The Design, Production and Evaluation of a Computer-based Multimedia Learning Program

Tamara Lynch-Dalgleish

A Thesis Equivalent

in

The Department of Education

Presented in Partial Fulfilment of the Requirements
for the Degree of Master of Arts at
Concordia University,
Montreal, Quebec, Canada

August 2000

ABSTRACT

The Design, Production and Evaluation of a Computer-based Multimedia Learning Program

Tamara Lynch-Dalgleish
Concordia University, 2000

This purpose of the thesis is to describe the design, production and evaluation of a computer-based multimedia learning program for 5 - 9 year olds. The first segment details project design, and production. The second segment examines a number of evaluation models available to the designers, and describes how formative evaluation contributed to the improvement of various project components. The third segment outlines the methodology and the results of summative evaluation which assessed the effectiveness of the electronic storybook portion of the program, as used in conjunction with an electronic glossary, on improved word comprehension and story recall in Grade 2 (7-9) year old students.

Sixty subjects were exposed to either the electronic storybook with an 'on-screen' glossary, or to the traditional printed book with a printed glossary. The experiment was conducted using a posttest only control group design. No statistically significant differences were found between the two groups in either improved comprehension or story recall. However, the research indicated a more vigorous use of the glossary and interest in word investigation by the children in the experimental (computer) group. Furthermore, comments from students and researcher observations indicated a greater degree of motivation and enjoyment from the students who read from the electronic storybook.

ACKNOWLEDGEMENTS

No endeavor, especially writing a thesis, is undertaken lightly. But without the help, support, advice and encouragement so freely given by many, would this attempt have ever come to fruition.

For their constant guidance, help, support, encouragement and patience throughout the entire process, I am truly indebted to my advisors Dr. Mei Chen and to Dr. Richard Schmid. I would also like to thank David Wells for his help and encouragement especially with the statistical analysis.

For sharing their knowledge, insight and experience of young learners, I am extremely grateful to Monique Caron-Bouchard, Maureen Baron and Margie Golick

Acknowledgments and thanks are due to many, but especially to: Tedd Dillon for helping out with the testing and transcripts, Lynne Wright for proofing the initial text, Louise Sayegh for her valuable comments and also to the teachers and children who enthusiastically took part in the research.

The continued support and assistance of my employer, the National Film Board of Canada has been, over many years, instrumental in my pursuit of academic goals for which I am very appreciative.

Lastly and most importantly my sincere thanks and appreciation go to my husband Andrew and our two children, Michael and Alexandra. Their love, support, encouragement, patience and endurance during the past two years have been remarkable.

TABLE OF CONTENTS

FIGURES AND TABLES

CHAPTER 1: INTRODUCTION

This thesis will outline the design, production, and evaluation processes, both formative and summative, of a computer-based multimedia storybook. Entitled ***"Has Anybody Seen My Umbrella? CD-ROM"***, the program was designed for use by children between the ages of 6 and 9 years old.

Broadly divided into three segments, the first part of the thesis details project design and production. Included in the first section is a survey of similar materials (existing at time of development), an outline of the conceptual team model, a discussion of the technical design and an outline of the production phase.

The second segment examines a number of evaluation models available to the designers, and describes how formative evaluation contributed to the improvement of various project components. The extensive use of subject matter experts at all stages of development and production is also outlined.

The third segment outlines the methodology and the results of summative evaluation. The summative evaluation assesses the effectiveness of the electronic storybook segment of the program, as used in conjunction with an electronic glossary, on improved word comprehension and story recall in Grade 2 students.

Rationale for developing and evaluating the computer-based multimedia storybook

After more than a decade of developing and producing educational enrichment materials for a Montreal based government film agency, in various forms of small media (e.g. sound filmstrips and curriculum enrichment videos), my personal interest arose in the development and use of educational computer applications, specifically in those that could be marketed in CD-ROM format. This interest coincided with a renewed children and youth programming mandate within the organization.

Moreover, in a climate of changing conditions for the distribution of educational audio-visual materials, rapidly fluctuating technology and an institutional re-focusing on consumer markets, there was some pressure within the organization to start producing interactive programs for children as quickly as possible. Consequently, a number of proposals were submitted to management by individual educational producers from which the project described in this document was selected. Based on a children's story by a well-known Canadian writer, ***"Has Anybody Seen My Umbrella?"*** is an odd twist on the classic Cinderella tale which deals with the trials and tribulations of an ill-educated prince who lacks basic literacy skills. The story provided a natural springboard from which to develop a computer-based interactive program that promoted reading, storytelling and increased word comprehension for early elementary grade children.

Within this context, research has shown (Manson, 1990) that children develop greater reading and comprehension skills by early exposure to children's literature and stories. In fact, Manson (1990) concludes that 'storybook reading activities enable children to link their listening and speaking skills to text comprehension' (1990, p.3).

Conversely, those children who do not receive this early exposure to print may lag behind other children, or may not acquire high quality reading skills at all (Glasgow 1996, Jackson, Ewald & Roller, 1993).

Paradoxically, as the discussion around the early acquisition of literacy skills continues, books, indeed the print medium at large, are changing and some books are now only published electronically (Matthew, 1997). Unlike printed books, electronic texts, through a mix of visual, tactile, and listening modalities provide learning environments that are user-directed (Matthew, 1997).

Adapting the storytelling process to an interactive or computer-assisted medium, may utilize the benefits of computer technology to greater advantage in the development of reading ability and language comprehension among early readers. Imaginative presentation of the narrative, in the interactive storybook form, may foster a greater appreciation for both books and reading in a computer-based learning environment that is both engaging and increasingly stimulating. Electronic text, by definition permits the interaction between the user and the story, taking on characteristics of a dialogue (Reinking, 1992). Computers can be programmed to adjust to the reader's level or ability through an easily accessed support structure from which the student may derive better understanding, expanded vocabulary, and improved reading skills. These objectives are achieved in a non-threatening, learner centered, and non-judgmental environment.

Inevitably, as more children are exposed to electronic print, many questions arise such as: How do electronic texts differ from printed texts in the way children learn? How do these differences impact on the acquisition of reading skills? How do students interact with electronic texts and ultimately does reading from electronic text have an impact on

reading comprehension (Reinking, 1992; Matthew, 1997)? Reinking (1997) further poses the question as to 'what issues related to electronic reading and writing are likely to become important in the future?' (p.1). These questions are not only relevant to academics. They must also be examined by those who develop and produce computer-based multimedia learning programs if these devices are to be successful. In developing "***Has Anybody Seen My Umbrella? CD-ROM***", (***'Umbrella'*** for short), such questions were kept firmly in mind.

CHAPTER 2: DESIGN THE DESIGN OF THE MULTIMEDIA STORYBOOK

The *'Umbrella'* project was developed in two main phases: design which included research and concept, preliminary design and flowcharting, prototyping and testing; and secondly the production phase which included the creation of the alpha disk and a post-production phase of beta testing. Though ultimately it became impossible to separate production from on-going revisions and re-design these tasks were distinctly divided in the initial stages.

As part of the initial research, an informal survey of existing materials was undertaken which is discussed in this chapter along with a detailed synopsis of the program design.

Survey of Existing Materials

The survey of commercially available CD-ROM programs for children was deliberately broad in its scope. The researchers reviewed both electronic storybooks and products that covered other subject materials including mathematical, informational and geographical/historical programs. Presentation of content, ease of navigation, program logic and overall graphic quality were areas of interest to the researchers. In addition the researchers wanted to know what types of programs were on the market, what age ranges they were aimed at and what kind of pedagogical content these programs included.

The survey provided the researchers with some interesting findings. On one hand, the encyclopedic or informational programs, such as ***Encarta***, ***Castle,*** and the ***Eyewitness Series*** among others provided excellent and easy-to-use storage and retrieval of information systems, well matched to the abilities of the stated age range. The popular ***Broderbund*** electronic storybooks were quite enchanting because of their visual quality and appealing animated sequences, although some of it is gratuitous. Several computer-based interactive music programs that were examined also kept user attention with catchy songs, good graphic quality and easy-to-use interfaces but again, while appropriate to the target age range, they offered little more than repetition in the way that the various games were constructed.

Conversely, ***Math Blaster,*** reviewed for its navigational approach and graphic qualities, and the ***Reader Rabbit*** series, a reading program, were competitively priced and well-publicized products but had low-quality graphics, and basically relied on drill and practice techniques not unlike those frequently seen in the traditional classroom. In other words the program relied on right or wrong responses and allowed the student little in the way of user-control. The much-touted first edition of the ***Oregon Trail*** was an interesting attempt to involve the user in both history and geography while employing a variety of cognitive skills. An attractive, but poorly designed user-interface made the program difficult to navigate. The product has since been replaced by a newer version, which was not tested for the survey.

The now defunct Canadian company that developed ***Discis Books*** was quite unique in its attempt to exploit multimedia potential. Well-loved children's stories were presented in electronic storybook format. The graphic interface was simple but formulaic

with little attempt to provide animation or other visual teasers which may have been due to financial factors. However, attention was paid to other details, for example, the possibility of reading and/or hearing the story in three languages (English, French and Spanish) along with glossary definitions. Although not the only Canadian materials on the market, the ***Discis Books*** offered some guidance to the ***'Umbrella'*** team. In part, this led them to conclude that an innovative and well-designed electronic storybook of this nature would provide a valuable addition in a marketplace dominated by US and British developers. Indeed, a niche market could be found for user-directed programs that allowed children to explore literature within the context of multi-sensory modes of learning. Few such products existed at the time. Despite the fact that improved authoring software was rendering sophisticated interactivity increasingly feasible and cost-effective, this was an ambitious undertaking for an uninitiated group. The survey, while not scientific, produced several main findings: (a) there were many high quality informational or encyclopedic computer-based educational programs available, although these often did not take full advantage of interactive potential; (b) electronic storybooks and music programs were well targeted age wise, but tended to resort to gratuitous animation rather than developing ancillary activities; (c) products that promoted their education content frequently did so by utilizing 'easy to program' drill and practice activities; (d) the usefulness of some programs was compromised by a 'user-interface' that was difficult to navigate; (e) programs lacked specific Canadian content especially as it related to children's literature.

Overall, the survey led the researchers to several conclusions in terms of justifying the ***'Umbrella'*** project. These were: (1) there was room in the marketplace for

a well designed electronic storybook that specifically promoted the work of a Canadian writer; (2) such a program should include related value added activities that took full advantage of interactive potential; (3) pedagogical objectives could be identified and embedded into accepted gaming strategies; (4) thematic activities could be imaginatively promoted through a variety of different and creative means, e.g. story, music, film, word games and creative writing activities.

The Development Team

At the outset, the project's co-initiators decided that a new organizational concept model, commensurate with the production needs of educational computer applications, was appropriate for this project. The standard vertically integrated film production model, common to both the organization and the film industry, was rejected as too pyramidal and rigid in structure. In standard film production, the producer is usually at the top of the hierarchy with overall responsibility for the production, followed in descending order by the director, cinematographer, editor, sound designer, technicians and support staff. Most tasks or phases are conducted sequentially by individuals working either alone or in hierarchical groups in surroundings that are often reflective and even silent. The creative leader is the film's director.

