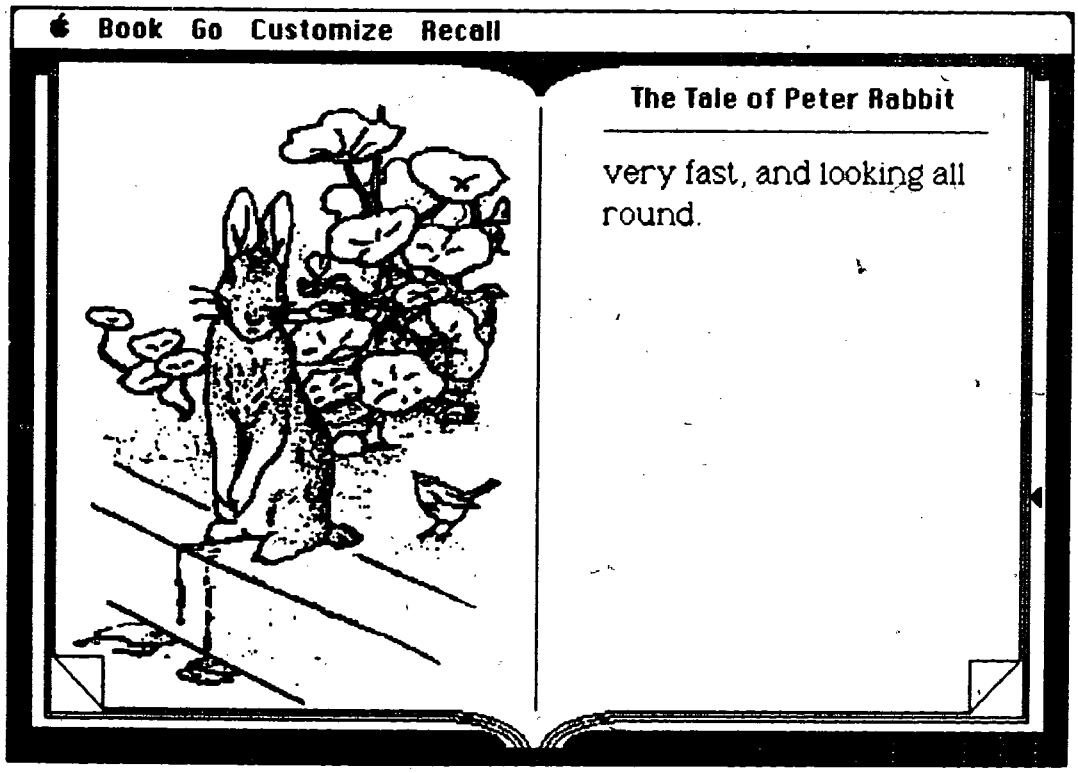


Figure H-22 - page 19a

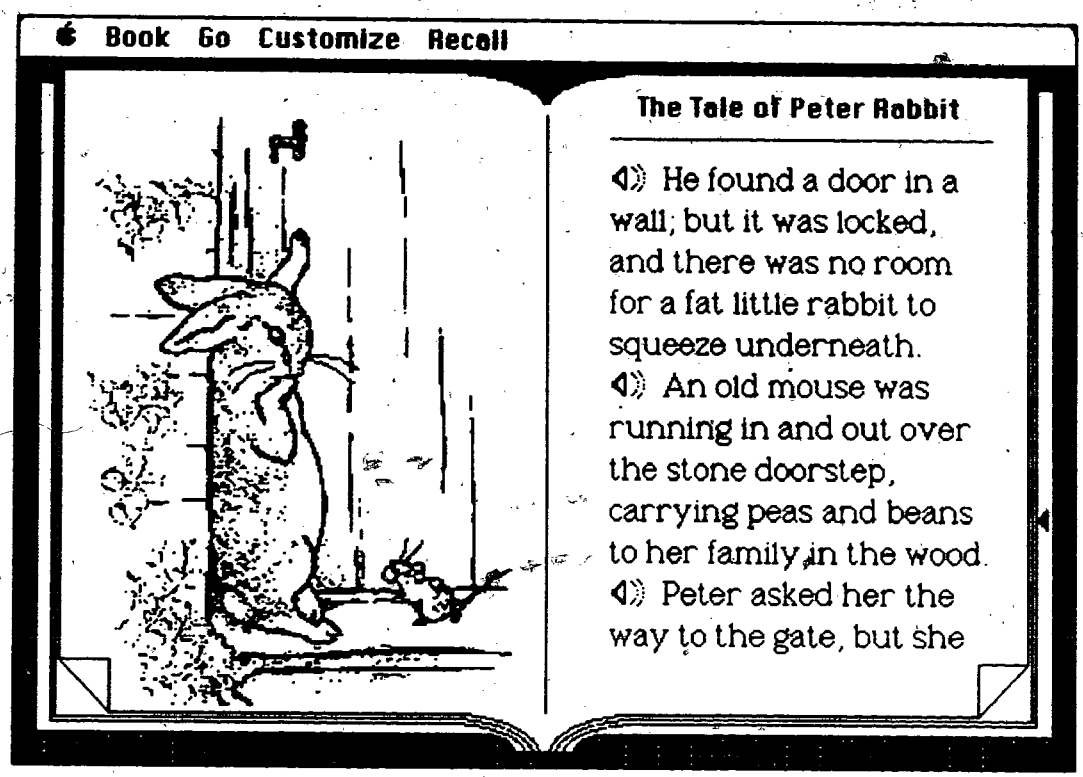


Figure H-23 - page 19b

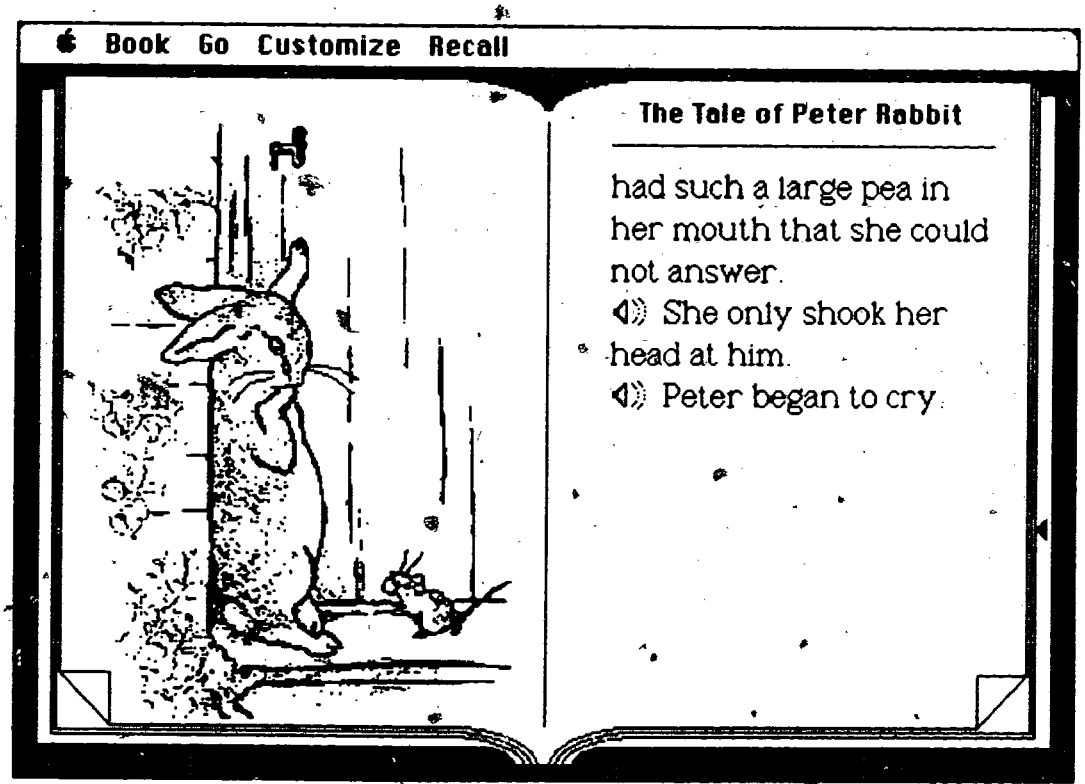


Figure H-24 - page 20a

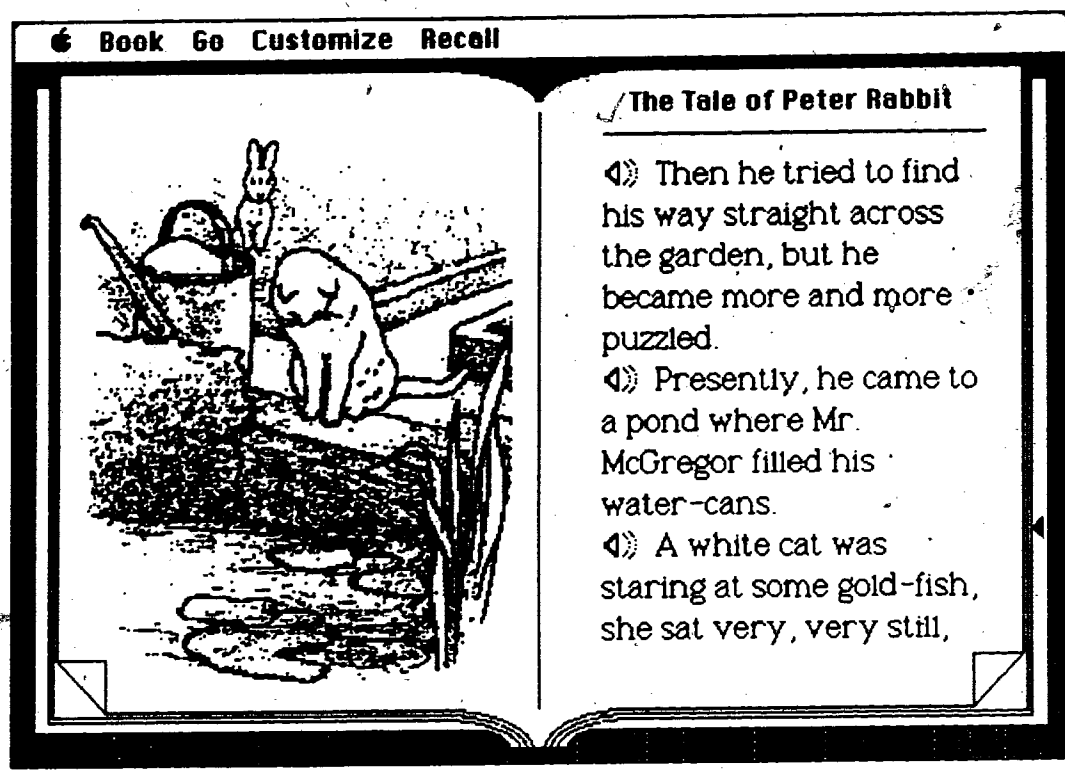


Figure H-25 - page 20b

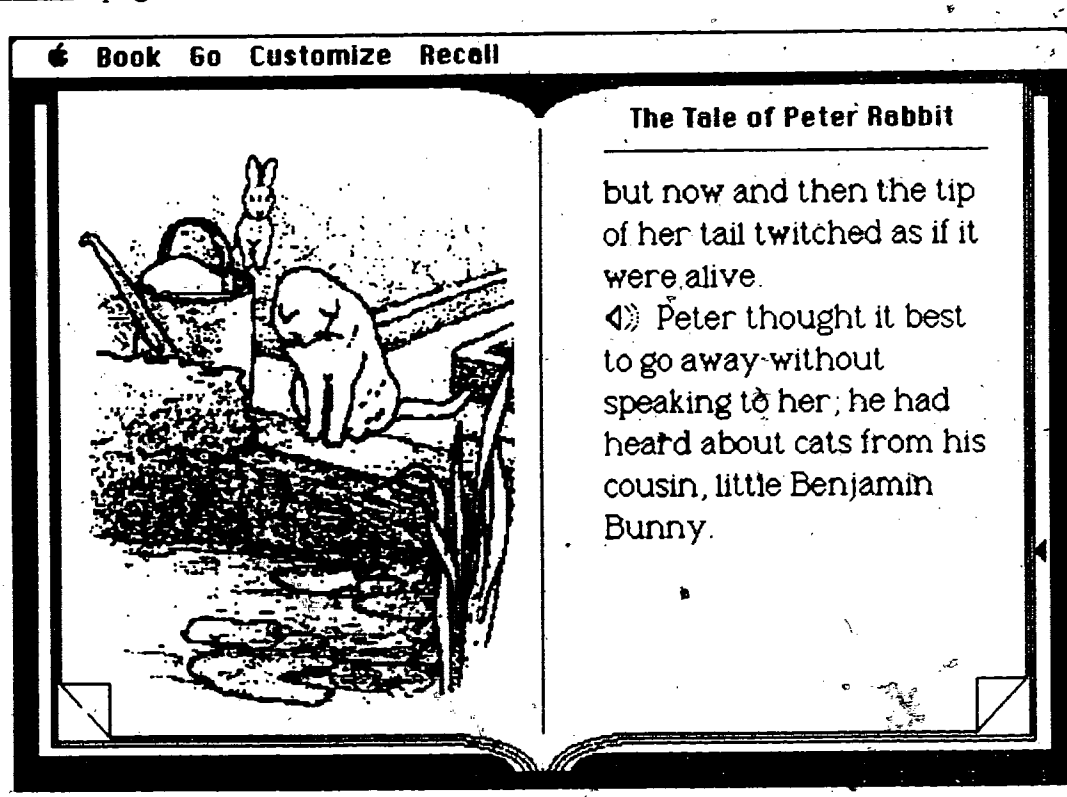


Figure H-26 - page 21a

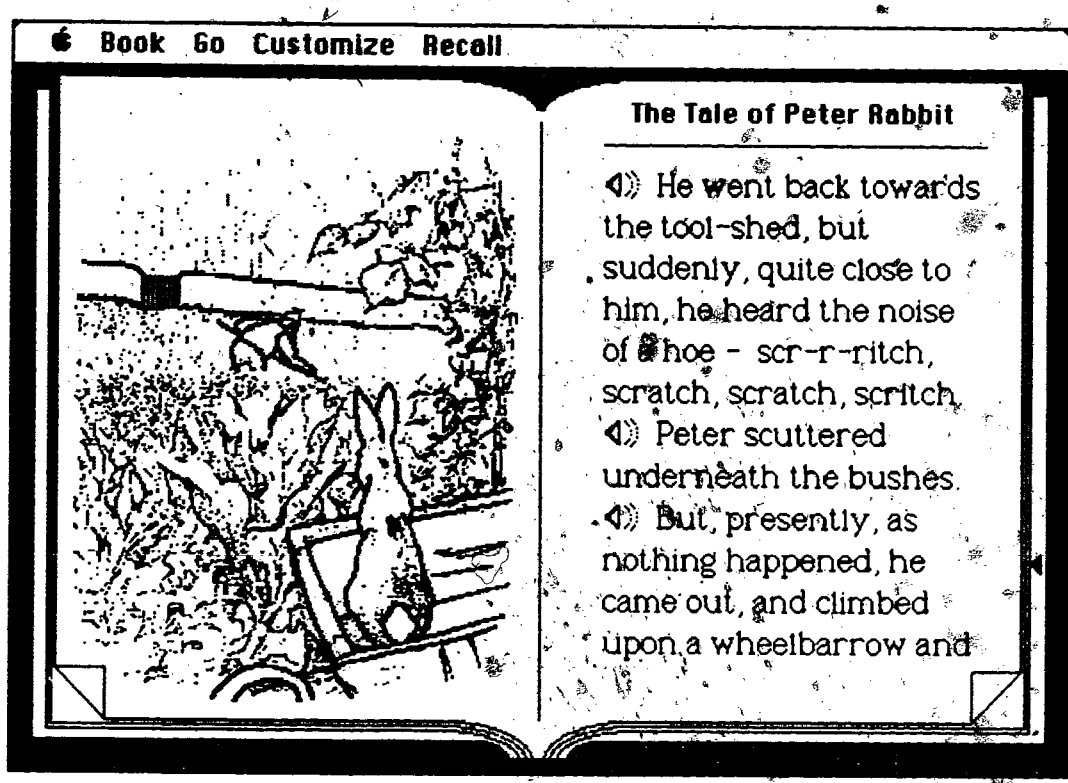


Figure H-27 - page 21b

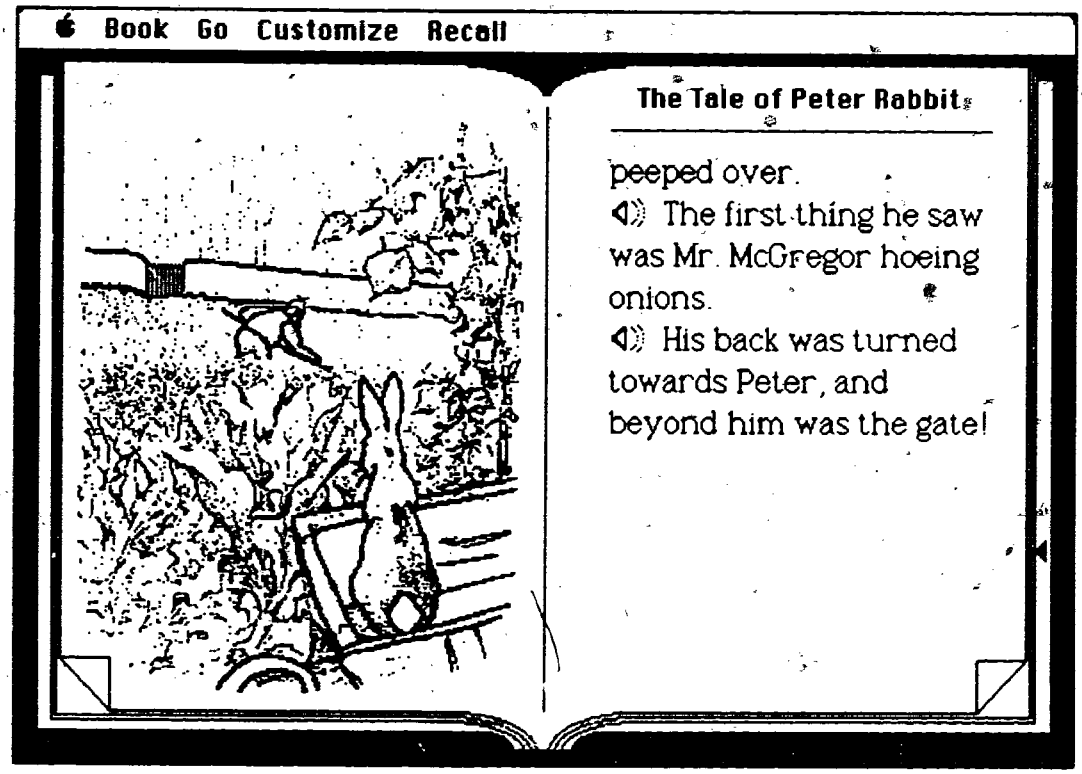


Figure H-28 - page 22a

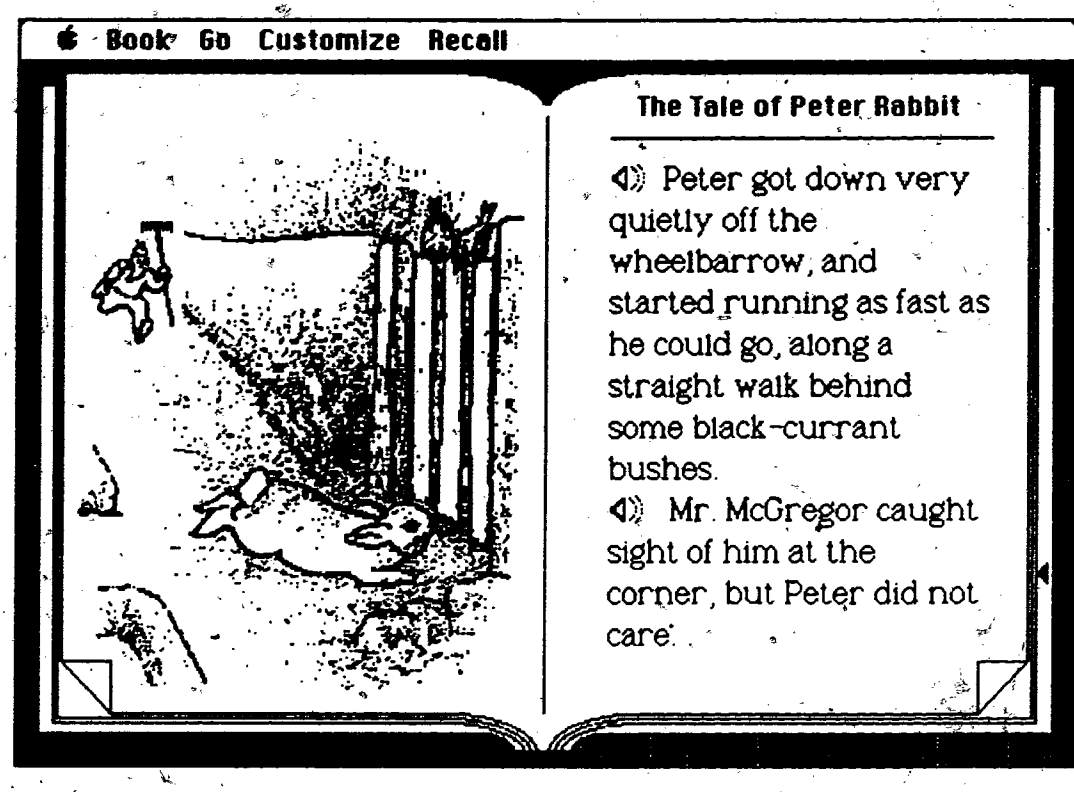


Figure H-29 - page 22b

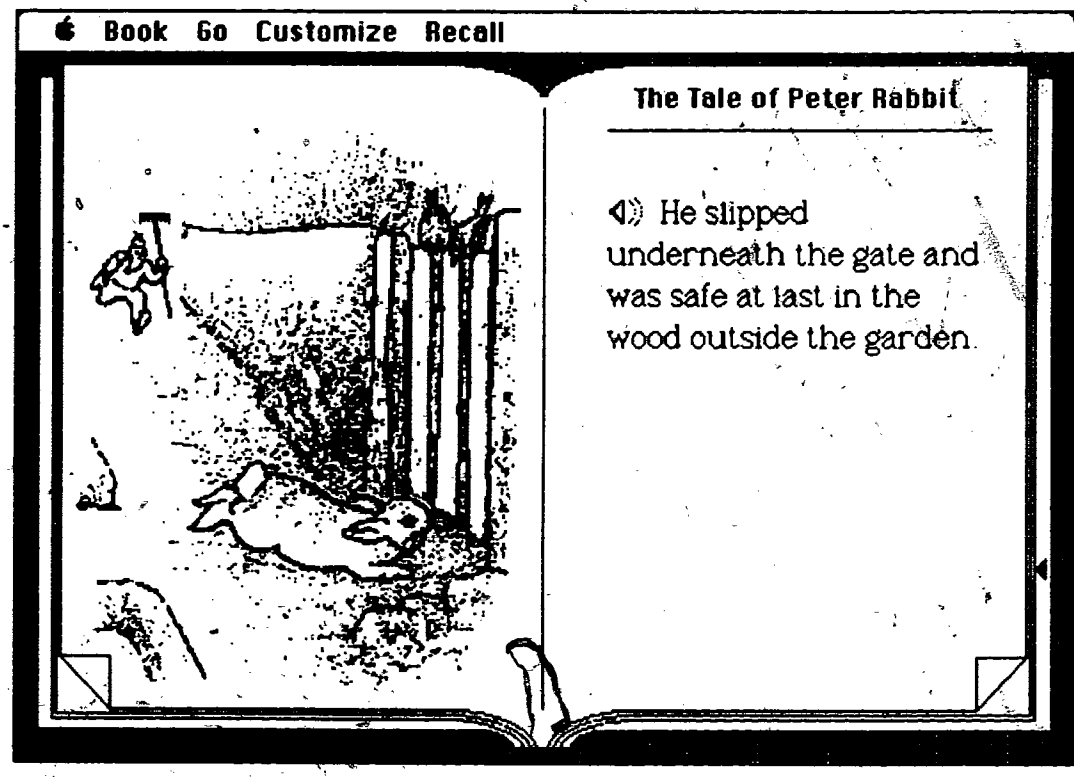


Figure H-30 - page 23

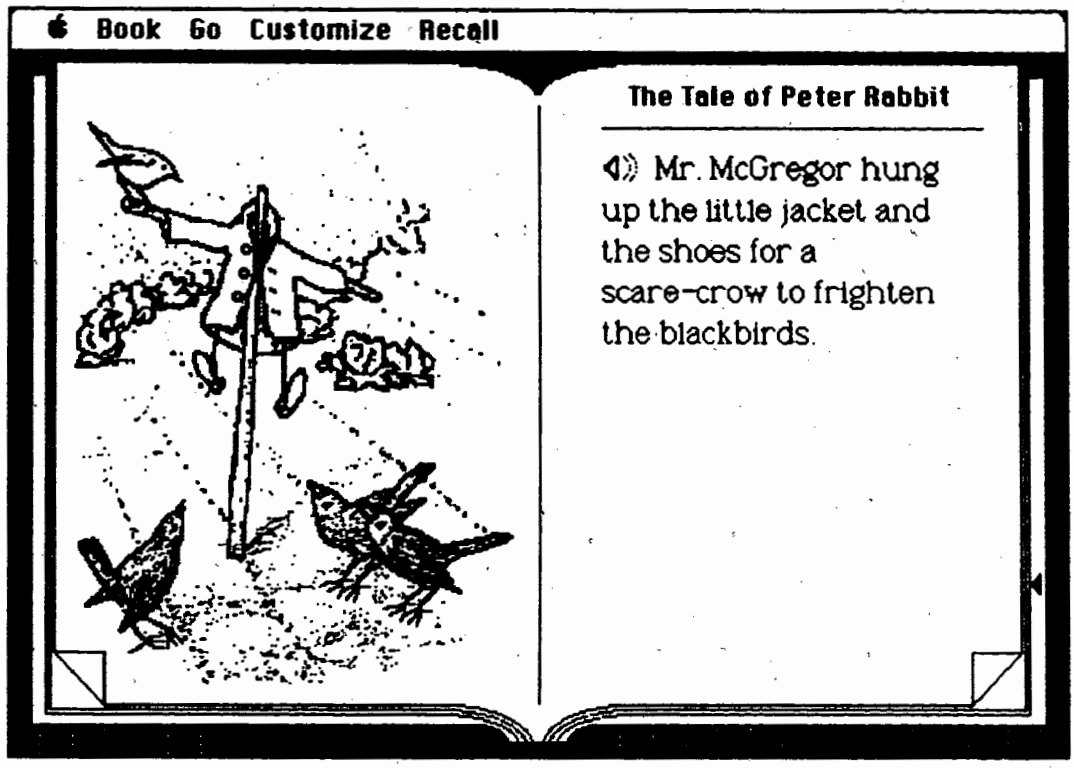


Figure H-31- page 24a

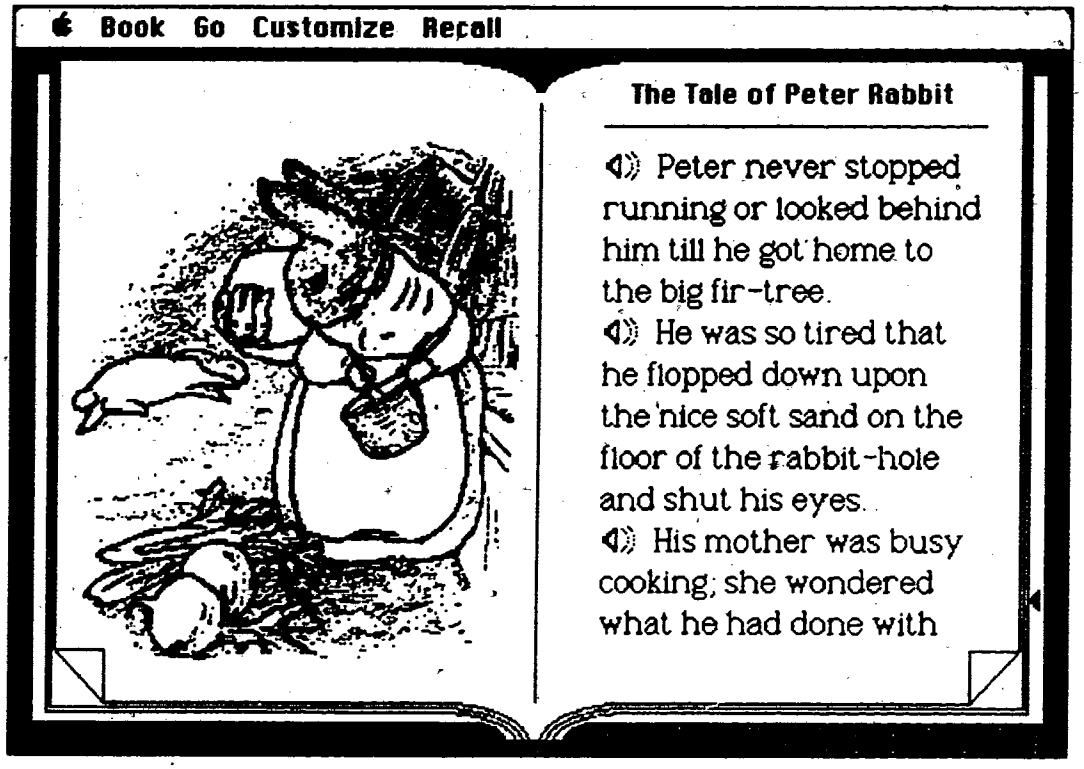


Figure H-32 - page 24b

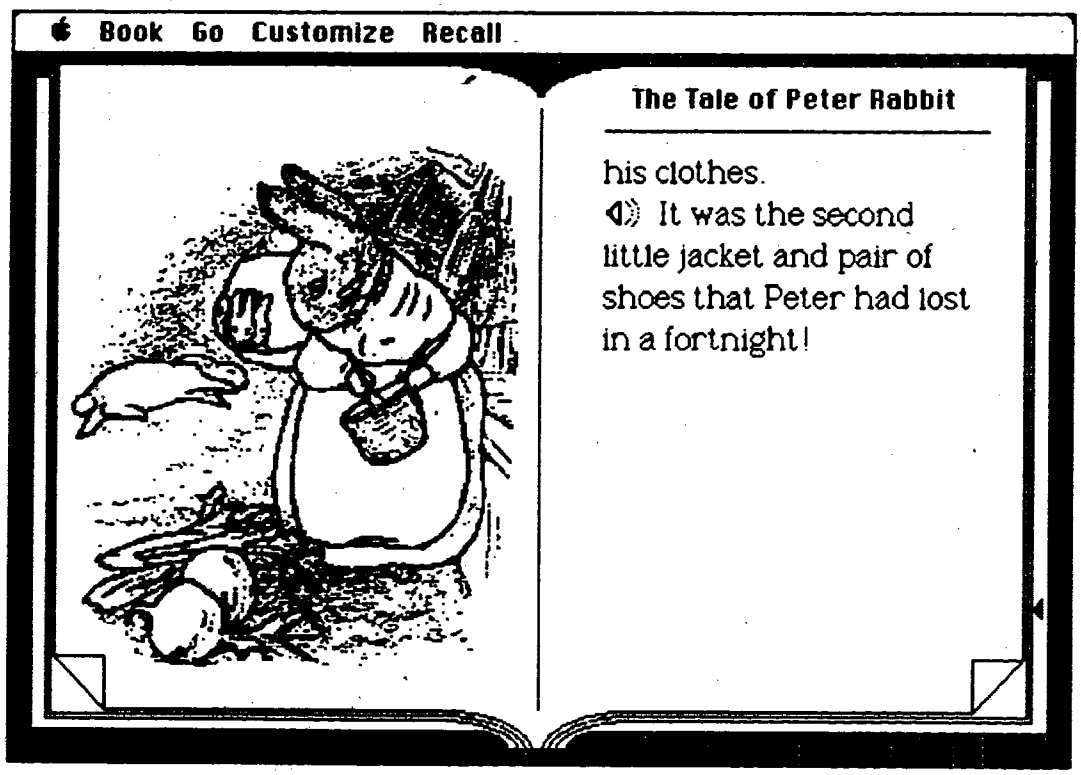


Figure H-33 - page 25

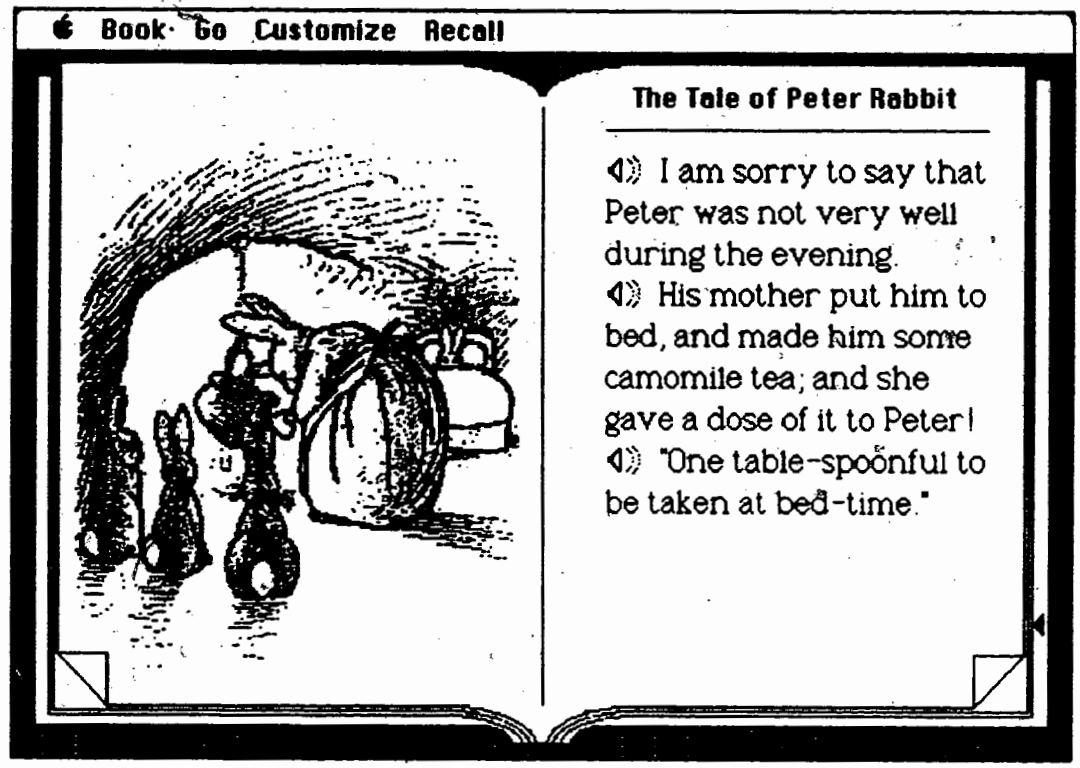


Figure H-34 - page 26

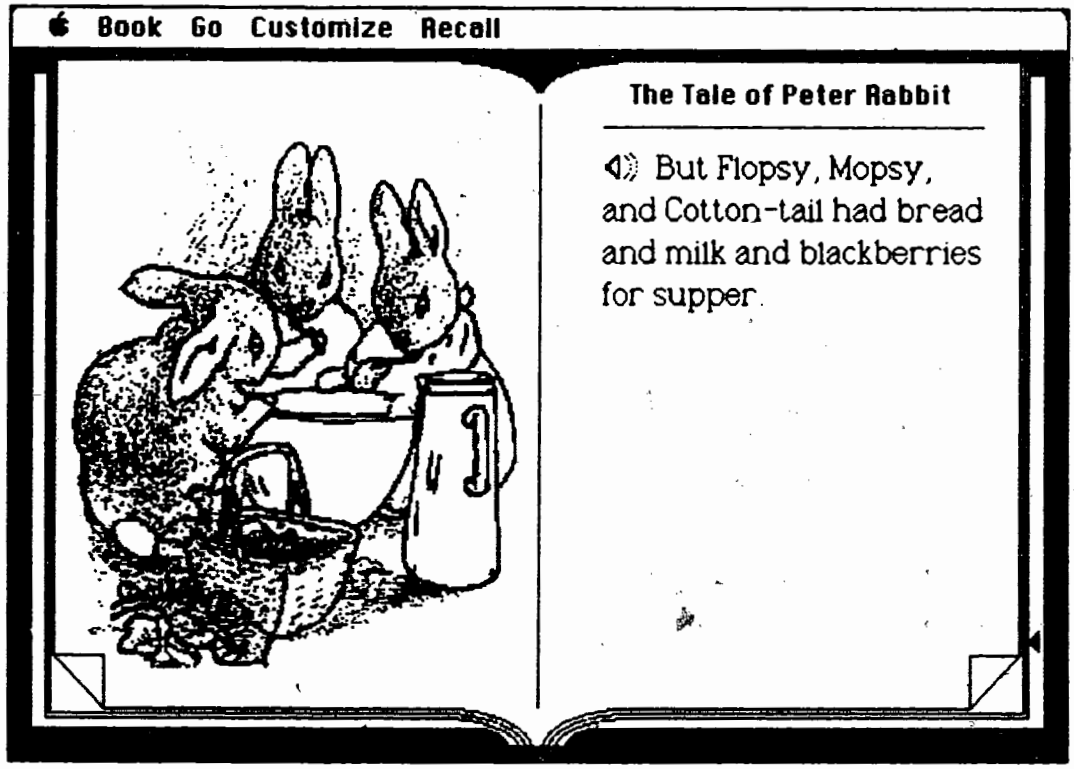
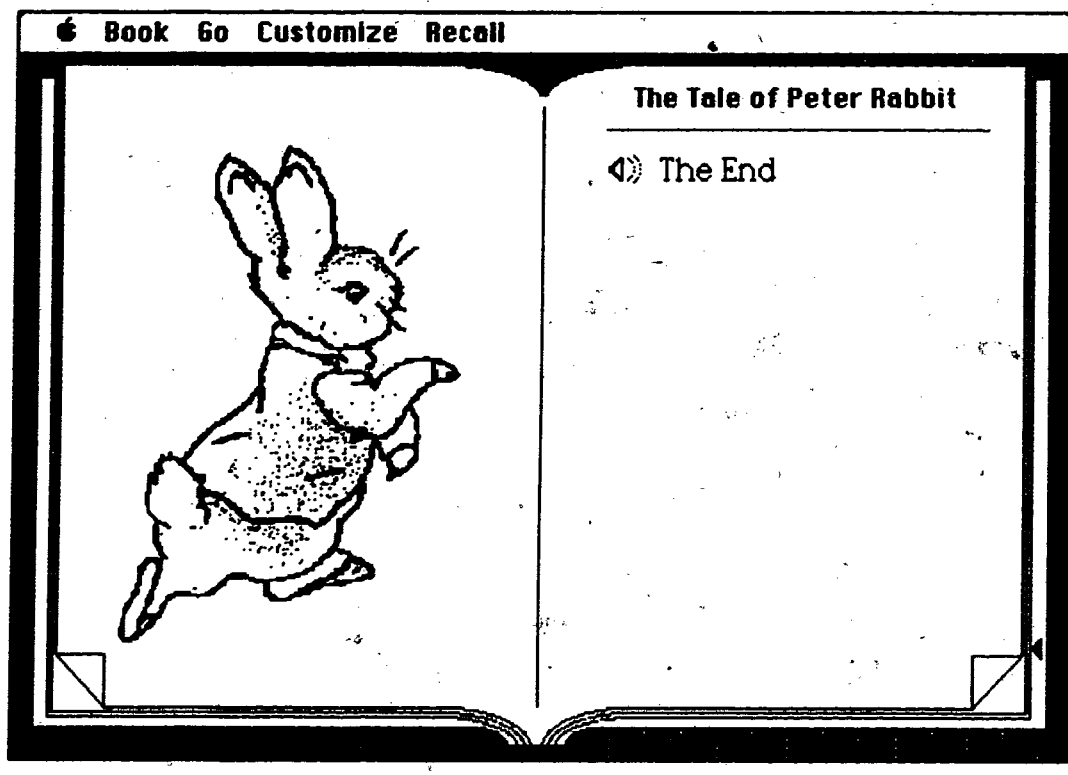


Figure H-35 - page 27



Appendix I

Observations of Randomly Chosen Students

Kindergarten

Adam

Adam spent about two minutes with the Discis Book. He clicked on the picture, on the words in the first sentence in reverse order, on the sentence speaker for the first sentence and then turned the page. He clicked on the same picture from the second part of the first page and turned the page again. After clicking on the sentence on the second page, he asked to stop.

Interview:

I like to listen to stories. I like pictures, army stories and lots of excitement stories. I can't read. Discis Books and books are about the same. The Discis Book was neat. I would not use another one.

Alex

Alex spent 11 minutes on the first six pages of the Discis Book. On the first page he clicked on some words but not in order. On the second page he clicked on words in the general order. By the third page, he was clicking on words in order with some accidental clicks on words in a higher line. On the fifth page, he clicked on words, a sentence speaker for the first and only time and then words again for that page and the next.

Alex had difficulty using the mouse as it was his first experience with one. He generally clicked on words before the music stopped except on page six where he waited for the sound effects to finish.

Interview:

I like to listen to stories. I like pictures. I can't read. I liked Discis Books better. I liked the munching sound in the Discis Book. I would use another one.

Angela

Angela worked with the first seven pages of the Discis Book for ten minutes. She spent three minutes on the first page, clicking on the second sentence speaker and on the words of the first sentence from the bottom line upwards but in a left to right order. She then clicked on the first sentence speaker and on the picture. On the second part of the first page, she continued clicking on words in a bottom-up left-right order.

On the second page, she clicked on the picture and on the sentence speaker.

On the third page, she clicked on the sentences in reverse order, on the words in reverse order and then on the sentences again in the correct order.

On the fourth page, she clicked on the sentences in reverse order and then on the words of the first sentence in order. She repeated the second sentence and then the words of the second sentence in order. From page four onwards, she clicked on words in correct order.

Angela explored pictures on the first three pages. Otherwise, she listened to sentences and words. She had trouble rolling the mouse on the pad.