On the other hand, multimedia production presents a picture of contrasts. Many processes take place almost simultaneously in a collaborative, energy charged environment. All voices may be heard, and consensus is usually gained through negotiation. Centered around a core group, some members function individually, while

others work in small teams or clusters, collaborating equally at the design level in a pattern that is horizontal or circular, rather than vertical. Each core member or cluster represents an expert group that brings a different skill set to the process. Much of the look and design still falls to the creative director, but with overlapping responsibilities within the core group, there are many more mitigating creative factors than in a film-related concept model.

This structure, or core team, revolves around five or six people. Generally speaking this includes: team leader (producer), technical director (programmer), creative director (graphic designer), editor and writer (Gilette, 1993). The ***'Umbrella'*** team was a variation on this model, in that the creative director doubled as the principal game designer and the lead graphic artist was responsible for much of the interface design. In addition to the programmer the team also included a technical director. All were part of the core group. The project was based on an existing story; therefore a writer was not required in the early stages. While the core team remains at the heart of the project, this model allows for expansion, especially for the inclusion of subject matter experts at the appropriate point. In the literature, the core group is responsible for a number of pre-production and planning functions, for example: concept, budget, staffing, interface design, licenses (Schuyler, 1996). Again, the ***'Umbrella'*** differed from the model in that responsibility for budget, license clearances and reporting to management was undertaken by the project leader (producer).

Nevertheless, as has been mentioned, an important characteristic of the horizontally integrated model is overlapping responsibilities. For example, the creative director acted as the principal game designer, and part of this task is to plot the

navigation. However, the functioning of a game's design is the responsibility of the lead programmer. To add to this, the amount of programming involved in a game's function and design might also have budgetary implications, hence the need for ongoing core group discussion and negotiations. If an impasse arises, the team leader may be asked to cast a deciding vote and to avoid incidence of negotiation breakdown. Good channels of communication are vital to the reliable functioning of this particular concept model.

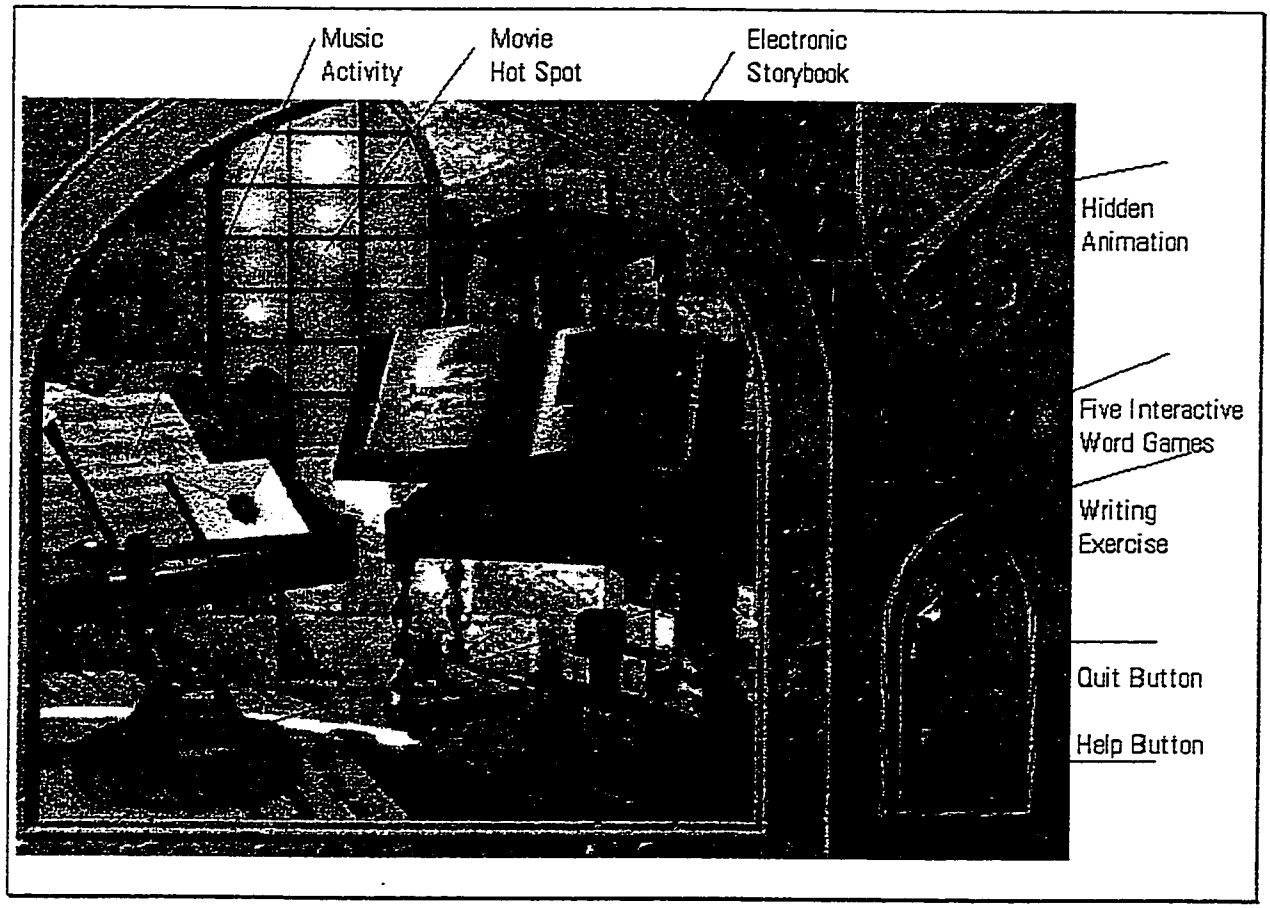
Although it could not be formalized within the overall institutional structure, the horizontally integrated archetype outlined above was implemented to a greater or lesser degree as a working model for the production. Nevertheless, from this new structure, as implemented, a positive group working dynamic evolved although it was not without problems as will be outlined in Chapter 3. In my role as both producer and team leader, I was able to move between the official vertically integrated structure and the horizontally integrated working model without difficulty.

Design

The proposed design was to take advantage of newly released authoring tools, in this case Director 5.0, thus allowing for greater interactivity and leading ultimately to an increase in the non-linear, learner-directed focus of the application. The program consisted of five major segments (see Appendix 1) accessed from a main menu, consisting of an electronic storybook, a film, five interactive word games, two music activities and a writing activity. A section containing parent/teacher information,

pedagogical skills, credits, user testimonials, other resources and a site map is accessible from the opening interface. An extensive 'Help' menu is embedded in each screen.

FIGURE 1 - MAIN MENU INTERFACE



Games were designed as separate and individual environments. Each screen is technically divided into a frame containing the buttons, and an action field where specific action occurs, with an invisible division between. The program is entirely mouse operated with only one keyboard control, the Quick Quit button. Three coloured jewels represent the universal buttons that appear throughout the program, and are augmented by

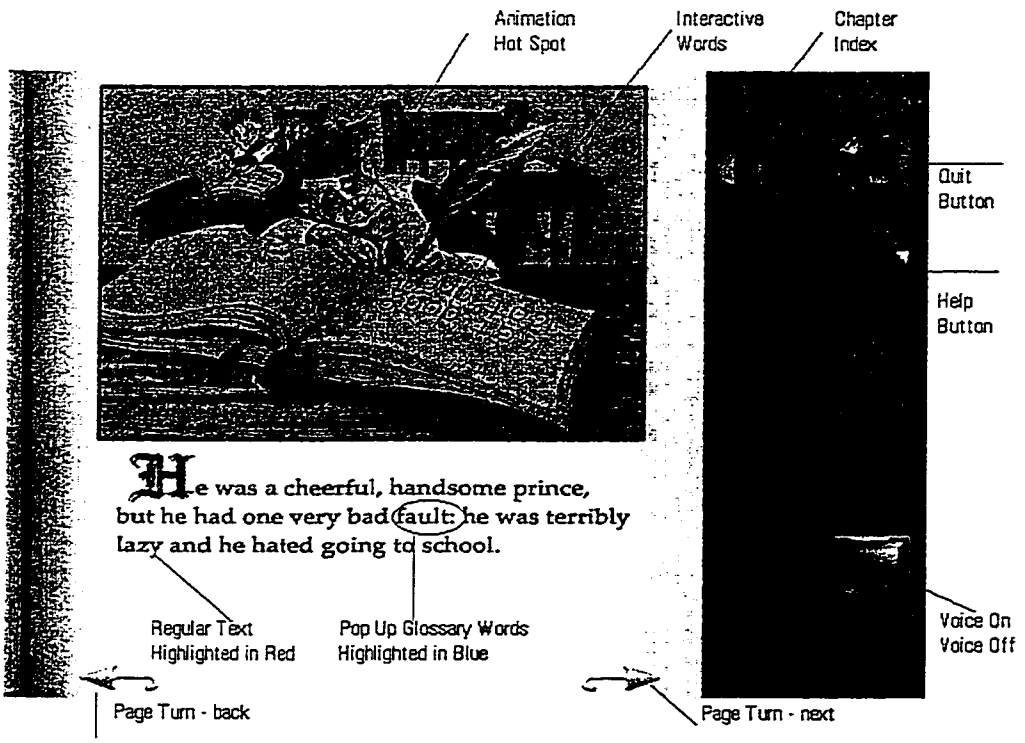
additional buttons in certain games where specific controls are necessary. The opening 'Main Menu' screen is a visual representation of the Prince's playroom and once entered, users can activate one of the five segments by double clicking icon highlights when passed over by the cursor. (See Fig. 1)

The electronic storybook provides access to an interactive version of the book with 48 individual screens, including two active fields, the storybook illustration and the text (see Fig 2). The book is augmented with several interactive options. The 'Voice On' feature allows the user to listen to a female narrator read while following along with the highlighting text. Further, the user can interact with elements in the illustration, e.g. short animation sequences and interactive words. An important feature of the storybook is the electronic glossary, which pops up automatically if the cursor remains dormant on a highlighted word for more than two seconds. Brief descriptions or descriptive sentences are provided for about 45 of the more difficult words extrapolated from the text. The voiced glossary was a major component of the research project described later in this document.

Another important design characteristic is the inclusion of 'voice over' for all written text, e.g. glossary words, help menus, word game clues and all buttons. The addition of this feature was based on the knowledge that children in the lower target-age user range (5-9 years old) operating the computer without adult intervention would require such assistance. Extensive voice recording and the use of a sound editor resulted from this decision. Skills acquisition promoted by this segment include reading, listening and word comprehension. Five interactive word games with three increasingly difficult

levels and 20 activities in each are derived from various aspects of wordplay. Finding words within words, rhyming, unscrambling, categorizing, synonyms, homonyms, and picture puzzles allow for almost limitless possibilities in the development of reading, vocabulary, and problem-solving skills in the target age user. Certain word games promoted basic problem-solving and visual and spatial skills. Others encouraged the user to practice several thinking processes simultaneously. The higher the level, the more complicated the ordering and sequencing becomes as the games progress. The opening of tiny umbrellas indicates advancement through each game after each group of five correct answers.

FIGURE 2 - STORYBOOK INTERFACE



Music activities promoting rhyming and learning about musical instruments, were scaled down after the initial concept proved too complicated to program. These consist of a rhyming game with 22 sing-along verses composed especially for the program. The lyrics are sung to one of five selected melodies, and at the end of every second rhyming couplet the user must complete the verse. At the easiest level the user may select from pictograms, and at the highest level the verse must be completed with a correct phrase. A bouncing egg allows the child to follow along correct musical notations, pausing at the missing last word or phrase, which must be completed by the user. A common feature to both the word and music games are surprise animated 'pay-offs' that pop up for each correct answer. The second music activity is a simple sampling of the songs written for the program and of the period musical instruments that appear in the storybook illustrations.

The movie originally thought to be a pivotal feature of the program was in the end relegated to a less focal position. Using whole films or sequences as branch or navigational points to the activities was touted in some film literature (Wimberly & Samsel, 1996), but was determined by the designers to be anti-logic in the evolution of user interface navigation patterns. The inclusion of an entire film is an unusual characteristic in an educational computer application, but one to which the developers were still committed. However, in the final analysis, the electronic storybook and word games generated greater pedagogical potential. Nevertheless, the film does allow for the reinforcement of comprehension and listening skills, although the original visual quality is not retained.

Digitized at 15 frames per second (fps), the original 10-minute film is presented as a QuickTime™ movie, allowing the user to fast forward or rewind as in a VCR. Visually presented as part of the Prince's puppet theatre, there are no additional games or exercises attached to this segment.

The writing exercise was to encourage storytelling and composition. Entitled 'What If?', this exercise was given much higher prominence than initially intended. The potential for retelling or relating the story and the possibility for a user to write their own, story was particularly popular with the subject matter experts. Five main branch points in the story allow for a total of 15 new storyline suggestions if the user requires prompting. As a peripheral activity, the segment has a print button.

Concerns that the interface be as user-friendly as possible, to both the pre- and emerging reader, were addressed by 'voice over' on all written instruction, as has been previously mentioned. To avoid any confusion, both male and female voices are used in the appropriate context. 'Help' screens are 'grayed out' to indicate that play will only continue when the user returns to a game screen and instructions appear in separate text balloons. User control vs. program control was the subject of many long discussions, and while maximum user control was desirable in most segments, implementation was sometimes controlled by the limitations of the software.

The so called 'Prince's Quest', a would-be role playing game in which the viewer assumed first-and third-person perspectives on a guided tour of the kingdom, was dropped. After much discussion and preliminary design, this labyrinth style game proved to be too complicated to program in a timely and cost-effective manner. Supplementary game upgrades downloaded from the Web were another area of discussion and although

technically feasible, it was thought to be premature. Today, this would be considered an essential feature. A promotional and support Web site exists, under the auspices of the marketing group and it may be upgraded by the production group to incorporate interactivity in the near future.

CHAPTER 3: PRODUCTION

This chapter outlines the production process as it relates to the inner workings of the design team and to the more mechanical output or alpha disk phase. Further, this section discusses some of the production problems that were encountered.

Prior to the design phase, a previously prepared concept proposal was approved along with a production budget. The budget would be revised several times during the 24 month production period. A refined version of the proposal formed the basis from which the core group worked during initial design and flowcharting. The size of the core team ebbed and flowed during the production period depending on staffing needs. In the early stages subject matter experts (e.g. content advisors), and pedagogical consultants supplemented the core group. As the production progressed their presence gave way to graphic artists, designers, sound editor and other technical specialists.

The initial design process was systematic, each segment of the project subject to discussion with the core group and appropriate experts. For example, the electronic storybook segment and the word games utilized one set of pedagogical consultants, but the music section required consultants with different skills. Here a songwriter and a music teacher were the principal consultants to the core group. Pedagogical consultants were involved at every stage, as will be discussed further in the following chapter.

The first overall disk design and flow-charting evolved from approximately six weeks of round table discussions. While a stimulating and exciting process, working in such a large group proved to be unwieldy except to sketch out the larger picture.

Ultimately much of the design work was developed by the creative director and brought to the core group for discussion, modification and flow-charting. The navigational path, skill objectives and program logic were given particular attention during these sessions. From this process, a concrete design for the program gradually emerged.

Nevertheless, a number of problems surfaced. The first, and perhaps the most important, was the lack of experience in the design and development of educational computer applications on the part of the producers. The second problem was technical.

Despite many years of training in producing educational materials for children, the development of effective educational computer applications requires the acquisition of a new and different set of skills. In this context, an understanding of computer navigation logic, especially as to how this might be applied to content development, is one example. The process of mastering a new skill set resulted in production delays. A modified team concept proved to be the correct approach, but still the lack experience impinged on its efficiency. Further, the modified team did not completely eliminate the tensions caused by overlapping responsibilities leading the author to conclude that implementation strategies commensurate with a horizontally integrated model cannot be achieved on an *ad hoc* basis. At the very least, workable job descriptions or detailed areas of responsibility, even if overlapping, are necessary. Furthermore, official recognition of the structure should have been a pre-implementation requirement. To counteract the difficulties and to deflect internal criticism, a slightly more traditional, vertically integrated structure was resumed in the latter part of the project.

Many of the technical problems, for example, the complete crash of the first computer prototypes, were rectified by the decision to scrap internal programming and

'contract out' the programming work. As a result of this move, two 'on site' programmers were added to the team. The programmer is part of the conceptual design team, and it is essential that this role be properly filled in the early stages of this type of production. Indeed, all essential key personnel must be included in the design process from the very beginning (Blank, 1993). However, the lack of a properly trained lead programmer in the early stages was to contribute to costly delays effecting both schedule and budget.

Other problems were more easily resolved. External specialists were required to help set up a server, design a database system for asset storage and retrieval, and to advise in the digitization of the original movie, adding to the cost of production. Lack of both hardware and software was a further problem that required resolution. In hindsight, difficulties could have been, for the most part, avoided if a more careful assessment of both technical and human resources had been undertaken beforehand.

The ***'Umbrella'*** program has been well received in educational circles, and well reviewed in educational (e.g.Resource Links) and parenting journals (e.g. Today's Parent). A separate marketing group later developed a teacher's guide and activity sheets, although the production team was consulted in this regard. Viewed in the context of an educational package the program has proved to be a success, and design objectives were met. Design of the program ultimately achieved the desired outcome, but the core team's inevitable learning curve, associated with a first-time attempt, was slow and sometimes inefficient, though perhaps this was to be expected. Blank (1993) advises that production schedules are frequently underestimated, and that in terms of time frame an additional 15 percent in production time should be added. Given the learning curve of the team on this program, increasing the production schedule by 30 percent would have been more

realistic. The initial concept to completion schedule for ***'Umbrella'*** was 18 months, but in the end production took 24 months, and that did not include the Beta testing period.

An important consideration was the selection of an authoring software as opposed to writing code in a programming language. A previous institutional experience with C++ had convinced the design group that a purchased authoring package was desirable. Consequently an evaluation was undertaken of several current software packages. The final choice came down to M-Tropolis and Director 5.0, the latter being ultimately selected. Industry preference for this software was a determining factor; a wise choice, as it happens. Market research indicated that a hybrid (MAC/PC) disk was essential for market penetration, with minimum system requirements aimed as high as possible (PC 486 or Mac 68040/Windows 95/98) to optimize end-user experience and maintain high graphic quality. Simplified installation procedures were later adopted to make target-age user installation feasible, and the core program was copied into a set director on the computer's hard drive with all data resources accessed directly off the CD-ROM. Incompatible formats was an on-going concern. In addition to Macromedia Director 5.0, other software used by the design group included PhotoShop, Illustrator, QuickTime 2.2,V12 Database Engine and deBabelizer. The programmers wrote the 'Read Me file'.

In addition to the active involvement of subject matter experts (SME's) several formative evaluations were carried out during the development process before the software program was completed. The results from such evaluations have served to improve the instructional package before finalization. A final round of technical testing took the form of beta testing. Two different groups, one primarily technical and the other principally examining the navigational logic were used in this activity. Both beta-testing

groups were independent of the organization. The producer was responsible for the contracts and ensuring that the work was completed in a timely manner but actual analysis of the so called 'bug reports' was undertaken by the technical director. Recommendations were made to the producer regarding the findings and some reprogramming resulted from this process.

In addition, a summative evaluation was conducted to determine the effects of the software program in comparison with the print-based material. The formative evaluation process, or alpha disk testing, is detailed in Chapter 4, whereas the summative evaluation is described in Chapter 5.

CHAPTER 4: FORMATIVE EVALUATION: EXPERT CONSULTATION AND PILOT TESTING

Generally speaking there are two ways in which educational material can be evaluated. The first is formative evaluation and the second is summative. Formative evaluation is the process of evaluating material that has not yet been completed, whereby the results will serve to improve the instructional package before finalizing. On the other hand, summative evaluation, takes place once the package of instruction has been completed, evaluating the overall effectiveness of the material or instruction. Simply put, formative evaluation has the potential to make a difference for the better in the design.

Summative evaluation changes nothing in terms of the development of the material but, in this instance, may provide producers/educators with valuable information in terms of the capability of the product. In turn, this may serve to improve future material produced by the development group.

During the production of the ***"Has Anybody Seen My Umbrella? CD-ROM"*** formative evaluation was a major developmental component as was expert consultation. This process will be fully described in this chapter and a number of formative evaluation models will be assessed.

Formative Evaluation Models

Formative evaluation and expert consultation were considered to be important aspects of the program development. Dick & Carey (1990) have suggested that many educational products do not receive adequate formative evaluation that would lead one to conclude that some developers produce materials without knowing whether or not these products achieve their goals. Considering the large financial investment made by the organization in the *'Umbrella'* project it was felt that no aspect of formative evaluation could be left to chance. Consequently, a number of formative evaluation models were reviewed to allow the designers to select the most appropriate model or models which could be applied to this process to ensure that design and pedagogical goals were met. The costs associated with formative evaluation were factored into the production budget.

Popham, in Educational Evaluation, (1988) discusses several models of educational evaluation. He divides these into four categories: goal attainment models, judgment models emphasizing intrinsic criteria, judgment models emphasizing extrinsic criteria and decision facilitation models.

Goal Attainment Models

Goal attainment models, as described by Popham, attempt to determine the success of the instruction by assessing whether the goals of the program were achieved. An early approach was developed by Tyler, who formulated goals by analyzing goal sources and screens and translating this information into behaviour objectives that could

be measured. Another goal attainment model was developed by Hammond in a five-step process that sought to determine the effectiveness of the instruction in terms of whether the goals had been achieved.

Metfessel and Michael developed an eight-step goal attainment approach, which Popham suggests was useful in setting out different classes of criterion measures that might be employed to reflect the goal attainment of an educational program. The weakness of the goal attainment model is that the model assesses the effectiveness of the instruction on the basis that the defined goals have been achieved and not whether those goals were sound and satisfactory in the first place. The Dick & Carey (1990) model is also a behaviourist multi-step approach. However, Dick & Carey clearly delineate between formative and summative evaluation and modification of the instruction as a result of the formative evaluation process.

Judgment Models

Judgment models emphasizing intrinsic and extrinsic criteria rely, to a large degree, on the judgment of the evaluator. However, this may be divided into intrinsic; where such factors as design, style and even colour might be considered, and extrinsic; where the value of what is being judged is determined by whether or not a student was able to learn from it. The intrinsic model, Popham (1988) states, is most commonly used in education 'but most are too haphazard to be properly classified as instances of systemic educational evaluation'. (p.26) However, this should not be discounted completely in

judgment models as they help expiain what it is that makes a particular program work, and the better elements of the intrinsic model should be included in the extrinsic model.