Interview:

I like to listen to new books and have new words to read. I can't read. I like a book better than the computer because it has new words. With the Discis Book I don't have to read. It goes by itself. I would use another one.

Alice

Alice spent 28 minutes with 19 pages of the Discis Book. She spent five minutes on the first page, then about one minute on each of the succeeding pages. She had some difficulty with

the mouse, clicking on the sentence speaker rather than clicking on the first word of the second line.

Alice was involved in the story, expressing her appreciation of the music, commenting about Peter Rabbit's behaviour: "Oh no. I already know that. Bad, bad boy. Ah..." (page 6), "That was a very scary sound" (the music of page 7) and "Oh, oh. Mr. McGregor sees him" (before beginning page 9) and commenting about story characters or their actions: "Yikes! Stop, stop" (page 10), "Hey you, bad rabbit" (page 14), "Oh, that stupid Mr. McGregor" (page 16) and "Bad boy, Peter" (page 17). She commented as well about her feelings and actions: "Turn the page" (to the computer for the page 3 turn), "This is fun" (page 5), "That 'a' won't work" (on the difficulty of clicking on the word 'a' on page 9), "There, good girl" (on her ability to click where she wanted on page 14) and "Hey, you" (on the mouse slipping off the pad during page 15), "I'm making it sound funny by not adding all the words" (on clicking on the first word on each line of the first sentence on page 16), "I read that myself" (on reading 'to his work' before clicking on those words on page 17) and finally "Because I'm using this computer, I'm not feeling so sick any more." on page 19 just before asking to stop).

Interview:

I like to listen to books because it's fun. I can't read but I would like to. I like books and Discis Books because I like to listen. I would use another one.

Earl

Earl spent 35 minutes on the Discis Book covering 11 pages. He spent seven minutes on the first page, six on the second, four on the third, and then about two minutes per following page.

Earl clicked on sentences, usually in reverse order. He explored the first picture and then concentrated on sentences and words. Words were chosen at the beginning in bottom up and

right to left order. Although the word order changed by page 10 to going from left to right, he never clicked on words of a whole sentence in the right order. Even on page 11, he still chose the second sentence speaker before the first.

He recognized some words, reading 'I' (page 3) and 'and' saying "Is there any more 'ands'? I know - here!" (page 6) and "Oh, my!" (on finding another 'and' on page 7).

Earl appeared to be very involved with the Discis Book. He enjoyed the music, waving his hands and commenting on the mood of the music or on the sound effects: "This one is a different song." (page 4), "Oh, my. He's eating carrots, right?" (page 7), "Is he sad?" (page 8) and "Whee!" (page 10). He repeated some words out loud after they were read (page 3) and made up interesting sound sequences to match some words he heard "Squeeze, squash. Squish, squash. I like that." (page 6).

Interview:

I like to listen to stories because they are fun. They are for kids and I like the pictures. I like both books and the Discis Book because it reads to me, because I could move the mouse. I would read another one.

Eric

Eric worked for six minutes with the first two pages of the Discis Book, of which five were for the first page. During the first page he commented "I know that." on repeating some of the words and "I have one of these stories at home already".