The Scriven model, as described by Popham, is particularly important as it makes the distinction between formative and summative evaluation. Further, this model stresses the importance of assessing the quality of the goals as opposed to setting goals for their own sake. Scriven also promotes the notion of goal-free evaluation in order to counter the evaluation focus on goals.

Another judgment model is the Countenance Model proposed by Stake (Popham, 1988). This model divides the evaluation process into two categories: description and judgment; and into three phases: antecedents, transactions and outcomes, allowing the evaluator to have a continual dialogue between the two. A weakness of the judgment models may be that they do not appear to collect data from target groups but rely on the opinion of those in a position to make a judgment.

Facilitation Models

Popham (1988) also describes several decision-facilitation models; the most important of these being the CIPP model as developed by Stufflebeam and Guba. Decision-facilitation models involve both the use of judgment and the attainment of goals. The evaluation process of this model has three main steps: delineating, with a focus on the required information; obtaining, which is the collecting, organizing and analysis of data; and providing the information for its optimal use. This model also takes into consideration the various areas or settings in which decisions are made.

Aiken's CSE model, as discussed by Popham (1988) is similar to the CIPP model, but focuses on different kinds of decisions at each of five stages of development, thus allowing for the instruction to be modified. In contrast to the CIPP model, the CSE model appears to more readily accommodate the process of formative evaluation in that the evaluators are involved in the production from the beginning right through to the final evaluation of outcomes.

Flagg (1990) favours the objective-based models and the decisions-oriented studies. She states that if 'objective based studies are to be of use to program developers, they should be employed with decision-oriented studies that provide interpretative information.' (p.137) However, the goal attainment models seem to favour the behaviourist approach to instruction whereby performance objectives are specified and skills are defined in a hierarchical manner. The presentation of interactive materials usually falls into the cognitive approach to learning where stimulus is provided and problem solving; attitude changes and analytical skills are encouraged. By definition, the development of cognitive skills takes place over a period of time and are less measurable than behavioural objectives.

In the process of producing curriculum enrichment materials that have a target audience or a grade range, but are not curriculum specific, the judgment models that emphasize extrinsic criteria, but include applied intrinsic criteria, would appear to be the most useful. Interactive projects probably need to be evaluated by both sets, intrinsic and extrinsic criteria. The approach emphasizing extrinsic criteria is the most important, for it does not matter how good a product looks if it does not achieve its stated objectives. Conversely, if a program meets the extrinsic criteria but has poorly designed graphics,

this will certainly detract from the cognitive value of the content. The argument for the use of one model over the other may be purely academic, as Dick & Carey (1990) suggest that many instructional materials are never tested adequately on the target group. Personal experience suggests that this is particularly true of audio-visual production, with the exception of certain high-profile children's TV programs. One might speculate that sufficient evaluation time and costs are not adequately factored into production budgets. However, Cambre (1982) suggests that testing frequently results in negative findings. On the other hand, Flagg (1990) contends that if testing is not going to result in revisions to the program then there is little point in undertaking it in the first place. One way around this problem is to produce a pilot program, or in the case of educational computer application, to undertake rapid prototyping. This is often done to test the navigational aspects of the games but less frequently undertaken to ensure the appropriateness of the content.

Chen (1994) suggests that methods currently being used to assess educational software applications are incomplete and presents a methodology for characterizing such programs on their 'cognitive, pedagogical and interactive features' (p.183). New methodologies for theory based evaluations for the computer interface design are becoming increasingly relevant. One method that could be helpful to educational computer application developers is the Cognitive walkthroughs (Polson et al, 1991) specifically developed to provide a theory-based evaluation of user interfaces early in the design cycle. The evaluation method involves hand simulations of the user's cognitive activity by applying the relevant cognitive theory in examining the user-interface in a

systematic way even before a 'mock-up' or prototype is available. This method was used for the formative evaluation of ***'Umbrella'***.

The difficulty with theory based evaluation methods is that all too often the program developers are from computer-related, not pedagogical backgrounds, and they lack grounding in cognitive theory in the first place. The Human Interface Checklist (Apple, 1989) offers some easy-to-follow principles and extols the virtues of testing early and often.

Another model proposed by Northrup (1995) recommends rapid prototyping as a viable strategy in multimedia development, along with other guidelines for concurrent evaluation at each stage of development. These include making modifications in initial documentation, the use of subject matter experts, rapid prototyping, collecting data on interface design, conducting paper-based content and storyboard evaluations and revising at each stage. In practical terms this is quite a functional design, especially if complemented by other guidelines for specific evaluations (e.g. interface design, navigation and placement of buttons). In this context, Hagg and Grabowski (1995) conclude lack of navigational consistency and poor interface design are widespread problems encountered in sections of many interactive programs, something that the ***'Umbrella'*** development team assiduously tried to avoid.

Overall, the designers tended to select appropriate elements from the models reviewed rather than adhering to a specific model. The goal attainment models, more appropriate to measuring the effectiveness of instruction based on defined goals, were not utilized other than the designers espoused the need for focus group testing. On the other hand, aspects of Judgment models evaluating intrinsic and extrinsic factors were used in

terms of expert consultation and elements of the CIPP decision-facilitation model, as outlined by Popham (1988), influenced the collection, organization and the analysis of the data. Perhaps more important, however, was model proposed by Northrup (1995), which advocated rapid prototyping and frequent evaluation and revisions as a viable strategy for multimedia development.

Expert Consultation and Pilot Testing of 'Has Anybody Seen My Umbrella?' CD-ROM

From the earliest stages of the production a decision had been made to use consultants to guide the design of each and every component. As Flagg (1990) has pointed out, experts not related to a project are often able to point out design problems that those too close to the material overlook. Indeed several experts were consulted on a regular basis as early as the concept phase. This included a principal pedagogical consultant, a cognitive specialist, and a pedagogical consultant with a background in elementary education and a music specialist. Conferences were held once or twice per week and every aspect of each segment was discussed. This was essential to ensure that the broad objectives of the program were maintained.

From a philosophical viewpoint, embedded pedagogical objectives masked by a gaming environment was a stated goal of the project at the outset. Broadly put, the stated objectives were to encourage storytelling and to enhance the acquisition of literacy skills for children in the early elementary grades. Providing the developers with a number of avenues to follow, different skill acquisition or reinforcement strategies, either separate or

overlapping were devised in the design of each game. For example, the writing exercise was to encourage storytelling and composition. Certain word games promoted basic-problem solving and visual and spatial skills. Another encouraged the user to practice several thinking processes simultaneously. The music activities promoted rhyming and learning about musical instruments.

In relating this process to judgment models (Popham, 1988), extrinsic factors, such as the extent to which such embedded skills successfully achieved their pedagogical goals, were not specifically tested. Conversely, testing intrinsic components that specifically related to the interface design and ease of navigation was an important aspect of production. From early evaluation of paper mock-ups and prototypes, through a formative evaluation process of the alpha disk to the mostly technical beta testing at the end, games and activities were evaluated by subject matter experts and with end-user groups. In addition, all vocabulary, words or phrases used, and even the text in the 'Help' function, were scrutinized for age-level appropriateness.

The process was facilitated by rapid prototyping, especially in the early development of the word games, but this technique was later abandoned in favour of conducting field trials with the completed alpha disk. Northrup (1995) warns that this approach to program development ensures that necessary modification identified by the testing will not be made due to the cost of reprogramming. Undoubtedly, this is so in many instances, but is not insurmountable or as costly as supposed if factored into the early planning process. Moreover, this project shows that evaluation of a draft alpha copy can be advantageous. Recruiting, assembling and organizing focus groups can be time-consuming and costly but in the case of ***'Umbrella'***, the testers were able to evaluate the

entire alpha disk as opposed to reforming test group for each segment as rapid prototyping would imply. Although influenced by technical and scheduling concerns, the decision to abandon rapid prototyping in favour of alpha disk testing turned out to be quite practical in the end.

Alpha disk testing of ***'Umbrella'*** was not conducted by the designers but by an independent group with practical experience as multimedia developers plus an academic background in educational technology. Their principal objectives were to verify the appropriateness of the activities *vis a vis* the age range, to assess the functioning and the user interface, to document any difficulties with the programming logic, to ensure that the user comprehension was commensurate with design intentions, to obtain overall user impressions and to contribute findings that would help improve the program.

The first round of alpha disk pilot testing took place at the originating institution. Organized by the producers, but conducted by the independent testers, six subjects from the target age group participated in one-on-one tests over a period of two days. This provided the independent testers with the means to evaluate their instrument and give the producers some initial user feedback. In the following weeks, evaluation took place at several Montreal area after-school programs with 33 target-age children. Over time, approximately 100 children were exposed to the CD-ROM prior to its release.

Interactions from the children in the sample were recorded on a structured data-gathering instrument and observations were compiled on a summary sheet. Much of the information was gathered by observation questions completed by the researchers, e.g. 'Is the treatment appealing to them?', 'Do they enjoy the program as a whole?', 'Are the games interesting and challenging?', and 'Do they like the musical elements?' (Lambert,

pp.7-8). Some direct questions to the subjects took the form of: 'What did you like most about the program?', 'What did you like least about the program?', 'How would you make the program better?' and 'Would you play it again?'

Each study variable was rated separately using a Likert scale of -2 (highly negative) to +2 (highly positive) (Lambert, 1997). The overall impression was positive. Rating of the appeal to the program material was 'very positive (+1.5), as was the rating of the appeal of the content as a whole (+1.6). The children also rated their enjoyment of the program highly (+1.4). These positive scores may be related to the favourable reaction the children had to the visual elements of the program (+1.4)' (Lambert 1997, p.5). Specific elements were also reviewed, with the word games receiving an (+1.1). With respect to the music games, a slightly negative finding was reported (-0.1), and overall a slightly less favourable impression was found among boys, who wanted more user control. However, participants asked if they would play the game again responded positively with a (+1.5) and generally agreed it would help them learn (+1.2).

Specific navigational and technical changes were recommended. Proposed design changes suggested the addition of a 'Quick Quit' keyboard function, simplification to voice instructions, the creation of a considerably more extensive 'Help' function and icon modifications. Some logic changes were required in the way the user moved between levels in the word games, all of which were implemented. Overall, the investigative aspects of the games were enjoyed, along with the motivating factor of increasingly difficult levels.

A further recommendation was to conduct research to gain insights into the dynamics of parent-support interaction with the program, as it pertains to early target- age

users. Formal research in this regard was not undertaken, but expert consultation was sought, and resulted in adding an on-screen parent/teacher segment. The on-screen movie, which consumed a huge amount of disk space, was thought to be expendable, but testing showed this segment to be popular with the children in the sample. Presenting the story in a different voice from the electronic book (male as opposed to female), the film allowed the user to hear the whole story beyond the amount they wanted to read. All of the recommendations were implemented in full or in part.

Beyond the formative evaluation process, which has been described in this chapter, a final round of technical testing was undertaken. In the design and development of educational computer applications difficulty seems to arise in separating out technical and content debugging, as logic and navigational concepts overlap into both areas. Certainly this was the case in the final program debugging, whereby part of the beta testing also involved an analysis of the program logic. Most of the changes made as a result of this process were technical programming corrections, however, several minor changes were made to the navigational functioning of some of the word games to correct the logic.

In order to understand the effects of the ***'Umbrella'*** electronic storybook, on target age users, a summative evaluation was conducted. The subsequent chapter will describe the methods and findings from such an evaluation.

CHAPTER 5: SUMMATIVE EVALUATION OF 'UMBRELLA': THE EFFECTS OF THE COMPUTER-BASED MULTIMEDIA STORYBOOK VERSUS A PRINT-BASED STORYBOOK

This chapter details the most important aspect of the thesis, a summative evaluation of ***'Umbrella'***, by comparing the effects of its computer-based multimedia storybook version *versus* a print-based storybook version. In this chapter, a review of the relevant literature, an outline of the research experiment and a detailed analysis and discussion of the results are explored.

Summative evaluation, as noted by Dick & Carey (1990), was conceived for the purpose of determining whether or not a completed educational instruction or program achieved its stated goals. Unlike formative evaluation, which is integral to improving the program, summative evaluation does not result in revisions or design changes. Moreover, summative evaluation, a process in which lack of familiarity with the material is considered an asset (Dick & Carey, 1990), is rarely carried out by the designer or developer.

In this instance however, a member of the design team undertook summative evaluation. Personal interest in evaluating the effects on reading comprehension through the use of a computer-based multimedia storybook *versus* a print-based storybook was a motivating factor. In the process, significant importance was placed by the researcher in determining whether the inclusion, in the ***'Umbrella'*** electronic storybook, of an easily accessed 'on-screen' glossary could be a contributing factor to improved word and reading comprehension skills.

The literature review examines a number of seemingly disparate but interrelated issues.. These include: the importance of storytelling with young children, a discussion of electronic text *versus* print-based storybooks, and a theoretical outline of a behaviourist *versus* a constructivist approach to the development of electronic text. The review further summarizes the literature regarding reading comprehension and outlines similar research studies, particularly as they relate to the measurement of reading comprehension and looks at questions raised in the on-going debate as to how media may influence learning. The experiment will be discussed in terms of subjects, test instrument, procedures, data analysis, results, and recommendations.

Literature Review – The Effects of the Computer-based Multimedia Storybook versus a Print-based Storybook

There is no greater means of learning and communication than through the power of written language. It allows for the expression and promulgation of ideas, access to differing points of view and sharing the experiences of others, while extending the means of individual comprehension and articulation beyond the confines of basic literacy. By extension, this fosters the development of good critical thinking skills, competence in which is considered essential in today's information laden society (Mason, 1990). Strongly influenced by social and cultural factors, successes and failures in an educational environment have been equated with the ability to read, to write and to articulate well.

Exposing children at an early age to stories and storytelling has long been demonstrated by researchers to contribute to the acquisition of literacy skills and good oral ability (Mason, 1990; Nikkelsen, 1990; Jackson *et al,* 1993). Reading and related storybook activities help children link their speaking and listening skills to text comprehension and expanded vocabulary use (Mason, 1990). Additionally, Abrahamson (1998) posits that storytelling promotes expressive language development in both verbal and written forms. Indeed, storytelling in this context has moved beyond the sphere of language arts into other areas of curricula, developing a context for active learning.

At first glance the link between the traditional methods of learning to read and the use of new technologies in the acquisition of literacy skills appears tenuous, but closer inspection of the literature reveals that academics see the many advantages. Reeves (1996) concludes that learners, including those with literacy problems, can improve their proficiency from the gathering, creating and dissemination of information in a non-linear manner. Or simply put, by acquiring these skills with the assistance of interactive means and supports, often referred to in an education milieu as "scaffolding". Abbott and Masterman (1997) conclude that in recent years, computer and print literacy have proceeded along parallel paths, and Reinking (1994) contends that the definition of print literacy should be extended to include electronic literacy. As succinctly put by Anderson (1990), "computer-based technologies are changing our notions of literacy and changing how students learn from text." (p.1).

Electronic Versus Print-based Storybooks

More recently, a proliferation of multimedia storybooks has raised many questions about the efficacy of electronic text, pertaining particularly to its classroom use. Proprietary software has been developed for specific applications, but more often than not, the available multimedia programs are CD-ROM based products, initially developed for the home consumer market. Frequently referred to as electronic storybooks or computerized books, an increasing number of these are finding their way into the schools. Prevalent in the early grades, popular titles featuring favourite characters predominate (McKenna, 1996; Reinking, 1994; Labbo & Watkins, 1996). In addition, teachers' guides, lesson plans, work sheets, lab packs and network licenses can be purchased by educational institutions. Supplementary classroom activities and other 'downloadable' resources are made available on the developer's Web site, all of which are intended to extend the 'shelf life' of these products.

Electronic storybooks vary in design and in the amount of contained interactivity and have evolved considerably in the fifteen years that the CD-ROM format has been commercially available. Nevertheless, these books were intended to, and most still do, emulate the printed trade versions in their on-screen presentation, and read in a linear, sequential fashion (McKenna *et al*, 1996).

Pedagogically, there are a number of reasons for the growing appeal of computerized storybooks in the classroom. In what has been described as scaffolding, electronic books can provide individualized reader support and intellectually rich and

engaging learning environments (Bloodgood, 1995; McKenna, 1996; Kahn, 1997). The better-designed programs allow for greater user discretion over the utilization of interactive features and contain barely discernible, at least to the user, embedded cognitive goals and objectives.

Specialized features, such as story narration, on-line glossaries and pronunciation functions for difficult or unfamiliar words, support the reader in ways that print cannot (Reinking, 1994). Second-language versions, animated illustrations, video sequences, sound effects, game-like activities and engaging surprise elements are supplementary features available with hyper-text programs. Additionally, Anderson (1990) points out that "phrases can be highlighted contributing to improved eye movement modeling proper oral reading techniques" (p. 6). All of which, posits Matthew (1997), provide educators with tools that they could only dream of just a short time ago. As new software design elements emerge, the products are becoming increasingly child-centred, and user controlled. Considered as highly motivational tools, the programs can be adapted to a student's individual learning style, pace and interest (Standish, 1992). Even so, the computer's classroom potential has often been under-utilized by drill and practice programs, which add little learning to what can be more readily accomplished by old-fashioned pen and paper methods. User-driven, content free programs are essential, contends Anderson (1990), if such programs are to be effective.

Nevertheless, electronic storybooks should not be viewed as teacher substitutes (Vaughan, 1994, Reinking, 1994). Since the advent of computers in the classroom, the role of the teacher has changed gradually from a passive/didactic one, to that of facilitating collaborative learning and skill building strategies in a classroom that is

teacher-directed and child-centred (Morrison & Lowther, 1998). In this milieu, electronic storybooks provide teachers with greater opportunities to support individual learners, and to create cooperative learning situations, especially in pairs, small groups or even with an entire class. An important success factor, Roblyer (1996) suggests, is in part explained by the way in which technology is used and particularly in the manner that teachers use it.

Perhaps one of their most important advantages, as McKenna *et al* (1996) suggest, is that electronic storybooks, due to the availability of such features as voice-over and glossaries, make it possible for a child to read, near or at, her or his level of oral comprehension. The existence of the features helps remove some of the frustration encountered by early readers and even stimulates a greater interest in reading in general. On a cautionary note, Reinking (1994) recommends a number of effective teacher initiated strategies to counteract any distractions that may be caused by the animated illustrations.

Characterizing the differences between printed and electronic text, Reinking (1994) puts the onus of responsibility on the reader for deriving meaning from the printed page. In the process the reader may consciously interact with the text by applying individual knowledge, but it is a passive interaction and not a dialogue. Electronic text, on the other hand, could constitute an interaction between reader and text. This dialogue could be further characterized as instrumental in enabling comprehension strategies on the part of the reader. Electronic scaffolding or supports could be construed as supplying or approximating some of the interactions that take place between an adult and child in a storybook reading situation.

Some of the differences between traditional and electronic text have been discussed in this document. A desire to find measurable differences between the two, through empirical research, is by no means unique. Numerous studies have attempted to do so. Studies comparing electronic and traditional print methods of literacy instruction by Helfeldt & Henk (1985), Manzo (1985), Nurss (1989), and Standish (1992), found no statistically significant differences in their results. Although, Helfeldt & Henk (1985) concluded that computerized reading aids do not have a "deleterious effect on reading achievement test performance" (p.120).

Gretes & Green (1994), on the other hand, conducted two experiments amongst low literacy adults and reported significant findings. And an ESL study, conducted by Thuy (1992), in an immigrant family literacy program comparing multimedia storybooks books versus traditional print storybooks, found markedly improved posttest scores in the high tech treatment group.

Matthew (1997) conducted two experiments comparing the impact of electronic text versus print on reading comprehension in Grade 3 students. These studies obtained statistically mixed results. The first experiment involved 37 matched pairs of students assigned to either the multimedia storybook or traditional print group. Matthew (1997) found no statistical difference in reading comprehension as measured by open-ended questions. However, statistically significant results were registered for the experimental group when comprehension was measured by story retelling. In the second experiment, the control print group participants from Experiment 1 were assigned to the treatment group in Experiment 2 with statistically significant results. The latter conclusion is consistent with research findings reported by McKenna (1996), Reinking (1994), Labbo

& Watkins (1996) suggesting that electronic text is effective if students have had an adequate grounding in print concepts.

Behaviorist vs. Constructivist Approaches

It may be useful at this point to place the development of electronic text within a conceptual framework for interactive learning or at least to examine these developments within the confines of instructional theories. Particularly as comprehension is such an important element in trying to rationalize the benefits of learning from electronic text. Learning theories abound, but the two that predominate in instructional design are behavioral psychology at one end of a continuum, and cognitive psychology at the other (Reeves & Reeves, 1997). Simply put, behavioral psychology is shaped by observable behavior, modified through stimulus, responses, feedback and reinforcement. Allied with this are instructivist approaches to learning. Objective-based skills are taught sequentially and learners are viewed as passive recipients of bounded knowledge and instruction, which can be easily and precisely measured.

Cognitive psychology, on the other hand, is further along the continuum, and in a simplified description, emphasizes internal mental states that include schema, rules, mental models and deduction (Reeves & Reeves, 1997). Constructivist learning theory is associated with cognitive psychology, whereby new cognitive structures are built based on the learner's previous knowledge and experience. The learning process is considered to be one that utilizes critical thinking and other deductive skills, supported by rich

learning environments, unbounded information, and motivated learners. In the constructivist model, measurability of outcomes may be difficult or even impossible.

Early interactive drill and practice materials, including electronic storybooks fall, for the most part, into the behaviourist/instructivist category with the computer theoretically replacing the teacher in giving feedback and responses (McLoughlin & Oliver, 1998). In a contructivist learning environment, the teacher takes on the role of facilitator (Sprague & Dede, 1999) in a collaborative venue of discovery learning, decreed in part by the need for shared resources. Such social interactions are considered to positively effect social behavior, collaborative learning environments and language development (McLoughlin & Oliver, 1998). Further, group interactions in a computer learning environment provide support for the development of higher-order thinking processes and writing skills.

Even so, Reigeluth (1997) cautions that the polarizing debate between instructivism and constructivism is a false dichotomy. Similarly this debate does not have to be characterized as an either/or situation but as one where different tools facilitate different types of learning and in such circumstances, the appropriate theory should be applied. Constructivist approaches to learning may support the acquisition of higher level skills but as Reigeluth (1997) further points out, these frequently require first "automatizing lower-level skills through drill and practice" (p.44).