Eric concentrated solely on the pictures, clicking about 15 times on the first page, four times on the second and only once on the fourth page. He skipped page 3 by clicking twice on the page turn. He generally ignored the music, clicking on the picture immediately after the page turn.

Interview:

I like to listen to stories because I like Peter Rabbit. He goes with his mother. I liked the Discis Book better because I like computers. I would read another one.

Ernest

Ernest worked with the Discis Book for six minutes, covering nine pages. He spent two minutes on the first page, one minute on pages 2 and 4 and about half a minute on each of the remaining pages.

As a general pattern Ernest clicked on sentence speakers, clicking on pictures only for pages 1, 2 and 4. He commented twice that he had this story at home (pages 1 and 2). He noticed that 'Mrs. Rabbit' was in the picture and in the text (page 2). He generally waited for music to finish before going on to the next page. On page 9, after clicking on the sentence speaker, he started to play with the menu and quit the program by himself.

Interview:

I like to listen to stories because they are funny, nice. I like books better because they are easier. I know what he is saying. I would not read another one.

Eve

Eve worked for 14 minutes on the first four pages of the Discis Book, spending three minutes on the first page, five on the second, seven on the third and three on the fourth. Because she clicked twice on page turns, she got only the first part of each page.

On each page, Eve clicked on words, pictures and sentences. She repeated some words out loud (pages 1, 3 and 4). She clicked on the words in order on the first page but on page 2, she clicked on words in random order and then from the bottom upwards and left to right.

She questioned the illustrations "Who is this? This is Mrs. Rabbit. She's not the same name as the other rabbit." (page 3), "I wonder what this is?" (about the basket on page 4) repeating the label 'basket' after clicking on it, and "Hey! This is her." (about Mrs. Rabbit on page 4).

Eve was also quite interested in the computer, examining the mouse during page 3 and exploring the apple menu and the recall list during page 4. She had the recall list repeat the words 'Mrs. Rabbit' and 'basket'.

Interview:

I like to listen to stories about people, wolves, dogs, little girls. I like Discis Books better. I liked playing with pictures. On one page, she has a basket. I would read another one.

Erin

Erin spent 25 minutes on the first 15 pages of the Discis Book. She spent three minutes on the first two pages and on page 11. The other pages had about one or two minutes each.

Erin clicked on all the words in order, saying some before clicking on them: 'Peter' (page 1), 'Mopsy' (pages 1 and 5), 'to Mr.'(pages 5 and 6), 'meet' (page 9). On page 12, she clicked the mouse accidently on the picture and then explored it a little, clicking three times on the picture. She then went back to clicking on words alone.

Interview:

I like to listen to stories because of the pictures. I liked the Discis Book because I didn't have to say the words. It said it for you. I would read another one.

Ethel

Ethel spent 47 minutes working with the Discis Book, spending six minutes on the first page, three on pages 4 and 10, five on pages 11 and 12, four on page 18 and one or two on each of the remaining pages.

Ethel clicked on sentences and then on the words in the same sentence in order. She clicked on three pictures (pages 1, 4 and 10) but generally stayed with the text. She repeated some words (e.g.'parsley' on page 8) and said some before the computer (e.g. 'Mr. McGregor' on page 10) and the 'a' when she couldn't click on it (page 4).

On pages where there was more than one sentence she clicked only on the first one. She usually clicked on the sentence speaker and then on all the words. On the first page these words were in random order, but from page 2 on she clicked on words in order.

She was involved with the story, laughing, moving her head to the music and commenting on Peter Rabbit's and the other rabbits' behaviour: "Peter is bad. But he likes his adventures." (page 24) and "Because they were good." (page 26). She also questioned the illustration "What's the cat doing there?" (page 20). She commented on the music "I like the songs." (page 12) and on using the book: "This is fun." (page 20). She was also interested in the computer, playing with the mouse during page 12.

She twice requested that the computer read the whole story (page 13 and 18) so she was asked if she would like the computer fixed to do that. She agreed and wanted the music to play before the page was read. The settings were changed accordingly. During the rest of the story, she looked around the room during the music or waved her hands while it played but during the reading, she looked at the screen.

Interview:

I like to listen to stories because they make me happy. They make me think of my dog who died. I like listening to somebody talk but a little bit from the computer. I liked the Discis Book because there was nobody near me. I would read another one.

Grade One

Bob

Bob spent nine minutes on the Discis Book, getting to page 21 but actually only working with nine pages because of clicking too many times on the page corners. He spent three minutes on the first page, then one minutes or less on each of the following pages.

He click on sentences before the music finished. On page 12 he clicked on the words of the second part of the page, clicking faster than the computer could respond.

Interview:

I like to listen to stories. They are interesting. Reading is fun. I like the Discis Book better than a book because it tells you what Peter Rabbit did and you can look at the pictures. I would read another one.

Brian

Brian worked for 18 minutes with the Discis Book, missing page 3 because of double clicking on page corners. He spent three minutes on the first page and then went very quickly through the remaining pages, reaching page 25 before stopping.

Brian clicked on words more often than he did on sentence speakers. On page 1 he clicked on the sentence speaker, then clicked on each word of that sentence and the next sentence. Although he skipped pages 2 and 3, he did not click on a sentence speaker again until page 8. After that it was a mixture of sentences speakers and words, although even on page 21, he clicked on words when a sentence speaker was present.

He clicked on words or sentences very soon after the page turn, seeming to ignore the music.

Interview:

I like to listen to stories because it helps me get sleepy, I need to know how to read, and its relaxing when someone reads. I like reading but it gets me into grownup business, it helps me grow up. I like a book better because I like reading; I need to know how to read. I guess I would read another one.

Barry

Barry worked for 40 minutes on the Discis Book, finishing the story. He spent three minutes on page 1, four minutes on page 2 then one or two minutes on each of the remaining pages.

Barry began the book by clicking on sentence speakers, words (in order) and pictures. By page 4 he began to click on sentences and words alone; by page 7, sentences alone. The mouse tracked words as they were being read. On double pages, he clicked on the second page words. By page 19, he turned the page with the reading, although he still clicked on the second page words individually. From page 21 onwards, he began clicking on pictures again as well as on sentences.

Interview:

I like to listen because they are neat. I like reading to my mom sometimes, it's fun to learn to read, but sometimes not, because I'm crabby. I like the Discis Book better because it's neat to press all the words and pictures and listen to it.. I didn't have to turn the pages as in a book. I would read another one.

Betty

Betty worked for 33 minutes on the Discis Book, finishing the story. She spent three minutes on page 1 and then one or two minutes on each of the remaining pages.

Betty was involved in the story, laughing with the sounds (page 14). She usually ignored the music, clicking on words or sentences soon after the page turn.

She began with clicking on words in order. On page three she clicked on the sentence speaker. Page four was a mixture of each. After this she clicked on the sentence speakers alone except for words on the second page of double pages. By page 24 she turned the page with the reading but still clicked on the words. She would occasionally read some words out loud before the computer (pages 1, 2, 4, 18, 19, 21, 24, 25).

Interview:

I like to listen - I know how to read Peter Rabbit a little bit. I like to read. I like a book better than the Discis Book because I can put my fingers on the writing. I would read another one.

Barb

Barb worked on the Discis Book for 29 minutes, spending one to two minutes per page. She reached page 20 but skipped two pages because of clicking too many times on page turns.

Barb generally waited for the music to finish before clicking on a sentence. Although she had never used a mouse before, she did not have too much difficulty. She would click on a sentence and then on the words of the sentence in order.

Interview:

I like to listen to books and I like to read. I like a book better than the Discis Book. I would read another one.

Bev

Bev worked for 43 minutes, finishing the Discis Book. She spent three minutes on the first page and then one or two minutes each on the remaining pages. Her clicks were very deliberate so she would get definitions as well as the word. When asked if she wished the definitions taken out, she said yes.

Bev seemed to enjoy the music, nodding her head to the beat and commenting on the mood of the music: "That's a neat sound." (page 14) and "That sure is a sad song." (page 19). She usually clicked on pictures and sentences throughout but would click on words on the second page of double pages. On page 15, she clicked on the sentences over and over again. She missed page 10 because of too many clicks on page 9.

Interview:

I like to listen to books - they're nice. I can't read, just some books my teacher taught. I like the Discis Books better because of the music and all the ways you can listen. You just have to click. I would read another one.

Fred

Fred worked with the Discis Book for 22 minutes, spending three minutes on the first page and one or two minutes on each of the remaining pages. He reached page 14.

Fred clicked on words in the wrong order - bottom up, left to right. Even though he began to listen to sentences on page 5, his word choices remained in the wrong order or random. He seemed to enjoy the music, waiting for it to finish before clicking on the words. He clicked on pictures only on page 14.

Interview:

I like to listen to stories a lot. They are interesting and make me happy. I don't like to read. I have to redo it. I liked the Discis Book better than books. I would read another one.

Frank

Frank spent 38 minutes on the first page of the Discis Book. Even though he was reminded once that he could turn the page, he remained on the second part of page one for the remainder of the time.

Frank clicked on sentences, their words in order, on the picture and back again. He clicked up to 22 times on the picture at a time. He occasionally repeated words out loud. He would say the parts of Mrs. Rabbit as he was clicking. He also tried to click on picture labels several times.

Towards the end of his experience with the book, he clicked all the way up the blank page until he got to the words.

Interview:

I like to listen to stories about rabbits. I like reading because it's fun. I liked the Discis Book better than books because it has lots of words. I would read another one.

Floyd

Floyd worked with the Discis Book for 53 minutes, finishing it. He spent two to four minutes per page, clicking on pictures first and then on words.

Floyd read the story out loud for the first 10 pages, clicking on unknown words as he came to them. He had to click on 'ate' the first time he came to it but on its second repetition, he was able to say it without clicking on it. He would also try to guess picture labels before the computer said them. On one page, he hummed with the music and usually he waited for the music to finish before clicking. On page 11 he began clicking on the sentence speakers, saying the first words with the reader. On page turns, he would say the last word on the bottom of the page and then the words at the top of the next page before clicking on the next sentence speaker.

He seemed quite involved with the story, saying "Poor Peter" when Peter was crying at the locked door (page 19).

Interview:

I like to listen to stories because they are interesting. I like to read because it is interesting and you get to know things that you think don't happen and it surprises you. I like the Discis Book better than books because you don't have to read - it reads for you. It is like book tapes which I have but it is better because the tape doesn't have pictures.

Fran

Fran finished the Discis Book in 20 minutes, clicking on sentences and an occasional picture (pages 1 and 23). She spent three minutes on the first page and then about half a minute per page afterwards.

She clicked on the sentence speakers before the music stopped. During the reading of the sentence, she brought the mouse down the page along the line being read.

Interview:

I like to listen to stories because they are interesting and because you can learn stuff from them. I like reading because it's fun. I liked the Discis Book better than books because you can move stuff around. I would read another one.

Faye

Faye worked with the Discis Book for 45 minutes, spending 4 minutes on the first page and usually about 2 minutes on each of the remaining pages.

Faye clicked on words in order with occasional clicks on pictures (pages 4, 12, 13 and 20). At first she clicked almost immediately after the page turned; then she waited for some of the music to play before clicking on the words. She double-clicked a page turn and asked for help the first time to go back. The next time she was able to go back on her own.

Interview:

I like to listen to stories because there is excitement and they are fun. I like reading because it's good for you. I liked the Discis Book better than books because books you use with your hands (turn the pages); the computer book you don't have to. And it was fun. I would read another one.

Flora

Flora worked for 30 minutes on the Discis Book, spending three minutes on the first page and from one to two minutes on each succeeding page.

Flora occasionally waited for the music to end but usually clicked on sentences before the music ended. She clicked mainly on sentences and pictures, with an occasional word, especially

those at the top of a second page of double pages. She skipped five pages because of clicking twice on page turns.

Interview:

I like listening to stories and reading. I like the Discis Book better than books and I would read another one.

Grade Two

Carl

Carl worked for 44 minutes on the Discis Book, finishing it. He spent one to two minutes per page.

He had his eyes fixed on the screen throughout. He said "I knew that!" after clicking on a word on the first page and then began reading some words with the computer. He did not show much reaction except for some giggling on page 2 and for sitting on the edge of the chair.

Carl clicked on pictures and on words in order only until page 13. Although the sentence speaker had been shown him on the title page, he asked about the amplifier icon on page 13. From then on he used it alternatively with word clicking. He would often click on words faster than the speaking speed.

Interview:

I like to listen -- it gives me something to do. I don't like to read that much, sometimes it's a lot too hard. I liked the Discis Book better. If you got tired, it would read the sentence for you. It was a bit fast, so went word by word. I would read another.

Cindy

Cindy worked for 25 minutes on the Discis Book, finishing it. She spent one to two minutes per page.

Cindy generally clicked on sentence speakers only, although she clicked on the first seven pictures. She clicked on words only if they were on the second page of a double page. She usually clicked before the music was finished except for pages 14 and 25. When she turned a page too soon so that the reading of the sentence was cut off, she went back to repeat the sentence.

Interview:

I like to listen -- it's nice. I don't have to read them, just listen. I don't like to read - I don't practice enough. I liked the Discis Book better. With the computer, it was fun to listen to stories. I really wanted to listen. I would read another one.

Charlotte

Charlotte worked with the Discis Book for ten minutes. She laughed at the story (page 15) but skipped five pages by clicking too many times on the page turns.

Charlotte clicked on sentences only, with the exception of one word (tool-shed) and the last picture. She generally clicked on the sentences immediately after the page turns so that the music stopped.

Interview:

I like to listen. Stories are fun; they have adventures and stuff. I like to read. You get to find out neat things about stories and other things. I like books better. You get to turn the pages. I kept skipping pages. I would read another one.

Candy

Candy went through the Discis Book silently in seven minutes. She clicked on words only once : 'Mr. McGregor' (page 16). She used the mouse to follow the words on the page as she read. She did not seem to listen to the music, turning the page before the music was finished.

Interview:

I like to listen to stories. I like to read - look at pictures. I like books better. You don't have to look at a screen. It hurts my eyes. I would read another one.

Christine

Christine worked on the Discis Book for 20 minutes.

She generally clicked on the sentence speakers, although she clicked on words on pages 2 to 5 and on the second page of a double page (18). She clicked on some pictures as well (pages 3, 5, 16, 22, 23).

She turned pages with the reading and tracked the reading with the mouse. She would occasionally pause between sentences with her eyes on the screen. She would also wait for music to finish before going on to the next page, although she did not wait for it before clicking on sentence speakers.

Interview:

I like to listen to stories. They are fun and neat. I like to read. It is fun and I can figure out lots of things. I liked the Discis Book better than books. I liked the music, it can show pictures and give names of pictures. It turns pages for you. I would read another one.

Gary

Gary worked with the Discis Book for 25 minutes, reaching page 22. He began the session with the book by having difficulty moving the mouse and by displaying visible bodily tension.

He clicked on most of the pictures and on words. The words seemed to be chosen randomly rather than because of their difficulty; for example, on page 12, he clicked on 'himself' in 'to exert himself'. He seemed to relax a bit by page 9 and even more by page 15. On page 17, he clicked on a sentence speaker for the first time and then on the words of the sentence in order. On page 20, he still clicked on words at random; then on the sentence speaker. On page 21 he clicked on the sentence speaker, then on a few words in order.

Interview:

I like to listen to stories. I like to read because I learn stuff. I liked the Discis Book better because it tells you what the pictures are. I would read another one.

Greg

Greg worked on the Discis Book for 12 minutes, reaching page 21.

He generally clicked on sentence speakers but clicked on individual words for some sentences (pages 3, 8, 13, 17). He clicked on sentence speakers before the music was finished. He used the mouse to track the words as they were read from page 4 on.

Interview:

I like listening to adventures. I like to read a little, not too much. I get bored. I liked the Discis Book because it reads for you. I would read another one.

Gina

Gina finished the Discis Book in 21 minutes. She spent three minutes on the first page, clicking on the sentences in order and the words of the second part of the double page.

Gina generally clicked on sentences only, clicking on second page words on page 11, difficult words on page 12 and the second part of pages 16 and 20. The mouse followed the beginning of the lines being read. She clicked on the sentence speakers before the music was finished.

She moved the mouse down the lines while the sentences were being read but did not turn pages when the sentence continued to the next page. She clicked too many times on two page turns but went back on her own.

Interview:

I like listening to stories because of the pictures. I like to read because sometimes it's funny. I liked the Discis Book; when you press buttons, it does things. I would read another.

Grace

Grace worked for 28 minutes on the Discis Book, reaching page 21. She was unfamiliar with the mouse, clicking it very slowly and holding it down on page turns.

She clicked on sentence speakers the first time through the story, and then came back towards the beginning after page 21, playing with pictures (pages 21 and 8) and the words of the title page (page 0). She turned the page with the reading on pages 12 and 17. She clicked words the second time on pages 1 to 3 and then sentences again from pages 4 to 9 at which she stopped.

Grace generally clicked on words or sentence speaker soon after the page turned, stopping the music.

Interview:

I like to listen to stories very much. I like to read, it's fun. I liked the Discis Book because it has lots of 'tells' (sentence speakers) where it told the story. I would read another one.

Gertrude

Gertrude finished the Discis Book in 16 minutes. She generally clicked on sentence speakers with the exception of some words on the first page and one picture (page 10). She said words with the speaker. By page 19 the mouse was tracking the words and she turned pages 20 and 21 with the speaker.

She clicked on sentences before the music finished.

Interview:

I like to listen to stories when people read. I don't have the time and it sounds very nice. I don't like to read. I liked the Discis Book because it was more fun to read and the mouse could be moved all around. I would read another one.

Gretel

Gretel read the Discis Book in 26 minutes. She had great difficulty with the mouse. She generally clicked for difficult words, sentences on pages 7 and 17 only and on several pictures (pages 2 - 8, 14, 15, 17, 21, 24 - 27). By page 11, the mouse was tracking the words as she read silently.

Interview:

I like to listen to stories. I like to read because you learn to read more words and get better at reading. I liked the Discis Book because his mom took him in and because you don't have to hold it. I would read another one.

Grade Three

David

David finished the Discis Book in 14 minutes.

He clicked on sentence speakers alone, turning the page with the reading from the first page. He generally ignored the music, clicking on the sentence speakers as soon as the page turned.

Interview:

I like to listen to stories sometimes, if they are good ones. I like to read. I can predict what's happening before I read. I like a book better. You can turn the pages and read it yourself. I would read another one.

Don

Don finished the Discis Book in 18 minutes. He had some difficulty turning pages at the beginning but by page 12, he turned the pages with the words.

He clicked on sentences and on six pictures (pages 4 - 6, 8, 22, 27). On page 21 he asked "How long is this?". After reading the book, he asked to begin again and then checked out each menu item before stopping a minute later.

Interview:

I like to listen to stories; they are fun. Liking reading - it depends on what kind of book. I like books and Discis Books the same. I liked the music and that it would read it for you. I would read another one.

Dennis

Dennis finished the Discis Book in 14 minutes.

He generally clicked on sentences, clicking on words only on the second part of the first page. He clicked on pictures on the first two pages and then three more pictures later (pages 9, 18 and 20). He tracked the words with the mouse as they were being read and turned pages with the reading starting on page 19. He skipped one page, clicking twice on the page corner.