Nevertheless, it is but a small leap to relate constructivist values to the unbounded aspects of interactivity associated with learner centred values. Constructivist approaches to learning strive to create environments where learners actively participate by helping to construct their own knowledge. Ideally, by engaging the teacher and learner in a kind of

Socratic dialogue, comprehension and understanding become essential components of knowledge mastery, forming a base upon which subsequent learning can be constructed.

Comprehension

Knowledge, built on experience, already exists in the pre-reader and is the base upon which the knowledge framework can be constructed. Starting from concrete knowledge and gradually becoming more abstract, Bloodgood (1995) postulates that literacy represents a further level of abstraction. Comprehension is a key factor and one of the most important aspects of reading.

Citing Geoffrion & Geoffrion (1983), Standish (1992) outlines four essential elements required for the comprehension of written text. They include understanding the vocabulary used, sentence construction or syntax so that meaning may be inferred, the application of prior knowledge and the use of manipulative skills to integrate them into a comprehensible format. Students, weak in one area, may compensate with strengths in another, and a good comprehension requires the successful and flexible integration of all these elements.

Similarly, by allowing children to retell, relate and reflect on something that has been read, heard, seen or experienced helps them reinforce comprehension and create new mental models (Schwartz & Bone, 1998). In elaboration, retelling becomes a sharing of knowledge, relating helps make connections to existing knowledge, and reflecting, through questioning and prediction, permits the beginnings of new meaning and

understanding. Additionally, this advantages the educator in learner assessment as to how much comprehension has occurred.

This type of evaluation may also be more appropriate in assessing comprehension of electronic text especially in comparing it to traditional printed books. All too often, reading and comprehension are measured by standardized testing procedures (Feathers *et al*, 1988). Matthew (1997), quoting Tierney (1992), suggests that if the effectiveness of technology in education is to be rationalized, then appropriate instruments of measurement must be applied. Feathers *et al.* (1988) advocate the use of story retelling and Matthew (1997) supports story retelling and other measures such as explicit and implicit open-ended questions to determine reading and text comprehension. In fact, Feathers *et al.* (1988) experimented with a number of different ways to assess comprehension by various story retelling methods.

In conclusion, any comparison between traditional means of learning and the use of technology inevitably raises questions about the overall benefits to be gained by the use of media in education. After conducting a meta-analysis of media comparison studies Clark (1983) concluded, "media do not influence learning under any conditions" (p. 445). On the other hand, Kozma (1993) posits that any relationship between "media and learning has yet to be made" (p. 7). Perhaps the more appropriate question to ask, Kozma (1993) suggests is " in what ways can we use the capabilities of media to influence learning for particular students, tasks and situations?" (p. 18). With the advent of convergence technology, Kozma (1993) concludes that there is some urgency to reframe the debate or pose the questions in a different way that "explore the conditions under

which media will influence learning" (p. 7). Computer-based learning programs provide an opportunity through which some of these questions may be further explored.

To summarize, literacy, of which comprehension is an important element, is integral to communication, to the dissemination of ideas and by extension to the development of good critical thinking skills. Early exposure to stories and storytelling has been shown to contribute to the acquisition of literacy skills as reading and related activities help increase comprehension and expanded vocabulary use.

A recent proliferation of computer-based multimedia storybooks and the use of electronic text has raised a number of literacy related questions to which adequate answers have yet to be developed. The studies reviewed, that compared print *versus* electronic text, obtained mixed results. Emerging technology, however, has the potential to allow for increasing user control and to provide intellectually rich and engaging learning environments. To this end, many feel that the acquisition of literacy skills can be advantaged by beneficial reader supports accessed through the use of computer-based multimedia storybooks.

In attempting to place the development of electronic text within instructional theory the behavourist *versus* constructivist approaches to instruction were examined. This debate has been characterized as a continuum (Reeves & Reeves, 1997) with behavioural psychology at one end and cognitive psychology at the other. Another representation of this would imply drill and practice programs with measurable outcomes moving incrementally along the continuum towards highly interactive user-controlled multimedia. The results of the latter might be difficult to measure in conventional ways and this typifies the difficulties noted in the studies surveyed in this document and in

using programs like ***'Umbrella'*** which are positioned within the constructivist model of learning.

The studies reviewed mostly related to improved reading skills through the use of computer-based multimedia storybooks by comparing them to print based materials. Of these, two studies, Standish (1992) and Matthew (1997) were particularly relevant to this research because they specifically focused on the use of reading comprehension as a measure of achievement. Assessment of comprehension is fundamental in trying to rationalize the benefits of learning from electronic text and how to effectively measure comprehension is an important question. Although, Standish (1992) used standardized reading tests to measure achievement. Matthew (1997), on the other hand, measured comprehension through the use of textually implicit and explicit questions and story retelling.

Additionally both used the same materials, ***Discis*** electronic storybooks, which included similar glossary features to ***'Umbrella'***. Only Standish (1992), however, mentions the inclusion of a specific design feature (e.g. electronic glossary) as part of the experiment. The inclusion of an easy-to-access glossary was a significant design feature of the ***'Umbrella'*** electronic storybook in terms of aiding target-age user comprehension and was a focal point for the experiment. If the use of media is to influence learning, then instruction must take advantage of the capabilities of the medium (Kozma, 1993).

The purpose of the experiment outlined below was to ascertain if electronic text, specifically including an easy-to-access 'on-screen' glossary is more beneficial than printed text, in improving children's word and story comprehension skills.

Experiment

The experiment was conducted using a posttest only control group design, each group reading either from the computer-based multimedia storybook or the printed storybook. Both experimental conditions included the use of a glossary.

For the purpose of this experiment, a segment (8 pages) from the electronic storybook '***Has Anybody Seen My Umbrella? CD-ROM'*** was excerpted. The 'on-screen' electronic text resembled an old fashioned illustrated printed book with 'function' buttons cleverly disguised as jewels on its inside cover. Activated by a mouse click, page turns were indicated by an arrow in the right hand corner. The students could investigate the program at their own speed following along with the cursor to highlight the text in either red for general text and blue for glossary words. If the cursor rested on a glossary word for more than a 2 second delay, an animated word definition automatically appeared in the illustration field above the text. The definitions were contextually explicit and were also spoken aloud by the narrator. Each page contained 3 - 6 lines of text.

Though, it should be noted that in the program, the word explanations provided were contextual, not dictionary definitions. An example of a contextually explicit glossary definition is for example: *'stepmother - when a father marries again the new wife is the stepmother (she is like a second mom)*. Other than the glossary, no additional computer program features were made available to the Experimental Group.

The book version, long out of print, was recreated for the experiment by taking screen shots of the illustrations from the electronic storybook. A glossary, which could be easily accessed by pulling down a flap on the opposite page, was added to the printed version. Achievement in word and story comprehension was measured using a posttest specifically developed for the experiment and involved word definitions, textually explicit questions, story retelling and prediction.

The selected experimental design, the posttest only control group, controls for all sources of internal validity except mortality (Campbell & Stanley, 1963) due to the presence of a control group and by use of random assignment. In the absence of pre-test data, mortality is not controlled for, but given the short-term nature of the study, mortality did not pose a problem. Despite random assignment, the groups could differ in terms of their prior knowledge, and in this context a pre-test might have been desirable. In this design threats to external validity could prove problematical in terms of generalizing the results to a non-experimental population.

Hypothesis

It was hypothesized that:

1) Young children (age 7-9) will score higher on a word comprehension test (based on words contained in the text) when reading from electronic text (with an electronic 'pop up' glossary) than when reading from the same text but in traditional linear print format (with a print glossary) and

2) Young children (age 7-9) will remember more information contained in the story when reading from electronic text than when reading the same story but in traditional linear print format.

Participants

The participants were at the Grade 2 level and between 7 and 9 years old. The average age for the Control Group was (7.98) years and the mean for the Experimental Group was (7.70) years, a negligible difference. A sample of 60 (N=60) children, equally divided between boys and girls, was drawn from three Montreal area English-language schools. One school was on the South Shore, with an ethnically and linguistically mixed population. The second, an inner-city school, shared a similar ethnic and linguistic diversity, but the school population might be characterized as having a lower socio/economic base. A former English-language confessional school, located on the north-east tip of the Island, also agreed to have students participate. Their school population was made up of children from mostly middle-class backgrounds of Italian origin, primarily English speaking with a strong emphasis on Italian and then French as additional languages. The multi-racial composition of the sample population was no doubt a reflective cross-section of elementary schools in most large Canadian cities. The 60 subjects used a total of 14 maternal languages. In all, 24 of the 60 children involved in the study spoke two or more languages at home. Several children stated that they did not know which language was in fact their mother tongue as English and French were spoken

equally in the home. The sample consisted of entirely intact groups, but in turn each school and by extension, each group, represented a different ethnic, cultural or economic reality and diversity.

The guidance of a educational consultant was also sought in terms of developing strategies for obtaining access to schools and for advice on what kind of testing procedures and time frame would be generally acceptable within the educational system.

Obtaining authorizations took several weeks. Letters outlining the nature of the research and the length of the study were sent to school boards, school principals, and ultimately to parents for participant consent (See Appendix vi). The study was conducted between March and May, 1999.

Apparatus and Test Instrument

The CD-ROM version of ***'Has Anybody Seen My Umbrella?'*** was loaded into a PC laptop computer and cued to the appropriate storybook page. Additionally, two storybooks using exactly the same images as the computer version and an additional print glossary were used. Copies of the measuring instrument were pre-prepared. Two tape recorders, audiocassettes and stopwatches were available for the researcher and research assistant.

In terms of the measuring instrument, a four-part posttest was devised by the researcher to measure the participants' word and story comprehension skills (See Appendix iii).

The four segments were broken down as follows:

Prediction: In this segment the subjects were asked to, in their own words, freely predict the outcome or ending of the story based on what they had learned from the passage that they had read. In doing so, this should allow the subjects to think about what comes next by organizing their thoughts and connecting what has transpired to what might happen in the future.

Free Recall: Subjects were asked to freely recall or retell the events that had taken place in the story. Matthew (1997) suggests that in the retelling process children can take possession or ownership of what has been read and elucidate their ideas. The process of sharing knowledge and relating the significance of experience allows us to know what the subject has understood.

Answers to textually explicit question: The subjects were asked to respond to 10 textually explicit questions about the story, the answers to which could be found directly in the text. This portion of the posttest was included on expert advice as it was felt that some subjects might have difficulty in responding to Free Recall without some prompting by questioning to determine if they had understood the most aspects of the story. Therefore two segments of the posttest, 'Free Recall' and 'Answers to textually explicit questions' were meant to complement each other. An example of a textually implicit question is: "Why did the Fairy Godmother ask Cinderella to go into the garden?"

Word Comprehension: Subjects were ask to explain the meaning of 13 words that appeared in the story. To measure word comprehension, an expert advisor suggested that the researcher adapt the basic Stanford-Binet comprehension test as part of the instrument. This test originally contained 14, words of which 9 were selected from the

glossary, plus 4 general vocabulary words from the excerpted story. One word was dropped as being totally inappropriate to the age range.

It should be noted that the entire 453-word storybook vocabulary was examined by a pedagogical expert, who concluded that approximately 50 words were above the normal vocabulary of a 7-to-9 year old. For example, words such as 'breathtaking', 'tattered', 'stepmother' and 'wretched' were put into the glossary. Words such as 'Fairy Godmother', 'magic wand' and 'pumpkin' were not.