He clicked on sentences immediately after page turns, stopping the music.

Interview:

I like to listen to stories. I like to read - books about stuff and learn stuff. I liked the Discis Books better. I didn't have to read out loud. I would read another one.

Donna

Donna read the story to herself in nine minutes, turning to the next page before the music finished. She didn't wait for the music to stop before going on to the next page. The first time she met a sentence continuing on a second page, she asked "What do I do now?"

Interview:

I like to listen to stories. I liked the music. I like to read. Books are neat; I like mysteries in them. I liked the Discis Books better than books because of the music and I don't have to turn the page. I would read another one.

Dawn

Dawn finished the Discis Book in 19 minutes.

She clicked on sentences throughout and on some pictures (pages 2, 11, 14-16, 18, 19, 22), usually only once. She clicked on the words on pages 3 and 25 only. She generally listened to the music, nodding her head to the beat and smiling with it (pages 3, 7, and 24). By page 19, she was turning the page with the reading. During page 9, she said "I've read this before".

Interview:

I like to listen to stories. They are interesting. I like reading. It is fun to do. I like books better than the Discis Book because I can pick long stories and read over a long time. I would read another one.

John

John finished the Discis Book in 14 minutes, reading it silently to himself.

John clicked on five pictures once (pages 3, 5 - 8) and on four difficult words ('exert', 'Mr. McGregor's garden', 'lippidity', and 'scritch'). He waited for the music to be finished before turning the page.

Interview:

I like to listen to stories because sometimes they're fun and exciting. I like to read because when you're older, you'll know how to read stuff. I liked the Discis Book because you don't have to turn the pages, some parts are fun and exciting, music made it different, if you don't know a word, you can click on it. I would read another one.

Jim

Jim finished the Discis Book in 20 minutes. He clicked on sentence speakers and all pictures except pages 17, 21, 24, 26 and 27. By page 17, he was turning the page with the reading.

Jim was involved with the book, continually commenting on it. He commented during clicking on pictures. Page 1: "Where is Cottontail?" "And this must be Cottontail." Page 8: "Oh, I thought it was wood" (the cucumber frame). Page 9: "Ah, cabbage" Page 20: "Now where's the cat? Oh, I was looking at it the wrong way." He commented on the length of pages. Page 11: "Oh, that's a long one." Page 16: "Holy, the longest one yet!" One comment concerned the scarecrow: "Huh. It doesn't look like it's doing much good." (page 23).

Interview:

I like to listen to stories because they take me on an adventure and give me something to do. I like to read a lot, they take me on an adventure and I really, really enjoy them and they are fun. I liked the Discis Book because it was a little funnier. The pictures are bigger. You can play around them. If you don't know a word, you can click on it and find out what it is. I would read another one.

Jean

Jean finished the Discis Book in 20 minutes.

Jean clicked on sentences, most pictures and an occasional word (page 1, 4, 18 and 20). She clicked on sentence speakers quickly, stopping music. The mouse was following the words by page 4 and she turned the page with the reader by page 12.

Interview:

I like to listen to stories because it gives me an idea for when I make my own stories. I like to read. I liked the Discis Book because I get to click on the pictures. I'd read another one.

Jill

Jill read the Discis Book silently in 13 minutes, saying at the beginning: "I have this book at home." She clicked only on page turns.

Interview:

I like to listen to stories if there's good characters in it. Some stories have surprises in it and it's exciting. When I go to bed, my sister reads because I'm too tired. I like to read because it's fun. I like books and Discis Books because I have to click with my finger. I would read another one.

Joan

Joan worked on the Discis Book for 35 minutes. She had difficulty moving the mouse at the beginning.

Joan clicked on sentences, all pictures except page 14 and occasionally difficult words (pages 1- 4, 9, 10, 13 - 15, 20). She usually clicked three or more times on each picture. She generally clicked the sentences before the music stopped.

Interview:

I like to listen to stories because they have characters and pictures. I like to read because it's exciting and teaches you a lesson. I liked the Discis Book because they read it to you. Whatever you point to, it tells you what it is. I would read another one.

Appendix J

Observations of Teacher-Designated Students - Single Use

Bea

Bea, a grade one student, suffers from a hearing impairment. Although she looked forward to working with the computer, she clicked on the sentence speaker of page 1 and then did nothing else. She moved the mouse a little and looked away. Her teacher aide and the researcher decided that further work with the book would be harmful to her so she was given the choice to stop immediately, which she did. Her total time working with the computer was three minutes.

Cathy

Cathy, a grade two student, worked on the Discis Book for 33 minutes. She spent 14 minutes on the first page alone and about five minutes on each of the seven other pages she used. She had difficulty with page turns, skipping five.

Cathy enjoyed the music, waving and laughing with it. She would click on a sentence and then the words of that sentence in order. As she clicked on each word, she turned around and repeated the word to her teacher aide. Occasionally she would repeat the word with actions to show she understood the meaning.

Cathy has a learning disability and cannot read at the grade two level. She was accompanied by her teacher aide who responded to her. The teacher aide suggested that the interview with Cathy be dispensed with as she would not be able to answer.

Dan

Dan, a grade four student, worked with the Discis Book for eight minutes, reaching page 13. He is an English Second Language student, being one year in Canada.

Dan clicked on sentences and occasional words (first three, last four, etc.). He clicked on these immediately after page turns, stopping the music. He tried to click on the page heading "The Tale of Peter Rabbit" (page 7). He was not too attentive -- looking around and saying about the disk drive: "You don't even have a disk here".

Interview:

I like to listen to stories because I don't have to read it. I like to read some books - mouse tales, most every kind. I liked the Discis Book better than books because I didn't have to read it. I would read another one.

Appendix K

Observations of Teacher-Designated Students - Repeated Use

Grade One

Patrick

First Time

Patrick worked for 17 minutes on the Discis Book, reaching page 11. He spent three minutes on the first page and about one minute on each of the remainder.

Patrick began the first use by spending a lot of time on the first page, clicking on pictures, on the sentences several times, and on the words. He did not click on all the words but those he did were clicked on in order.

He generally waited for the music to finish before clicking on sentences on the next page. After the first page, he clicked on pictures only once (page 9). He also concentrated on sentences, clicking on words only on six pages of the other ten.

The mouse followed the words on page 5 while the reader was speaking. On page 7 he made chewing sounds, imitating Peter Rabbit. About the picture on page 9, he commented: "Oh, he has a rake".

Second Time

This time Patrick spent 16 minutes, working with only 7 pages.

Patrick clicked on sentences and a few words on pages 1 and 3, skipping page 2 and 4. He changed the volume control through the Customize menu while on page 2 and opened the book through the book menu while on page 5. He started again.

He clicked on the picture once, the sentence speaker and the words in order on the title page. He then went to the second part of page 1, configuring the words to speak in Spanish through the Customize menu. He then clicked on words on that page.

He then skimmed through the book, clicking on sentences on pages 2, 6, 7, 12, and 16 and on the picture of page 6. During page 15 he turned down the volume control again. On page 19 he listened to the music, questioned the use of the buttons on the CD-ROM drive, and closed the book through the book menu.

Third Time

This time Patrick worked 12 minutes, working on 9 pages.

Patrick clicked a few words on page 1 and on a sentence. He turned to page 2, clicked on the sentence and then checked out the rest of the menus. He changed the font, brought up the table of contents, changed configuration settings even though he didn't know the meaning of the words. He then asked for the font to be changed back because his configuration changes didn't change that. He tried the Recall menu, choosing the word 'I' which he said before the computer did.

He then clicked on the first sentence of page 3 and all the words of that sentence and then next. He clicked sentences on pages 6, 8, 10, 17, 20 and words on the second part of page 21.

First Interview:

I like listening to stories. I like Roger Rabbit, Peter Rabbit and watching Ninja Turtles. I don't like to read because sometimes my teacher gives me five or ten words or sentences to learn. I like the Discis Book better because I have a computer at home with a mouse and a keyboard. I also play with it when I come home from school. I would do another one like it.

End Interview:

I liked using the book. I liked the story and it was fun. It would help me learn words. Words I learned are 'Peter Rabbit' and 'the'. I would like to tell the one who made it to let me type, to have a keyboard. I like to type.

Patty

First Time:

Patty is a child with learning disabilities and poor motor coordination as a result of brain damage. During her first visit she spent 20 minutes on the first page only, clicking on the words in random order, on the sentence once, and on the picture. She had difficulty moving the mouse as well as learning how to click. She would hold the mouse button down as she moved the mouse.

Second Time:

Patty still had the tendency of holding the mouse button down. However, in her 20 minutes, she clicked on words on random, on the first sentence three times (with words interspersed) and on the picture three times. On pages 2 - 4, she clicked on words at random and on the sentences. She skipped page 5 and clicked only on words on page 6.

Patty clicked all over the page, starting from the bottom and working upwards to the text.

Third Time:

Patty skipped page 1, clicking on sentences only on page 2, sentences and random words in pages 4, 6 and 8. On page 9 she clicked on words only. She worked for 15 minutes this time.

She still had difficulty moving the mouse but her clicking had improved. Once the mouse would eventually get to the edge of the pad, she didn't know what to do to get the cursor to move again.

She would always wait for the music to stop. She clicked on the sentence speakers before random words on a new page. When there were two sentence speakers, she would click on the bottom one first.

First Interview:

I like listening to stories. It's fun. I would do another one like it.

End Interview:

I liked the Discis Book. I liked the pictures and the music. I liked Mrs. Rabbit and the pictures. I learned about a bunny. I would like a copy with pictures. I would really like one like yours.

Grade Two

Paul

First Time:

Paul worked for 36 minutes on the Discis Book, finishing it. He spent 3 minutes on the first page.

Paul click on words, sentences and pictures on the first page. After that he clicked on sentences and pictures, clicking on words only when sentences ran onto the next page. He would occasionally read some words out loud after the speaker. The mouse followed the words a bit during the reading.

He checked out menus (during pages 4, 11 and 12) and the ball under the mouse (page 21). However, even though he had a little car in his left hand, his attention was on the computer screen about 95% of the time. He laughed at sound effects (pages 15, 16 and 23), but usually clicked on sentences before the music finished.

Second Time:

Paul concentrated more on sentences during his 23 minutes, clicking on pictures only on pages 7 and 21. He clicked on definitions on the first page, went back to the title page for definitions, and then more definitions on the first and fourth page.

He made comments about the story saying "Oh, this is where he gets into mischief" as he turned to page 7 and "He's eating a carrot" for page 8. He read pages 8 and 16 with the reader,

turned some pages with the reader for sentences extending to the next page, and read a sentence on page 17 before clicking on it. His mouse tracked occasional sentences as they were read.

Third Time:

Paul read the book in 21 minutes. He clicked on definitions on four pages (page 0, 1, 4 and 12) and pictures on page 8 only. Otherwise he clicked on sentences, tracking them occasionally. He turned the pages with the words. He said words before or with the reader or even before clicking on the sentence speaker.

He again made comments: "He's naughty" for page 6, "I like that one" for the sound effects on page 15. He stopped the music consciously on the first page, saying "I stopped the music." He tried the recall list and at the end, moved the scroll bar up to the beginning for the next person.

First Interview:

I like listening to stories because they are fun and because they always have a happy ending. I like reading because it's good to read small words and big words. I like the Discis Book better because you don't have to flip the pages with your hand. I would do another one like it.

End Interview:

I find the book exciting and funny. I liked the pictures, the words and the mouse. It would help me learn how to use a computer with different programs and all about rabbits and people. I didn't like it when Peter got wet.

Peggy

First Time:

Peggy worked on the Discis Book for 33 minutes, finishing it. She spent three minutes on the first page and about one or two on each of the remainder.

Peggy clicked on the words in order in the two sentences on page one. After that she clicked on the sentences, clicking on words only when a sentence continued onto the next page. She also clicked on most pictures.

Even though it was the first time she was using the mouse, she did not have too much difficulty with it. She used it for tracking the words with the speaker by page 17. Before that she mouthed the words. She would occasionally say the words of sentences continuing onto the next page before clicking on them.

Second Time:

Peggy finished the book in 21 minutes this time, working for five minutes on the first page. Peggy clicked on definitions on the first and sixth page and on words only twice when sentences ran on. Otherwise, she clicked on sentences before the music stopped, tracking the lines with the mouse.

Third Time:

Peggy finished the book in 16 minutes. She clicked on sentences throughout, clicking for a definition only on pages 6 and 18. Although she usually didn't wait for the music to finish, she did wait before turning page 10 and before clicking on a sentence speaker on page 24. She turned and laughed with the sound effects on page 16.

First Interview:

I like listening to stories because they are fun. I like reading because it learns me new words and it's fun. I like the Discis Book better than books because it is interesting. I would do it again.

End Interview:

I liked using the Discis Book because it was funny. I think it could help me learn reading. I learned the word 'supper'. I think it was O.K.

Grade Three

Peter

First Time:

Peter worked for 32 minutes with the Discis Book, finishing it. He spent three minutes on the first page and about one or two on each of the remainder.

Peter is an English Second Language student who came to Canada a year ago. He whispered the first sentence before clicking on the sentence speaker and would guess the picture names before clicking on them.

He clicked on sentences and pictures throughout, clicking on words occasionally at the end of a sentence (saying the word softly before) or the words of sentences that ran onto the next page. He asked for two definitions ('parsley' and 'gooseberry net'). The first one was given to him; the second was postponed. He was told that the book would be set up for definitions the next time.

He laughed at the sound effects of page 15 and turned the page with the words on page 21. He usually clicked the sentence speakers after some music but before it ended.

Second Time:

Peter took 27 minutes to read the book this time.

Peter clicked on the sentences throughout, clicked on the pictures of ten pages and clicked for definitions on eight pages, including the two words he had questioned the previous day. He said the illustration names with the computer.

The mouse tracked the words from the beginning of the story. He also questioned "Where's Peter. Oh yeah, Peter went..." on page 5. He occasionally waited for the music to finish, sometimes clicked immediately, and sometimes waited for some of the music to play before clicking on a sentence speaker.

Third Time:

Peter finished the story in 30 minutes this time, spending more time on pictures than previously. He missed clicking on only two pictures (pages 15 and 19).

Peter clicked on sentences and pictures throughout again, saying words before or with the picture labels. He clicked for definitions on five pages this time. He occasionally double-clicked rather than press-and-held for these definitions.

On one occasion, he clicked on a picture label and then clicked on the same word in the text, this being the only time he clicked on a word.

First Interview:

I like listening to stories a lot. I like their characteristics, that they have characters. I like to read. I can spend my time in fun and I can do something quiet. Mom likes me to do things quiet. I like Discis Books and books. I liked using the mouse. I would read another one like it.

End Interview:

I liked the book a lot. A lot. I like the music, the story, and playing with the computer. I learned English words, like 'gooseberry net'. I found moving the mouse hard.

Philip

First Time:

Philip spent 32 minutes with the Discis Book, reaching page 12 but working only with 10 since he skipped a page by clicking too many times and he did nothing on the other (page 6). He spent seven minutes each on the first two pages alone.

Philip is a student with learning disabilities because of some brain damage. He found moving the mouse very difficult, grunting and panting with the effort. He required special help to learn how to move the mouse.

He clicked on words in random order throughout the first experience with the book. He clicked on a sentence speaker on pages 2 and 4 and then on the next page on which he clicked

(page 7), he clicked on a few words in order and more words in order on page 8. However, on pages 9 to 12, he was clicking on words at random again or in reverse order (bottom-up and right-left). He skipped pages 5 and 6 the first time.

He would wait for the music to end before he clicked and occasionally, he would say words after the reader. On page 9 he said two words before clicking on them.

He would comment about the sounds: "Listen. It's scratching" (page 7) and about Peter Rabbit: "The guy's too fat." (page 8).

Second Time:

Philip worked for 16 minutes this time, skipping many pages. Even though he got to page 20, he worked on only 16.

Philip generally clicked on words this time from the bottom up but left to right order. He clicked on sentences as well on pages 4 and 5 and then on sentences only on pages 18 and 19. He skipped pages 11 to 14 and the first part of pages 10, 16 and 20. On pages 15 to 17, he clicked on the last line of words only.

He waited for the music to end again before doing any clicking.

Third Time:

This time Philip worked for 15 minutes, reaching page 6 without skipping any.

He clicked on the words of the title page in order. On pages 1 and 2 he clicked words in a bottom up and left to right order. On page 3, he clicked on the second sentence, clicked on its words in order and on the sentence again. He then clicked on the bottom row of sentence 1, on the sentence speaker, and then on the top row in order. On page 4 he clicked on sentence 2 and then sentence 1. However, he then clicked on the words of sentences 1 and 2 in order. On page 5 he returned to his habit of clicking on words from the bottom up and left to right for half of the sentence. He then clicked on the first half of the words of the sentence in order and then on the sentence speaker again. On the last page, he clicked on the words in bottom-up, left to right order.

As well as clicking on words and sentences, he clicked on pictures more today, clicking on the title page and pages 1 to 3 four or five times. On page 2 he clicked on the picture 20 times.

First Interview:

I like listening to stories. Some are about sheep and wolves. I like reading. Some books I like are Three Bears and Three Pigs. I liked the Discis Book better because Peter Rabbit, he didn't listen to this mother. He went into the garden. He ate and got too fat. The other three were good. I would do another one.

End Interview:

I liked the Discis Book. I liked the story. He was too fat and I liked the bird singing. I learned that he didn't listen to his mother.

Appendix L

Adult Comments and Interview Answers

School Librarian

The Discis Book won't replace sitting in a lap or curling in a chair with a good book but it is wonderful for kids who haven't gotten to the point of becoming independent readers. It's wonderful. I liked the different sounds on each page. I like the nature sounds. They're really nice.

Kids love computers. They can control it the way they don't over a book and they can make it do what they need.

A negative aspect would be if they didn't go on from this to books and if they got stuck here. If they always wanted it read on the computer and didn't go on to books, that would be a problem. It is a stage in reading.

The best use in school would be with kids in late grade one and early grade two having trouble reading. Some have a poor attitude because they have trouble reading. If this helps it will be wonderful.

If it can't be networked, then teachers would have to cycle kids in its use. Since it would be an independent activity, teachers can fit it in. It can be part of a unit on Peter Rabbit. Children can draw maps of his trip, do a presentation. Use this first for those having trouble reading.

Kindergarten Teacher 1

This manner of presenting literature has more variety. Some of the kids would appreciate it. It's different. It's a different way of approaching print. Some students would find it novel and pay attention. They like computers. It's too bad the Discis Book is not a bit slower so that they can follow along. But I think the kids would like it.

The speaking speed is too fast for grade ones. There are also too many options for them. Keep it as simple as possible.

Suggestions: For kindergarten, have them hear it read. For grade ones, they can't track because the reading speed is too fast. Have an option to slow it down for some, keep regular speed for others.

The best level of readers for its use is: non-readers in kindergarten, beginning readers if it were slower and independent readers. It can be used in a listening center by a small group who could read with it if it were slowed down.

Kindergarten Teacher 2 and Parent of Kindergarten Child

The Discis Book is great as a supplement to the real life situation. Once children are introduced to a story and have gone over it with the teacher, it can be used at a listening center to help children reread, listen and help them start exploring with the text.

It is linked to story listening, focusing their attention and expanding the length of their attention. I see a value in their exploration of the text. They develop reading from left to right and become aware of words. They see clusters of letters to make a word so they develop an appreciation of syntax. It helps their sight vocabulary. The music is important. Kids can use music to figure out feeling that the computer wants them to have. The text is a link between the music and the story. The same message is being presented through different media. The kids can check their idea about the mood of the music by reading the text. It develops hand-eye coordination and fine motor skills. Older grades can look at it for paragraphing, punctuation and conversation models.

If the book is not used as supplementary but as a primary method of teaching reading, it could be very negative. Teachers have to allow the kids to explore, but once they know how to use it, teachers should give them goals. Kids have to get used to the page turns, get used to how

long the music plays, how to stop the music and what causes the reading to stop. There needs to be a training period.

It can be used in school as a supplement in a listening center.

It should be used for primary students especially because older students read faster. Primary students need its emphasis on vocabulary and sentence structure. It could be used for remedial work in older grades, even up to grade seven, for motivation with them and as a different way to keep reviewing the words they need. It could be used for anyone who has this reading level even if they be adult illiterates. However, the story would have to be chosen to suit them.

Teachers must devise goals for the students. It can be used for developing skills (focus attention, expand length of attention, hand-eye coordination, fine motor skills, sight vocabulary, left to right progression, up to down progression, syntax matching, paragraphing, punctuation study and conversation.).

Kindergarten Teacher 3 and Parent of Grade Three Child

The Discis Book is delightful. I like the phrase highlighting (second page). It would be good if they had another signal to darken phrases as on page 2, especially for the younger children. It's so cute. You can relax and look for details and study the picture. You don't have to hurry to keep up with the reading. They can hear the music and then they can have it read for them. It's very relaxing.

I feel that any tools are valuable. In the past some teachers felt threatened that computers would replace them. They are tools to present another way. Kids love them and have fun. Kindergarten children love 20 minutes of computer work. They find it interesting and stimulating.

I like the variety. It's another way of presenting books. At the beginning there is novelty, but that will wear out. The computer looks realistic, like a book. The voice is like a record, not a stilted, synthesized voice. The pictures, sound and pleasant lady's voice are positive aspects.

The sound effects are more realistic than a teacher can do. Kids can go into details - pictures or words. I would like accenting of phrases for the younger ones.

Kids can learn first what's available and then be allowed to use it during their choice time. It would be popular.

It should be used by grade two or slow grade three readers. It should not be the only way of learning and practicing reading.

Teachers can use it as another station. They can make up job card activities for kids to do after reading the story. E.g. finding a solution for Peter - what could he have done? The book can be used for problem solving, art, creative writing, crafts, experiments, making up their own version, language arts activities.

Parent of Kindergarten and Grade Three Children

The book is innovative, stimulating and exciting. Children are learning to read through it in a visual manner that stimulates their creativity as well as their learning skills, enabling them to learn without feeling the pressure. For a child having difficulty visualizing the word, it provides the image they need to stimulate their memory. They see the word as well as hear it.

The only drawback I would see is that extremely bright children would tend to play with it rather than learn through it.

It can be integrated into the computer program with children using it once or twice a week. They can do the program and discuss afterward so that the teacher can check how much they are absorbing and which child is benefiting from it.

It can be well used in primary for children that have a lack of interest in the written word; they see a word as well as hear it. English Second Language students would be able to use it. It would also help children who lack self confidence or are incapable of reading. It would give them confidence and a sense of achievement. "I can see this and understand it." If there is a priority

needed because of lack of equipment, it should be used with children who have a problem in reading skills.

Grade One Teacher 1

I like the Discis Book. It opened up whole new possibilities for me. I can see how it can be used in the classroom. It won't take the place of a book but it would be fun to use it in conjunction with the regular reading program.

When students click on a word, it highlights the individual words. For reading, the sight and sound go together. I like having the definitions if needed. Clicking on the picture reinforces certain words.

Some definitions are given out of context. It would be better in the context of what they are reading, especially for beginning readers.

It would fit in well with individual programs for the kids. They can work independent with it once they are computer literate. It would be hard for the teacher to set it up initially so they know what they are using. If the Discis Book is similar to class books used, it can be used to reinforce the class book but geared to an individual pace.

It can be used with all levels. The younger students can't read as fast as the speaking speed. I would like to see an option for chunk phrasing for them.

Teachers can use it to supplement what they are already doing. It would be good to have it backed up in print as large books or group sets of paperbacks.

Grade One Teacher 2

The book is excellent, creative and motivating. It meets the needs of students at different levels. It is self-paced--the children have control. They control their own learning and speed. A child can explore any facet of the program. The children can be active learners, exploring the

book. The different modalities are important: the visual for visual learners and the auditory for those students who recall sound better.

One difficulty might be in its use by special needs children. If the story is not at their level, it could be tiresome and a tedious task for them. If they don't know what to do, they can be frustrated. They may also have poor motor coordination.

Remedial students of grade three would be the ones who would benefit from it the best.

It can be used effectively in a learning center. I would like to see comprehension of the story addressed. Teachers can check comprehension (e.g. cause and effect, sequencing, details, main idea) after children have used the book.

Parent of Grade One Child

This is a great manner of presenting literature. My only concern for a grade one child is that this story is too long. It encourages involvement in the book. It's a fun way to learn. Any way fun can be used to encourage learning should be used.

The use of the mouse helps develop motor skills. Hearing the speaker helps promote good pronunciation and diction. The capability to change font size is excellent for little children. Most of the definitions are geared toward the child.

However, the story is too long for a grade one child and the mouse is difficult for a novice to use. The pages should turn automatically when a sentence runs on to the next page.

Children who are having problems reading or are lacking in a desire to read may be encouraged by the Discis Books.

Lots of readers may benefit from them, depending on the book. Older children may benefit from having definitions available while younger children would benefit from hearing as well as seeing the words. This helps their retention.

Teachers can use basic literature that makes sense (not like some of the books my son brings home). After going over it together in class, those having difficulty reading can use the

matching Discis Book to help them retain the words they see and hear. Older children who are more advanced can use the books for fun and as a challenge. They can read it first silently and then to check their words.

Parent of Grade Two Child

This manner of presenting literature could force the children to interact with books more but it doesn't make them read. It is better than story tapes during which a child listens while looking at the pictures. This book encourages looking at text but not as much as straight reading would. I would play with the pictures to get the explanations.

There is interaction and the element of control to a degree within the structure of the program. I like the ability to make the font large. Some of the definitions and examples are excellent, including that of the gooseberry net.

There is no creativity allowed for in the program. Everything is in the structure of the program. I'd like a loop off into a graphics program and a wordprocessing program so that they can create their own books with sound effects from a library of sound effects. I like the idea of using already published literature as a spur for children to create their own literature. Publishing is being done in the schools.. Kids love incorporating sound effect and video.

The black and white pictures are a drawback. The lack of colour makes it difficult to differentiate the pictures.

The book can be used as a trigger. Intermediate students can use these books as a spur to go on to creating their own books. Intermediate children who are familiar with computer games would not find this interesting enough without a creative extension. This particular type of book matches the primary students better.

Teachers can use these books to help develop computer skills and for work in Language Arts depending on the material in the stories. Depending on the definitions used, stories with a historical or cultural background can be used in social studies. There is a lot of power in the

definitions and the pictures. If the company wants to bring the book into other curriculum areas, more would have to be done with them.

Grade Two-Three Teacher

I prefer books. I'm not comfortable with computers. If I have a choice, I'd rather have a book. It would motivate some kids as most kids like computers. The music, sound, mood are neat for kids. It's nice to have variety. However, it lacks colour and the pages are too slow in turning.

It is best used individually, not in a large group. It would be no good for discussion or for getting feedback. It can be used as an individual activity, helping remedial students and learning-disabled students or for enrichment as independent work. In the library, it could get kids more involved in books as it opens literature up more to them. For home use, I would prefer a book.

It should be for the younger children -- K to grade three. It depends on what you want to use it for as all can benefit. Kindergarten students would like it because it shows them that they are 'reading'.

It can be set up as a learning center and activities can be made to go along with it.

Grade Three Teacher and School Librarian

The Discis Book is good because it presents pictures with words. The story is being read to the child so for someone having trouble reading, it reads the words. Also the program is user friendly so the child can work through it without a whole lot of frustration. It is better than being read to because they are looking at the words. The meanings for the words are also there.

A child would want to do more reading. It might help children who have trouble reading to have the music playing while they read the story out loud (or tell it). It does encourage higher level thinking skills such as inquiry. It enables teachers to use higher level thinking skills in the

follow-up. There can be character study, author's intention, story setting, and analysis of the story.

A negative aspect is that the children are not interacting with another person so they are not exchanging ideas. It is not a social event. The child is not giving input.

It can be used in a school in a lab where children work in groups. A child with difficulty can be coupled with one who is a strong reader.

All reading levels of children can benefit from it. Low level children can listen to it. Medium level children can read along and get the meanings. High level children would click on pictures and the words they need. It can be used throughout kindergarten to grade four and with special needs children above that.

As a follow-up to using the book, children could make a big book. They could choose five or six main ideas from the story, draw pictures to illustrate the book, write sentences and put them into a book.

In Language Arts, the children could take the main characters and write their characteristics as seen in the story that is read. After a group has seen it, they could be given this activity.

Parent 1 of Grade Three Child

My child would be too advanced for this.

I think I would always read to my kids. The Discis Book might have value as a side thing, in addition to hearing other books. It is valuable for an adult to read to the child because of the human interaction.

They can do it on their own as an independent project. It doesn't rely on having a parent available.

A negative aspect is that the book is impersonal, a machine speaking.

I see it being used with kids between kindergarten and grade two that need extra help in reading and in comprehension. It has a novelty value. Since kids enjoy the technology, they can learn without realizing it. Teachers can read the story with the kids and use this as an extra.

Parent 2 of Grade Three Child

I think the Discis Book was great. The voices saying the words with the proper pronunciation and with expression would help the children's understanding. The music enhances the story, helping them get the meaning. It is also quite dramatic.

A disadvantage I would see is that it emphasizes reading without phonics. It can help the children be lazy, recognizing words by sight rather than trying to get them by their pronunciation. I think it should be used for children in grade three and up who have already learned phonics.

A Grandmother of Four Children and Four Grandchildren

This manner of presenting literature should appeal to quite a few children because of the visual appeal as well as the auditory appeal. There is interaction with a book in a different way. It is not heavy like a regular book. Some might have difficulty with the mouse and this could be frustrating. The use of the mouse might help hand-eye coordination. It does for my four year old granddaughter.

Children should become familiar with computers as early as possible in a non-threatening way and this way of using the computer is fun. It would have more appeal if it was in colour. I liked having both male and female voices and having highlighting of phrases being read on the second page.

The language options are helpful for English Second Language students. The font choices are good as the font can be changed to look like primary writing (Avant Garde) with the 'a' and the 'g' written as a primary child writes them. However, the font style difference between the pictures and the text may confuse the child.

Children with poor hand-eye coordination or motor skills, palsy, eye astigmatism or auditory programs could become very frustrated with using the mouse. They could feel uptight and upset, trying hard to do something they want and can't do.

The books can be a useful tool for English Second Language instruction. They can also be used for those having difficulty holding books or be used for individual enrichment or reward in a quiet area. The books should be used for children at the primary level because they are learning to read there. They could benefit those with learning disabilities as they match the development ability of the children.

Education Faculty Member 1

I like the Discis Book and find it intriguing. It has to be used as only one way of presenting literature and it can't take away from story telling. But it's a good way to get them to read along and to enjoy books.

I like the highlighting of phrases as if the child were marking the words with his finger. The sound effects are great. It provides a nice model for kindergarten children to read along with. I would state a caution that nothing can replace sitting down and reading with children. If it is used for the children to read and afterward have comprehension questions, it would ruin it. It would become more of a skill. It is a way to enjoy books. I would hate to see anything that would take away this exploration aspect.

It can be used in a learning station where children can sit individually or in small groups. It should be an extension of reading rather than a substitute. The story can be read aloud first in class and then the children can come to the computer story. It can be used all the way through the grades. Even intermediate grades can use it with relevant stories.

Education Faculty Member 2

I think it's wonderful. I really like it. It seems particularly appropriate for young children in terms of learning words, with sounds and words put together which they are able to repeat indefinitely without feeling stupid or receiving negative input from adults. Letters and words are matched with sound. The children have the experience of getting a story, hearing new vocabulary, seeing the different structures of stories in different books, seeing different sentence structures and observing that meaning is created through text.

I like the ability to customize, especially for English Second Language students. I liked the page highlighting. It made concrete which phrase was being said. It could be at the word level as well so that it would be like pointing visually. I would like the highlighting in bold rather than in reverse.

Definitions were good and bad. Some of the definitions were excellent. 'Brown bread' gave the colour 'brown' in context. They are contextualized in that they give only the one meaning that fits in. Some of the examples are bad, such as using the word 'encounter' as a synonym for 'meet'. 'Meet' is easier than 'encounter' for kids.

I don't like the fact that sentence speakers say sentences with words that continue onto the next page. The page should turn automatically with the reader so that the mapping of words and sounds continues.