Prior to the actual experiment, a number of steps were undertaken to ensure the viability of the instrument. As described by Dick & Carey, (1990) summative research has two main phases, the expert judgment phase and field trials. A series of one-on-one tests were also carried out during the expert judgment phase and prior to the field trials to test the instrument, and to ensure that the proposed target test group, Grade 2 children, had attained the appropriate reading level.

Procedure

A total of 60 subjects participated in the experiment. The participants were equally distributed by gender and randomly assigned to either the print or the computer group. No segregation or streaming in terms of subject's reading level took place prior to the testing. The treatment was administered individually, usually in an office or the school library. The posttest was always administered in the same sequence and all responses were oral. Although the reading was taped, all other data was recorded longhand on individual sheets. The treatment and posttest usually took about 45 minutes.

Upon arrival at the testing room, each participant was identified by first name and school only. Other relevant information noted was gender, age and maternal language. All participants received the same instructions on what was required and were given a simple explanation of the story up to the point where they were asked to start reading. The way to use the glossary was also explained as part of the instructions to both groups. Each participant was then asked to read from the selected text.

Data were collected by means of an observation sheet and a four part prefabricated posttest. During each reading observations were made and written down by the researcher. Reading difficulties, if any, attentiveness, investigated glossary words and time on task were noted. Immediately following the treatment, the posttest was administered in the following order: Prediction, Free recall, Answers to textually explicit questions and Word Comprehension.

Data Analysis

The experiment took a total of five school days, and depending on the number of participants, the researcher worked alone or with a research assistant. To avoid contamination, subjects were asked after the posttest not to discuss the study with fellow students. Each posttest was marked with the participant's first name, school, date, time of test and the experimental condition.

Typed transcripts, compiled from voice tapes, were analyzed by the researcher. Randomly selected transcripts and posttest sheets were reviewed by two independent consultants prior to, and after scoring, to ensure that the process was as accurate as

possible. One of the two consultants also listened to a number of the voice tapes. Both consultants concurred with the scoring procedures and the manner in which the experiment had been conducted.

Collected data were treated in two different ways. Posttest data, with the exception of Prediction, were scored and subjected to statistical analysis. Ancillary and observational data, e.g. time on task, number of glossary uses, gender, attentiveness, age and maternal language were collated. Time on task and the number of glossary uses were statistically analyzed for correlation effects. Differences between the scores of girls and boys were subjected to descriptive statistics. Ancillary data, e.g. multi-racial/ethnic composition of the participants, observational and anecdotal evidence were assessed.

The posttest responses for 'Word Comprehension' and 'Answers to textually explicit questions' were scored by the researcher following the completion of the study. Data collected from 'Prediction' is given. The 'Prediction' data, however, was insufficient for statistically analysis. Conversely, data obtained from 'Free Recall', initially intended for the discussion only, proved quite interesting and a post hoc scoring method was established by breaking the story down into semantic units and a scoring procedure was devised. Sequencing of events by participants is presented as observational data.

Raw data for both groups was collated (see Appendix iv) and laid-out in the following order: age, gender, home language, time on task, number of glossary uses, 'responses to Answers to textually explicit questions' and 'Word Comprehension'.

Logic dictated the order of data collection and the administration of the posttest which could be categorized in three distinct segments: (a) Ancillary data, e.g. first name,

age, gender, and maternal language, were noted prior to the treatment, (b) Researcher observations were made during treatment, e.g. time on task, attentiveness and (c), the posttest given following the treatment.

In terms of data analysis and discussion, however, the order is reversed commencing with segmented skills and progressing to more advanced global skills. The posttest results will be analyzed in the following manner:

1. Word Comprehension: This segment of the posttest was adapted from the basic Stanford-Binet comprehension test by substituting those on the existing text with vocabulary words from the text and glossary. In scoring the test, a maximum of 2 points was given for a complete response, 1 point for an incomplete response and 0 was assigned for an incorrect or no answer. The maximum score for the test was 26 points.

2. Story Comprehension was measured by:

(a) Answers to textually explicit questions: As questions were textually explicit, only simple sentence responses were required. This was scored out of 10 with one point assigned for each correct answer,

(b) Free Recall. As implied, this involved the subject freely recalling the events that had taken place in the story. The text was broken down into 22 semantic units. 2 points were assigned for a complete response, one point was given for a partial response and 0 was assigned for an incorrect or no answer. The maximum score was 44 points, and

(c) Prediction: In this segment the subjects were asked to freely predict the outcome of the story based on the segment read. This data collected was insufficient to be scored.

Statistical analysis was conducted by using Microsoft Excel. Descriptive statistics were systematically applied to all aspects of the data. In some instances t-Tests (one tail) and the correlational tests (two tailed) were also applied. The results are outlined below.

Word Comprehension

It had been hypothesized that the Experimental Group would score higher on this segment of the posttest. In spite of this expectation, the Control Group mean (13.03) was higher than the mean for the Experimental Group (11.73), the reverse of what had been hypothesized. Given that the maximum score on this part of the posttest was 26, the mean scores for the entire sample were disappointingly low. Overall analysis of means and standard deviation for 'Word Comprehension' indicated little difference between the two groups (n=60) (see Table 1). Application of t-test procedures, $t(58) = 0.136$, ($p > .05$) (one-tailed), did not support the hypothesis, that the Experimental Group (computer) group would score higher than the Control Group (print), and was not significant.

Individual school posttest results for this segment were mostly consistent with those for the overall population. However, the scores obtained in one school, a South Shore public school (School #1) were as hypothesized. In the Experimental Group (n=8) the mean score (12.62) was higher than the mean score (10.57) for the Control Group (n=7). Application of t-test procedures, $t(13) = 0.190$, ($p > .05$) (one tailed) revealed that this perceived difference was not significant. Observations in regard to word comprehension are reviewed in the discussion segment.

An examination of the means and standard deviations indicated almost no differences based on gender in the Control Group, however in the Experimental Group, boys scored lower than girls. In the Control Group, the boys' (n=14) mean (12.71) was almost identical to the girls' (n=16) mean scores (12.62). In the Experimental Group, however, the boys (n=13) mean (10.76) was lower than the girls (n=17) mean (12.58). (see Table 1). Application of t-test procedures, however, $t(28) = 0.134$ ($p > .05$) (one tailed) revealed that this was not significant.

Table 1

WORD COMPREHENSION TEST

	CONTROL GROUP (Print)			EXPERIMENTAL GROUP (Computer)		
	n	**Mean**	**SD**	**n**	**Mean**	**SD**
Sample	30	13.03	4.46	30	11.73	4.61
Indiv.						
School 1	7	10.57	4.23	8	12.62	4.5
School 2	5	12.4	6.1	7	11	4.04
School 3	18	14.16	3.8	15	11.6	5.12
Gender						
Male	14	12.71	3.54	13	10.76	3.65
Female	16	12.62	3.65	17	12.58	5.14

Story Comprehension

As described previously, story comprehension was measured by: (a) Answers to 10 textually explicit questions, (b) Free Recall, and (c) Prediction.

Answers to (10) Textually Explicit Questions

It was hypothesized that subjects in the Experimental Group would retain more information contained in the story when reading from electronic text than from reading the story from a printed book. The segment was measured by 10 textually explicit questions for which the answers could be found in the text. The measures on the textually

explicit questions indicated that overall there was a high degree of comprehension and understanding of the story in both groups. The Control Group mean, (8.26) was higher than the Experimental Group mean, (8.13) (see Table 2). No further analysis was undertaken with this data.

TABLE 2

10 TEXTUALLY EXPLICIT QUESTIONS

	CONTROL GROUP (Print)			EXPERIMENTAL GROUP (Computer)		
	n	Mean	SD		Mean	SD
Sample	30	8.26	1.65	30	8.13	2.49

Free Recall

Based on 22 semantic units extrapolated from the segment, this portion of the posttest involved the subjects freely recalling the events that had taken place in the story. In the scoring, 2 points were awarded for complete answers, 1 point for a partial response and 0 for an incorrect or no answer. It was hypothesized that subjects in the Experimental Group would recall more information contained in the story when exposed to the 'enhanced' electronic text than those in the print based control group. For the total sample, however, the Control Group mean (5.53) was higher than the Experimental Group mean (3.88) (see Table 3). Application of t-test procedures, $t(49) = 1.46$ ($p > .05$) (one tailed) revealed that this difference was not significant. In all, 4 children in the

Control Group and 5 in the Experimental were not able to give any response. This mortality was disappointing but may be explained by the fact that children in the 7 and 8 year old age group have difficulty in recalling a story without some prompting.

TABLE 3

FREE RECALL (based on 22 semantic units)

	CONTROL GROUP (Print)			EXPERIMENTAL GROUP (Computer)		
	n	Mean	SD		Mean	SD
Sample	30	5.53	4.40	30	3.88	3.11

An observational analysis was made of how the participants sequenced the events in the story. The researcher noted that in both groups some participants were quite linear and sequential in their manner of recall, some quite scattered, while others gave less details but focused clearly on the main (fractured) events. The most frequently recalled events in the story were similar for both groups although these were slightly more pronounced in the Control Group. Of the 5 most frequently recounted events, 3 are common to both the traditional and fractured fairy tale as presented in ***'Umbrella'***. Both of the remaining two events are only presented in the ***'Umbrella'*** version of the story.

Anecdotally, one child, a boy, in the Experimental Group, regurgitated the entire traditional Cinderella story sequentially and in great detail, paying no attention whatsoever to what had been read.

Prediction

Participants were asked, in their own words, to freely predict the outcome or ending of the story based on what they had learned from the passage that they had read. In fact, little useful data was collected as participants had a difficult time making predictions with many subjects giving only partial or no response (see Table 4).

TABLE 4

PREDICTION (OF STORY OUTCOME)		
CONTROL GROUP (N=26)		**EXPERIMENTAL GROUP (N=26)**
Adequate prediction	5	4
Partial prediction	10	9
No prediction	11	13

Some individual responses, however, were quite interesting from an anecdotal view point. One boy, a Control Group subject, stood out. Certainly he was slow at reading the text (9 minutes) but his glossary uses (6 word looked up) were around the average for the Control Group. He scored quite well on the various posttests, e.g. (15) Word Comprehension, (9) on Fixed Recall and (5) on Free Recall, all well above the average mean score. His most interesting comments though came in the Prediction segment, where he insisted that the seemingly stupid Prince in the story would be highly motivated to learn to read before his children (after he married Cinderella) realized he was illiterate. Quite an insight from a eight year old child and whose empathy for the

Prince in the story was no doubt based on his own reading difficulties. This participant was described to the researcher by a teacher as being reading disabled.

Another child, a girl, when asked to predicts the story outcome, recounted the entire classic Cinderella story with little bearing on the story that been read, although this subject had scored quite well on responses to the textually explicit questions. The glass slipper of the classical tale was not referred to in the segment read by the participants, yet it was mentioned by a number of children in their predictions which was perhaps to be expected in building a new story around a well known fairy tale.

Time on Task and Use of the Glossary

The Control Group mean for Time on Task (5.67 minutes) was lower by one minute than the mean (6.85 minutes) for the Experimental Group (See Table 5). An analysis was undertaken to see if there was a correlation between Time on Task and Word Comprehension test scores. A correlation test for the Control Group, ($df=28$), $r = -0.185$, ($p > .05$) (two tailed) was not significant. A correlation test for the Experimental Group ($df=28$), $r = 0.0128$, ($p > .05$) (two tailed) was not statistically significant.