I find the music distracting. I wanted to listen as it was interesting but found the music interrupted the flow of the story. It was too long.

It takes a long time to read the whole story. I would suggest smaller stories for beginning kids.

Limit the customizing of font styles so that highlighting can be done in bold. However, I do not mind the reverse for clicking on a word.

The book could be used by an individual at a work station for an activity chosen by the student. It would be like an adult reading to the child. It could be used by beginning readers and

by kindergarten children with simple stories. It could even be an alphabet book or something like the Sandra Boynton books (such as Doggies and But NOT the Hippopotamus).

The story should be read out loud, should be discussed together in class and then have the book on the computer for children on their own. Rereading of texts is very beneficial. The first time they look for meaning. During the first six or seven times, they ask questions about pictures, and then they ask about words. The whole class should work with the story. The Discis Book is good for letting them explore it on their own (for words).

To help children develop the mouse skill they need for the book, a help feature could be set up in which the children would click on numbers, one at a time, and have them fly away. The Tour disk is too short for practicing this skill.

Appendix M

Sample Definitions

blackberries	small, sweet, juicy, black or purple fruit that grow on shrubs.
brown bread	any bread made of dark flour. Example: *I like to eat brown bread with honey.*
camomile tea	a hot drink brewed from the dried leaves of small, white, scented flowers. Example: *He drank so much camomile tea that he fell asleep at once.*
currant buns	sweet bread rolls made with dried, seedless raisins or currants inside. Example: *Our currant buns have a crunchy crust.*
damp	slightly wet. Example: *The dish rag is damp and smelly.* The same as moist, dank.
exert	make an effort. Example: *Kindly exert yourself and make some tea.*
fortnight	two weeks. Example: *We shall go to Timbuktu for a fortnight.*
gooseberry net	a support for growing round, sour fruit. A gooseberry net is made of knotted threads woven together. Example: *Tom and John played hockey and used the gooseberry net as a goal.*
implored	asked or begged somebody for something. Example: *She implored her mother for more pudding.* The same as beseeched, entreated.
lippity-lippity	a hopping sound made by something wet and floppy. Example: *The boy who fell into the lake went lippity-lippity over the carpet.*
meet	to come upon. Example: *I meet my friends after school.* The same as encounter.
mischief	an action that is playful and fun, but often causes harm or trouble. Example: *Little Percy got into mischief every time he was left alone.*

naughty	mischievous. Example: *We were naughty not to eat our spinach as Ma asked us to do.* The same as disobedient.
on his hands and knees	crouched or in a bent position. Example: *The boy scout was on his hands and knees planting trees.* The same as on all fours.
parsley	herbs or plants whose small leaves are used to season food. Example: *You should grow some parsley on your farm, Mr. McGregor.*
scare-crow	the figure of a person dressed in clothes. Example: *A scare-crow in a corn field frightens away birds.*
scratch	the noise made by scraping something. Example: *He went scratch with the comb.*
scr-r-ritch	a scraping sound. Example: *He dragged the chalk on the slate so that it made a noise like scr-r-ritch.*
scuttered	scurried or ran fast. Example: *The shy girl scuttered behind the bookcase.*
sieve	a thing made of metal with holes in the bottom. Example: *You pour the rice into a sieve to drain the water out.*
squeezed	forced a way through a small or crowded place. Example: *My friend, Conchita, squeezed through the window.*
underneath	below. Example: *He found a marble underneath the bed.*

References

Allington, Richard L. (1980a). Teacher Interruption Behaviors During Primary-Grade Oral Reading. Journal on Educational Psychology, 72(3), 371-377.

Allington, Richard L. (1980b). Poor Readers Don't Get to Read Much in Reading Groups. Language Arts, 57(8), 872-876.

Allington, Richard L. (1983a). Fluency: The neglected reading goal. The Reading Teacher, February, 556-561.

Allington, Richard L. (1983b). The Reading Instruction Provided Readers of Differing Reading Abilities. The Elementary School Journal, 83(5), 548-559.

Allington, Richard L. (1984). Content Coverage and Contextural Reading in Reading Groups. Journal of Reading Behavior, 16(2), 85-96.

Ambron, Sue. (1987). New Visions of Reality: Multimedia and Education. In Kaplan-Neher, Anne (Ed.). Learning Tomorrow: Multimedia in Education. The Journal of the Apple Education Advisory Council, Spring, 3-13.

Ambron, Sue. (1990). Multimedia Composition: Is It Similar to Writing, Painting, and Composing Music? Or Is It Something Else Altogether? In Ambron, Sue and Hooper, Kristina (Eds.). Learning with INTERACTIVE MULTIMEDIA: Developing and Using Multimedia Tools in Education. Redmond, Wash.: Microsoft Press, 69-84..

Anderson, Betty. (1981). The Missing Ingredient: Fluent Oral Reading. The Elementary School Journal, 81(3), 173-177.

Anderson, G., Higgins, D. and Wurster, S. R. (1985). Differences in the free-reading books selected by high, average, and low achievers. The Reading Teacher, 39, 326-330.

Anderson, John. (1989a). Multimedia: About Interface. MacUser, March, 88-96.

Anderson, John. (1989b). Interactive Multimedia: Discovery by design. MacUser, March, 96-98.

Anderson, Linda M., Evertson, Carolyn M. and Brophy, J. E. (1979). An Experimental Study of Effective Teaching in First-grade Reading Groups. The Elementary School Journal, 79(4), 193-222.

Anderson, Richard C., Mason, Jana and Shirey, Larry. (1984). The reading group: An experimental investigation of a labyrinth. Reading Research Quarterly, 20, 6-38.

Anderson, Richard C., Shirey, Larry, Wilson, P. T. and Fielding, L. G. (1987). Interestingness of Children's Reading Material. In Snow, R. E. and Farr, M. J. (Eds.). Aptitude, Learning and Instruction Vol. 3: Conative and Affective Process Analyses. Hillsdale, N.J.: Lawrence Erlbaum Assoc., 287-299.

Apple Computer, Inc. (1989). HyperCard Stack Design Guidelines. Don Mills, Ontario.

Atkinson, Richard C. (1974). Teaching Children to Read Using a Computer. American Psychologist, 29, 169-178.

Balajthy, Ernest. (1987a). Implications of Artificial Intelligence Research for Human-Computer Interaction in Reading Instruction. In Reinking, David (Ed.). Reading and Computers: Issues for Theory and Practice. New York: Teachers College Press.

Balajthy, Ernest. (1987b). What Does Research on Computer-Based Instruction Have to Say to the Reading Teacher? Reading Research and Instruction, 27(1), 54-65.

Bangasser, Thomas F. (1989). The Utility Value of Information. In Oberlin, Salley and Cox, Joyce (Comp.). CD-ROM Yearbook. Redmond, Wash.: Microsoft Press, 5-8.

Barrett, E. and J. Paradis. (1988). The on-line environment and in-house training. In E. Barrett (Ed.), Text, ConText and HyperText: Writing With and For the Computer. Cambridge, Mass: MIT Press, 227-249.

Barrett, Edward (Ed.). (1988). Text, ConText and HyperText: Writing With and For the Computer. MIT Press, Cambridge, Mass.

Bastiaens, Gaston. (1989). The Development of CD-I. In Oberlin, Salley and Cox, Joyce (Comp.). CD-ROM Yearbook. Redmond, Wash.: Microsoft Press, 59-66.

Becker, Henry Jay. (1987). Using Computers for Instruction. Byte, February, 149-162.

Benware, C. A., and Deci, E. L. (1984). Quality of learning with an active versus passive motivational set. American Educational Research Journal, 21, 755-765.

Biemiller, Andrew. (1978). Relationships between oral reading rates for letters, words, and simple text in the development of reading achievement. Reading Research Quarterly, 13, 223-253.

Bracy, Gerald. (1989). 1988-89 The year of negative conclusions - but there's hope. Electronic Learning, June, 22 - 23.

Brandon, Paul R. (1988). Recent developments in instructional hardware and software. Educational Technology, 28(10), 7-12.

Bruner, J. S. (1966). Toward a theory of instruction. Cambridge, Mass: Harvard Univ. Press.

Buddine, Laura and Young, Elizabeth. (1987). The Brady Guide to CD-ROM. New York: Prentice Hall Press.

Burnett, Frances Hodgson. (1938). The Secret Garden. J. B. Lippincott Co.

Bush, V. (1986). As We May Think. In Lambert, S. and Ropiequet, S. (Ed.). CD-ROM: The New Papyrus. Microsoft Publ. Wash. (Reprinted from Atlantic Monthly, 1945, 176).

Carbo, Marie. (1978). Teaching reading with talking books. The Reading Teacher, 32, 267-273.

Carr, Clay. (1988). Hypertext: A new training tool? Educational Technology, 28(8), 7-11.

Carroll, Lewis. (1972). Alice's Adventures in Wonderland and Through the Looking Glass. London: J. M. Dent & Sons, Ltd.

Carver, Ronald P. and Hoffman, James V. (1981). The effect of practice through repeated reading on gain in reading ability using a computer-based instructional system. Reading Research Quarterly, 16, 374-390.

Chall, Jeanne S. (1983). Stages of Reading Development. Toronto: McGraw-Hill.

Chanowitz, B. and Langer, E. (1980). Knowing more (or less) than you can show: understanding control through the mindlessness-mindfulness distinction. In J. Garber & M.E.P. Seligman (Eds.) Human helplessness: Theory and applications. New York: Academic Press, 97-129.

Chomsky, Carol. (1976). After Decoding: What? Language Arts, 53, 288-296, 314.

Clark, Richard E. (1983). Reconsidering Research on Learning from Media. Review of Educational Research, 53(4), 445-459.

Combs, Martha. (1987). Modeling the reading process with enlarged texts. The Reading Teacher, 40(4), 422-426.

Computers the weapon as Mississippi takes aim at illiteracy. (1990, January 24). The Vancouver Sun.

Condry, J. C. (1977). Enemies of exploration: Self-initiated versus other-initiated learning. Journal of Personality and Social Psychology, 35, 459-477.

Conklin, Jeff. (1987). Hypertext: a survey and introduction. IEEE Computer, 20(9), 17-41.

Conte, Richard and Humphreys, Rita. (1989). Repeated Readings Using Audiotaped Material enhances Oral Reading in Children with Reading Difficulties. Journal of Communications Disorders, 22(1), 65-79.

Cullinan, Bernice E. (1989). Latching on to Literature: Reading Initiatives Take Hold. School Library Journal, April, 27-31.

de Charms, Richard. (1968). Personal causation. New York: Academic Press.

Dowhower, Sarah Lynn. (1987). Effects of repeated reading on second-grade transitional readers' fluency and comprehension. Reading Research Quarterly, 22, 389-406.

Dowhower, Sarah Lynn. (1989). Repeated reading: Research into practice. The Reading Teacher, March, 502-507.

Durlak, Jerry. (1989). Apple's Multimedia Lab. Minds in Motion, Spring, 32-48.

Dwyer, T. (1980a). The significance of solo-mode computing for curriculum design. In R.P. Taylor (Ed.). The Computer in the School: Tutor, Tool, Tutee. New York: Teachers College Press, 104-112.

Dwyer, T. (1980b). Heuristic strategies for using computers to enrich education. In R. P. Taylor (Ed.). The Computer in the School: Tutor, Tool, Tutee. New York: Teachers College Press, 87-101.

Elley, Warwick B. (1989). Vocabulary acquisition from listening to stories. Reading Research Quarterly, 24(2), 174-187.

Engelbart, Doug with Kristina Hooper. (1986). The Augmentation System Framework. In Ambron, S. and Hooper, K. (Eds.). Interactive multimedia: Visions of multimedia for developers, educators, and information providers. Redmond, Wash.: Microsoft Press, 17-34.

Fisher, M. D., Blackwell, L. R. Garcia, A. B., and Greene, J. C. (1975). Effects of student control and choice on engagement in a CAI arithmetic task in a low-income school. Journal of Educational Psychology, 67, 776-783.

Fraase, Michael. (1990). Macintosh Hypermedia: Volume I, Reference Guide. Glenville, Illinois. Scott, Foresman and Co.

Friedlander, Larry. (1987). The Shakespeare Project. In Kaplan-Neher, Anne (Ed.). Learning Tomorrow: Multimedia in Education. The Journal of the Apple Education Advisory Council, Spring, 123-152.

Fry, Edward. (1977). Fry's Readability Graph: Clarifications, Validity, and Extension to Level 17. Journal of Reading, 21(3), 242-252.

Fuller, Robert G. and Zollman, Dean. (1985). From the Dragon's Lair to the Tacoma Bridge. Videodisc and Optical Disk, 5(1), 37-51.

Gamby, Gert. (1983). Talking books and taped books: Materials for instruction. The Reading Teacher, 36, 366-369.

Gay, G. (1986). Interaction of learner control and prior understanding in computer-assisted video instruction. Journal of Educational Psychology, 78, 225-227.

Geoffrion, Leo D. & Geoffrion, Olga P. (1983). Computers and Reading Instruction. Don Mills, Ontario: Addison-Wesley.

Gilman, Louie. (1989). CD-I: The Dark Horse. CD-ROM EndUser, October, 75.

Goetzfried, L. and Hannafin, M. J. (1985). The effect of the locus of CAI control strategies on the learning of mathematics rules. American Educational Research, 22, 273-278.

Gray, S. H. (1987). The effect of sequence control on computer-assisted learning. Journal of Computer-Based Instruction, 14, 54-56.

Hannafin, Michael J. and Colamaio, Mary Anne E. (1987). The effects of variations in lesson control and practice on learning from interactive video. ECTJ, 35(4), 203-212.

Harris, Margaret and Cody, Michael. (1988). The dynamic process of creating hypertext literature. Educational Technology, 28(11), 33-40.

Harter, Susan. (1981). A new self-report scale of intrinsic versus extrinsic orientation in the classroom: Motivational and informational components. Developmental Psychology, 17(3), 300-312.

Herman, Patricia A. (1985). The effect of repeated readings on reading rate, speech pauses, and word recognition accuracy. Reading Research Quarterly, 20(5), 553-565.

Hiebert, Elfrieda H. and Colt, Jacalyn. (1989). Patterns of literature-based reading instruction. The Reading Teacher, October, 14-20.

Hoffman, James V. (1987). Rethinking the Role of Oral Reading in Basal Instruction. The Elementary School Journal, 87(3), 367-373.

Hooper, Kristina. (1987). Multimedia in Education. In Kaplan-Neher, Anne (Ed.). Learning Tomorrow: Multimedia in Education. The Journal of the Apple Education Advisory Council, Spring, 357-374.

Hooper, Kristina. (1990). HyperCard: A Key to Educational Computing. In Ambron, Sue and Hooper, Kristina (Eds.). Learning with INTERACTIVE MULTIMEDIA: Developing and Using Multimedia Tools in Education. Redmond, Wash.: Microsoft Press, 5-25.

Hoskisson, Kenneth. (1977). Reading Readiness: Three Viewpoints. The Elementary School Journal, September, 45-52.

Ito, Russell. (1989). Making the Jump to HyperMedia. MacUser, March, 129-130.

Jachym, Nora K., Allington, Richard L., and Broikou, Kathleen A. (1989). Estimating the cost of seatwork. The Reading Teacher, October, 30-35.

Jenkins, Yolanda. (1990). Multimedia Technology: Tools for Early Learning. In Ambron, Sue and Hooper, Kristina (Eds.). Learning with INTERACTIVE MULTIMEDIA: Developing and Using Multimedia Tools in Education. Redmond, Wash.: Microsoft Press, 111-123.

Johnston, Jerome (Ed.). (1984a). Evaluating the New Information Technologies. San Francisco: Jossey-Bass Inc., 1-3.

Johnston, Jerome. (1984b). Research Methods for Evaluating the New Information Technologies. In Johnston, Jerome (Ed.). Evaluating the New Information Technologies. San Francisco: Jossey-Bass Inc., 73-87.

Johnston, Vivien M. (1987). Attitudes towards microcomputers in learning: 2. Teachers and software for language development. Educational Research, 29 (2), 137-145.

Jonassen, D. H. (1985). Interactive lesson designs: a taxonomy. Educational Technology, 25 (6), 7-17.

Jonassen, David H. and Hannum, W. H. (1987). Research-based principles for designing computer software. Educational Technology, 27(12), 7-14.

Jonassen, David, H. (1988). Designing structured hypertext and structuring access to hypertext. Educational Technology, 28(11), 13-16.

Kamil, Michael L. (1987). Computers and Reading Research. In Reinking, David (Ed.). Reading and Computers: Issues for Theory and Practice. New York: Teachers College Press, 57-75.

Kearsley, G. P. and Frost, J. (1985). Design factors for successful videodisc -based instruction. Educational Technology, 25(3), 7-13.

Kern, Gary M. and Khalik, F. Matta. (1988). The Influence of Personality on Self-Paced Instruction. Journal of Computer Based Instruction, 15(3), 104-108.

Keyes, Elizabeth, Sykes, David and Lewis, Elaine. (1988). Technology + Design + Research = Information Design. In E. Barrett (Ed.). Text, ConText and HyperText: Writing With and For the Computer. Cambridge, Mass: MIT Press, 251-264.

Kinzie, Mable B. and Sullivan, Howard J. (1988). Learner Control and Achievement in Science Computer-Assisted Instruction. Journal of Educational Psychology, 80(3), 299-303.

Kleinmann, Howard H. (1987). The Effect of Computer-Assisted Instruction on ESL Reading Achievement, The Modern Language Journal, 71(3), 267-276.

Kozma, R. B. (1987). The implication of cognitive psychology for computer-based learning tools. Educational Technology, 27(11), 20-25.

LaBerge, David, and Samuels, S. J. (1974). Toward a Theory of Automatic Information Processing in Reading. Cognitive Psychology, 6, 293-323.

Lacey, Hugh M. (1979). Control, Perceived Control, and the Methodological Role of Cognitive Constructs. In Perlmutter, L. and Monty, R. (Eds.). Choice and Perceived Control. New York: Halsted Press, 5-27.

Langer, E. J. (1980). The Psychology of Control. Beverley Hills: Sage.

Laub, Leonard. (1986). What is CD-ROM? In Lambert, Steve and Ropiequet, Suzanne. (Eds.). CD-ROM: The New Papyrus. Redmond, Wash.: Microsoft Press, 47-71.

Leinhardt, G., Zigmond, N and Cooley, W. W. (1981). Reading Instruction and Its Effects. American Educational Research Journal, 18(3), 343-361.

Lewis, C. S. (1950). The Lion, The Witch and The Wardrobe. Collins.

Lundsteen, Sara W. (1989). Language Arts: A Problem Solving Approach. New York: Harper & Row.

Malone, Thomas W. and Lepper, Mark K. (1987). Making Learning Fun: A Taxonomy of Intrinsic Motivation for Learning. In Snow, R. E. & Farr, M. J. (Eds.). Aptitude, Learning and Instruction Vol. 3: Conative and Affective Process Analyses. Hillsdale, N.J.: Lawrence Erlbaum Assoc., 223-253.

Marchionini, Gary. (1988). Finding Facts vs. Browsing Knowledge in Hypertext Systems. Computer, 21(1), 70-80.

Marchionini, Gary and Shneiderman, Ben. (1988). Hypermedia and learning: Freedom and chaos. Educational Technology, 28(11), 8-12.

Martinez, Miriam and Teale, William H. (1988). Reading in a kindergarten classroom library. The Reading Teacher, February, 568-572.

Mason, George E. (1980). Computerized Reading Instruction: A Review. Educational Technology, 20(10), 18-22.

McCarthy, Robert. (1989). Multimedia: what the excitement's all about. Electronic Learning, June, 26-31.

McConkie, George W. and Zola, David. (1987). Two Examples of Computer-Based Research on Reading Eye Movement Monitoring and Computer-Aided Reading. In Reinking, David (Ed.). Reading and Computers: Issues for Theory and Practice. New York: Teachers College Press, 97-107.

McCormick, Sandra. (1983). Reading Aloud to Preschoolers Age 3 - 6: A Review of the Research. Reading Horizons, Fall, 7-12.

McCormick, Sandra. (1977). Should You Read Aloud To Your Children? Language Arts. 54(2), 139-143, 163.

McMahon, Margaret L. (1983). Development of reading-while-listening skills in the primary grades. Reading Research Quarterly, 19, Fall, 38-52.

McReynolds, Paul. (1971). Nature and assessment of intrinsic motivation. In P. McReynolds (Ed.). Advances in psychological assessment, (Vol. 2). Palo Alto, CA: Science and Behavior Books, 157-163.

Megarry, Jacquette. (1988). Hypertext and compact discs: the challenge of multi-media learning. British Journal of Educational Technology, 19(3), 172-183.

Merrill, M. D. (1988). The role of tutorial and experiental models in intelligent tutoring systems. Educational Technology, 28(7), 7-13.

Michener, Darlene M. (1988). Test your reading aloud IQ. The Reading Teacher, November, 118-122.

Miller, Larry and Burnett, J. Dale. (1987). Using Computers as an Integral Aspect of Elementary Language Arts Instruction: Paradoxes, Problems, and Promise. In Reinking, David (Ed.). Reading and Computers: Issues for Theory and Practice. New York: Teachers College Press, 178-191.

Moran, Mary. (1989). Classroom Technology. British Columbia: Provincial Educational Media Centre.

Morariu, Janis. (1988). Hypermedia in instruction and training: the power and the promise. Educational Technology, 28(11), 17-20.

Moyer, Sandra B. (1982). Repeated Reading. Journal of Learning Disabilities, 15(10), 619-623.

Naiman, Adeline. (1987). A Hard Look at Educational Software. Byte, February, 193-200.

Neill, Keith. (1979). Turn Kids on with Repeated Readings. Teaching Exceptional Children, 12, 63-64.

Nelson, Ted. (1987). Computer Lib/Dream Machines (rev. ed.). Redmond, Wash.: Microsoft Press.

Nix, Don. (1988). Should Computers Know What You Can Do with Them? Teachers College Record, 89 (3), 418-430.

Obertino, Priscilla. (1974). The PLATO Reading Project: An Overview. Educational Technology, 14(2), 8-13.

Olson, Richard and Wise, Barbara. (1987). Computer Speech in Reading Instruction. In Reinking, David (Ed.). Reading and Computers: Issues for Theory and Practice. New York: Teachers College Press, 156-177.

Olson, Richard, Foltz, Gregory and Wise, Barbara. (1986). Reading instruction and remediation with the aid of computer speech. Behavior Research Methods, Instruments & Computers, 18(2), 93-99.

Onosko, Timothy. (1990). CD-ROM Hit Parade. MacUser, April, 160-181.

Oren, Tim. (1988). The CD-ROM Connection. Byte, December, 315-319.

Oren, Tim. (1990). Cognitive Load in Hypermedia: Designing for the Exploratory Learner. In Ambron, Sue and Hooper, Kristina (Eds.). Learning with INTERACTIVE MULTIMEDIA: Developing and Using Multimedia Tools in Education. Redmond, Wash.: Microsoft Press, 125-136.

Palincsar, Annemarie Sullivan and Brown, Ann L. (1986). Interactive teaching to promote independent learning from text. The Reading Teacher, 39, 771-777.

Patton, Michael Quinn. (1980). Qualitative Evaluation Methods. Beverly Hills: Sage Publications.

Phillipo, John. (1989). CD-ROM: A new research and study skills tool for the classroom. Electronic Learning, June, 40-41.

Pohlmann, Ken C. (1989). Compact Disk Recording Technologies: The State of the Art. In Oberlin, Salley and Cox, Joyce (Comp.). CD-ROM Yearbook. Richmond, Wash.: Microsoft Press, 83-90.

Rashotte, Carol A. and Torgesen, Joseph K. (1985). Repeated reading and reading fluency in learning disabled children. Reading Research Quarterly, 20(2), 180-188.

Rasinski, Timothy V. (1988). The role of interest, purpose, and choice in early literacy. The Reading Teacher, 41(4), 396-400.

Reinking, David. (1987). Computers, Reading, and a New Technology of Print. In Reinking, David (Ed). Reading and Computers: Issues for Theory and Practice. New York: Teachers College Press, 3-23.

Reinking, David. (1988). Computer-mediated text and comprehension differences: The role of reading time, reader preference, and estimation of learning. Reading Research Quarterly, Fall, 484-498.

Reitsma, Pieter. (1983). Printed Word Learning in Beginning Readers. Journal of Experimental Child Psychology, 36, 321-339.

Reitsma, Pieter. (1988). Reading practice for beginnners: Effect of guided reading, reading-while-listening, and independent reading with computer-based speech feedback. Reading Research Quarterly, 23(2), 219-235.

Rice, Ronald E. (1984). Evaluating New Media Systems. In Johnston, Jerome (Ed.). Evaluating the New Information Technologies. San Francisco: Jossey-Bass Inc., 53-71.

Rizzo, John et al. (1990). Most Valuable Players. MacUser, March, 151-170.

Robson, Cliff and Whitley, Steve. (1989). Sharing Stories: Parents' Involvement in Reading with Inner-City Nursery Children. Reading, 23(1), 23-27.

Romeu, Joost. (1988). Visionary Presentations with a myriad of Media. Macintosh Horizons, September, 46-49.

Ropiequet, Suzanne. (1989). Audio, CD-ROM, and CD-ROM XA. In Oberlin, Salley and Cox, Joyce (Comp.). CD-ROM Yearbook. Richmond, Wash.: Microsoft Press, 391-397.

Roser, Nancy L. (1987). Research Currents: Relinking Literature and Literacy. Language Arts, 64(1), 90-97.

Roth, Steven F. and Beck, Isabel L. (1987). Theoretical and instructional implications of the assessment of two microcomputer word recognition programs. Reading Research Quarterly, 22, 197-218.

Rubin, Andee. (1983). The Computer Confronts Language Arts: Cans and Shoulds for Education. Classroom Computers & Cognitive Science, 201-217.

Rude, Robert T. (1986). Teaching Reading Using Microcomputers. Englewood Cliffs, N.J.: Prentice-Hall, Inc.

Salomon, G. (1984). Television is "easy" and print is "tough". The differential investment of mental effort in learning as a function of perceptions and attributions. Journal of Educational Psychology, 76, 647-658.

Salomon, G. and Leigh, T. (1984). Predispositions about learning from print and television. Journal of Communication, 34, 119-135.

Salomon, Gavriel. (1986). Information Technologies: What You See is Not (Always) What You Get. Report No. 3, Tel Aviv University.

Salomon, Gavriel and Gardner, Howard. (1986). The computer as educator: Lessons from Television Research. Educational Researcher, January, 13-19.

Samuels, S. J. (1970). Effects of pictures on learning to read, comprehension and attitudes. Review of Educational Research, 40, 397-407.

Samuels, S. Jay. (1979). The method of repeated reading. The Reading Teacher, 32, 403-408.

Schaffer, Lemuel C., and Hannafin, Michael J. (1986). The effects of progressive interactivity on learning from interactive video. ECTJ, 34(2), Summer, 89-96.

Schneeberg, Helen. (1977). Listening while reading: a four year study. The Reading Teacher, March, 629-635.

Semper, Rob. (1990). HyperCard and Education: Reflections on the HyperBoom. In Ambron, Sue and Hooper, Kristina (Eds.). Learning with INTERACTIVE MULTIMEDIA: Developing and Using Multimedia Tools in Education. Redmond, Wash.: Microsoft Press, 51-67.

Skinner, B. F. (1984). The Shame of American Education. American Psychology, 39(9), 947-954.

Skinner, E. A. and Chapman, M. (1984). Control Beliefs in an Action Perspective. Human Development, 27, (3-4), 129-133.

Sony unveils electronic book at show. (1990, January 29). The Vancouver Sun.

Stanovich, Keith E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. Reading Research Quarterly, 21(4), 360-407.

Steinberg, E. R. (1977). Review of student control in computer-assisted instruction. Journal of Computer-Based Instruction, 3, 84-90.

Stipek, D. J. and Weisz, J. R. (1981). Perceived personal control and academic achievement. Review of Educational Research, 51, 101-137.

Streibel, Michael J. (1986). A Critical Analysis of the Use of Computers in Education. Educational Communication and Technology, 34(3), 137-161.

Strickland, Dorothy S. and Morrow, Lesley Mandel. (1988). New perspectives on young children learning to read and write. The Reading Teacher, October, 70-71.

Strickland, Dorothy S., Feeley, Joan T., and Wepner, Shelley, B. (1987). Using Computers in the Teaching of Reading. New York: Teachers College Press.

Stauffer, Richard A. (1989). The Commercialization of DVI Technology. In Oberlin, Sally and Cox, Joyce (Comp.). CD-ROM Yearbook. Redmond, Wash. Microsoft Press, 69-71.

Sugiyama, Takashi. (1989). The Impact of CD-ROM XA. In Oberlin, Salley and Cox, Joyce (Comp.). CD-ROM Yearbook. Richmond, Wash.: Microsoft Press, 51-55.

Swann, W. B., Stephenson, B. and Pittman, T. S. (1981). Curiosity and control: On the determinants of the search for social knowledge. Journal of Personality and Social Psychology, 40, 635-642.

Tennyson, R. D. (1980). Instructional control strategies and content structure as design variables in concept acquisition using computer-based instruction. Journal of Educational Psychology, 72, 525-532.

Tennyson, R. D. (1981). Use of adaptive information for advisement in learning concepts and rules using computer-assisted instruction. American Educational Research Journal, 18, 425-438.

Trelease, Jim. (1989). Jim Trelease speaks on reading aloud to children. The Reading Teacher, December, 100-206.

Tuinman, Japp, Johnstone, Sandy and Pfaff, Carol. (1989). Journeys: Teacher's Resource Book 1 Emergent Levels One and Two. Toronto: Ginn & Co.

Wang, M., and Stiles, B. (1976). An investigation of children's concept of self-responsibility for their school learning. American Educational Research Journal, 13, 159-179.

Weiss, Maria J. and Hagen, Ranae. (1988). A key to literacy: Kindergartners' awareness of the functions of print. The Reading Teacher, February, 574-578.

Weyer, Stephen A. (1982). The design of a dynamic book for information search. International Journal of Man-machine Studies, 17(1), 87-107.

Yaden, David. (1988). Understanding stories through repeated read-alouds: How many does it take? The Reading Teacher, 41(6), 556-561.

Yaden, David, B. J., Smolkin, Laura B. and Conlon, Alice. (1989). Preschoolers' questions about pictures, print conventions, and story text during reading aloud at home. Reading Research Quarterly, 24(2), 188-214.

Yankelovich, Nicole, Mayravitz, Norman and Van Dam, A. (1985). Reading and writing the electronic book. Computer, 18(11), 15-30.

Younggren, Geri. (1988). Using an object-oriented programming language to create audience-driven hypermedia environments. In E. Barrett (Ed.). Text, ConText and HyperText: Writing With and For the Computer. Cambridge, Mass: MIT Press, 77-92.

Zarrillo, James. (1989). Teachers' interpretations of literature-based reading. The Reading Teacher, October, 22-28.

Zarry, Len. (1984). A Case for Early Reading. English Quarterly, 18(2), 42-44.

Microcomputer Software References

BEETHOVEN HyperCard Stacks, Voyager, 1989.

DOLCH WORDS Vol. 1 & 2 by Campbell River Junior High School, Campbell River, B. C., MECC.

HYPERCARD, Apple, 1987.

HYPERSTUDIO, Roger Wagner Publishing, 1989.

IBM LINKWAY, IBM, 1989.

KIDSMATH, Great Wave Software, 1989.

KIDSTIME, Great Wave Software, 1986.

MAGIC SPELLS, The Learning Company, 1984.

MECC ELEMENTARY VOLUME 7, MECC.

MISSING LINKS, Sunburst Communications, 1983.

THE MYSTERY FOSSIL, HyperCard Stack, University of New York, 1989.

PALENQUE, The Center for Children and Technology at New York's Bank Street College of Education.

PLUS, Spinnaker, 1989.

READER RABBIT, The Learning Company, 1984.

SUPERCARD, Silicon Beach, 1989.

THE THEATREGAME, Larry Friedlander, Stanford University, 1986.

TUTORTECH, TechWare, 1988.

THE WRITING TO READ SYSTEM, IBM.