The glossary use mean, or how often participants looked up words, was higher in the Experimental Group (5.56 times used) as opposed to the Control Group utilization (3.56 times used) (see Table 5). This result is not surprising as higher glossary use was expected in the Experimental Group due to the mode of presentation as will be explored in the discussion. A analysis was undertaken to see if there was a correlation between the number of glossary uses and Word Comprehension test scores.

A correlation test for the Control Group, (df=28), r = -0.30 (p > .05) (two tailed) was not significant. A correlation text for the Experimental Group, (df=28), = 0.11, (p > .05) (two tailed) was not statistically significant.

TABLE 5

TIME ON TASK (MINS.) & GLOSSARY USE

	CONTROL GROUP (Print)			EXPERIMENTAL (Comp.)		
	n	Mean	SD		Mean	SD
Time	30	5.67	3.09	30	6.85	2.84
Gloss.		3.56	2.43		5.56	3.53

Although no further statistical analysis was undertaken, how frequently individual words were accessed in the glossary was subjected to a observational analysis which ranged from 0 to 20. Simply put, some words were not looked up at all while others were accessed as many as 20 times.

The most frequently looked up words in the Control Group were 'wretched', 'tattered' and 'burst of light'. In the Experimental Group, 'wretched', 'tattered', 'burst of light' were also most frequently searched words, but in addition so were 'sire' and 'accidentally'. Words such as 'wretched' and 'tattered' are not common to our everyday vocabulary and it is not surprising that participants did not know them. Moreover, participants frequently could not respond to them on the posttest even though they had been looked up in the glossary.

Ancillary Data: Age of Participants, Multi-racial Mix, Attentiveness, Observations

The average age for the Control Group was 7.98 years old and for the Experimental Group the average age was 7.70 years old. There was not difference between the two and no further analysis was undertaken

The multi-ethnic, multi-racial nature of the study did not, with one notable exception, appear to have any effect on outcome. In fact, most of the children were familiar with the Cinderella story, no matter what the cultural background.

The notable exception mentioned above was a Francophone boy, in his first year of English schooling, who surprisingly read the text fluently and without hesitation in 3.37 minutes but had low posttest scores. His score was (2) on 'Answers to textually explicit questions', (2) on 'Free Recall' and (9) on the 'Word Comprehension'. Despite the fluency of his reading, it was obvious that he had little comprehension of what he had read.

Participants were generally quite attentive during the treatment and posttest. This is not surprising given one-on-one attention from the researcher and a change from the normal classroom routine. Nevertheless, researcher(s)' observations indicate that children in the Experimental Group (computer group) were the more enthusiastic participants in the project. The disappointment among the children who discovered they had been randomly assigned to the Control (print) Group was perceptible. No formal data was collected in this regard.

Discussion and Constraints

Although the opposite was hypothesized, the principal conclusion that can be drawn from this study is that in general no statistically significant differences were found between the two experimental conditions.

In the experiment, both groups were given exactly the same text, visuals and glossary, only the medium and the manner of glossary presentation, electronic text *versus* traditional print format, differed. The study expected to confirm that reading from electronic texts with the inclusion of an 'easy-to access glossary', is beneficial to grade two students in terms of improved vocabulary and reading comprehension. This was not shown to be so and since expectations were high, this was something of a disappointment. These results, however, are consistent with the view expressed by Clark (1983) that only content can influence learning. From other perspectives, though, there are a number of implications and insights to be gained from the results. The research found some interesting ancillary data, in terms of age, gender, and glossary use, as well as observations and anecdotal evidence which will be outlined in the following discussion. Observation, as a tool among others, Kozma (1994) noted, helps provide the researcher with an abundance of details that cannot be provided by statistical analysis alone.

Word Comprehension

The segment of the posttest was expected to confirm that the presence of an easy to access glossary, when reading from electronic texts, would lead to greater

improvement in vocabulary and reading comprehension in 7-9 year old children. While both groups had access to the glossary, the computer group had the advantage of an almost automatic glossary presentation. Despite this and greater glossary use by the computer group, the print group achieved higher mean scores on the posttest although no significant differences were found between the two. These results suggest that, in this instance, no differences can be attributed to the manner of presentation or to the presence of the glossary.

The researcher though noted one interesting observation. The subjects in the Experimental Group (computer group) often tried to guess at words they did not understand or could not quite remember the definition. In some cases where a certain glossary definition had been accessed during the reading, a regurgitated definition was given but without obvious comprehension of the word or its correct usage. For example, the word *"Sire":* was defined in the glossary definition as: *"in the olden days it was polite to call an important man, Sire. Today we say sir."* An example of students' responses is: *"man when we are being polite"* and *"now we say sir but in the olden day they said sire."*

Matthew (1997) made a similar observation but attributed this to dictionary type definitions, as opposed to contextual definitions. This raises an interesting question as to whether those subjects who scored well on this portion of the posttest, did so due to the presence of a contextually constructed glossary or, to prior knowledge. In the absence of a pre-test this would be difficult to assess. Conversely, some students were able to guess or give a partial response using the vocabulary from the glossary definition after a one time exposure. This second observation raises the questions as to whether a longer

experiment or multiple exposures to the materials would have achieved more positive results.

On the other hand, one or two of the glossary definitions seem to be misleading and elicited interesting responses. For example: *"breathtaking - so surprising that you can hardly breath"*. One sample response was: *"brush teeth so bad breath goes away"*. Another example was: "*breathe in, breathe out*".

Individual school posttest results for this segment were mostly consistent with those for the overall population. However, the scores for one school, a South Shore public school were as hypothesized. The researcher could not explain this other than attributing the difference to sampling error.

An analysis of gender showed no differences between boys and girls in the Control Group. An unexplained, although not significant, difference appears in the Experiment Group means in that the girls scored slightly higher than the boys. Gay (1992) cautions that unhypothesized results must be carefully interpreted but gender differences could form the basis for further study with new hypotheses formed in this regard.

Story Comprehension

Answers to (10) Textually Explicit Questions

In this segment the subjects were asked a series of 10 textually explicit questions about the story. Both groups, Control and Experimental, scored well and differences between the two were negligible. Reasoning that many children of this age might not be

able to give sequential recall responses without some prompting, this test was included in the posttest package on expert advice. Even so, the data provides little, if any, real insights into the questions that the study was trying to resolve. The findings can be interpreted as: (a) students in both groups comprehended the text almost equally well, (b) the use of a different medium in this case did not have any effect on student reading comprehension.

In regard to the former assumption, this finding is consistent with Matthew's (1997) experiment. Even with using textually explicit and implicit open-ended story related questions to measure reading comprehension, the study was not able to produce an educationally significant result. By contrast, the high average score from both groups as opposed to the generally low means in the Free Recall segment as discussed below might warrant further investigation.

Free Recall

Analysis of the Free Recall or a story-retelling segment in this study indicates little difference was found between the two groups. Overall the Control Group (5.53) and the Experimental Group (2.88) means were both disappointingly low. Other researchers, such as Matthew (1997) were able to achieve statistically significant results when using story retelling to measure reading comprehension. However, longer experiment duration, full use of the available program features and maturity in the participants may have been an advantaged to the Matthew (1997) experiment.

Cluster responses, where participants' responses were bunched around the same or similar frequently recalled events, appeared in both groups and often in comparable

pivotal parts of the story. These clusters, however were more pronounced in the Control (print) group. Such anomalies are difficult to explain, although the Matthew (1997) study found that 17 percent of the subjects had higher mean comprehension measures when reading from printed text.

Similar in both groups, cluster responses often occurred around elements of the fractured fairy-tale. The most obvious one, for example, was the incidence of the Fairy Godmother sending Cinderella off to the ball on a bicycle as that was the best she could do with a broken wand. Obviously, this fractured element caught the attention of the participants. Fractured storytelling might be a subject of further research especially as it relates to electronic text.

Another interesting research observation was sequencing of the cluster responses. In both groups, it was noted, that some participants were quite linear and sequential in their manner of recall, some quite scattered, while others gave less details but focused clearly on the main (fractured) events. Possibly, this emulates normal patterns of recall but the story segment, read by the participants, is mostly narrated by Cinderella who explains to the dumbstruck Prince how she came to be at the ball. Part of this sequence of events takes place in the present, but much of it is told in the past-tense and this may provide an explanation for the difficulty that some children had in relating it.

Prediction

In the Prediction segment, the subjects were asked to explain in their own words how they thought the story would end based on what they had read. Most children had little to say and of these their predictions often paraphrased the original Cinderella story rather than the fractured one presented. Only 9 of the 60 participants were able to give a reasonable prediction of what they thought the story outcome would be. About one third of the participants, in both groups, gave partial responses and the rest gave no responses at all. This result, however, is in complete contrast to the results of the 10 textually explicit recall questions where the scores for both groups were high.

Prediction, nevertheless, is an important element of the development of children's comprehension skills. Schwartz & Bone (1998) suggest that prediction allows students to organize their thoughts and connect what has happened to what might happen next. Conversely, a consultant had earlier suggested to the researcher that prediction is sometimes difficult for this (7-9 years) age group.

Time on Task & Number of Glossary Uses

An analysis of Time-on-Task indicated that subjects in the Experimental Group took an average of 58 seconds longer to read the text than those in the Control Group. Observations made by the researcher(s) showed that subjects waited for the voice to complete the definition before moving on which may account for the difference in time for the Experimental Group.

As expected, subjects in the Experimental Group utilized the glossary more frequently. In fact, they looked up, on average, two more words than their 'print' counterparts, which may explain the average of 58 seconds longer that this group took to read the text. Application of the correlation coefficient between the number of glossary uses and posttest scores for both groups was not significant and no relationship can be inferred between glossary use and achievement.

The researcher(s) further noted that there was a novelty factor in the voiced definitions and a number of children deliberately waited for the glossary screen to 'pop-up', which may also account for an increase in both utilization and Time-on-task factors in the computer group participants.

Frequently looked up glossary words such as 'wretched' and 'tattered' are not commonly used in everyday language and it was noted, by the researcher(s), that subjects rarely were able to explain them. Presuming no prior knowledge of these words, on the part of the participant, one could conclude that it takes more than a one time exposure to any new word for that word to enter a child's vocabulary. This is consistent with Kozma's (1994) view, which stresses the importance of prior knowledge in enabling students to make connections with new learning situations.

Ancillary Data: Age of Participants, Multi-racial Mix, Observations

The age difference between the two groups was negligible, although the average age of the Control Group participants was about two months older than the Experimental Group. Perusal of the data indicated that three children in the Control Group were 9 years

old and one was almost 10, which may have caused the higher average age in this group and could be attributed to the result of randomization and seemed to have no bearing on the experiment.

The multi-racial and multi-ethnic composition of the sample population was, no doubt, a reflective cross-section of elementary schools in most large Canadian cities. The 60 subjects shared a total of 14 maternal languages. In all, 24 of the 60 children involved in the study spoke two or more languages at home. The multi-ethnic, multi-racial nature of the study did not appear to have any effect on outcome. As noted in researcher observations, a couple of children had language difficulties, due to lack of fluency, but most did not. In any event this condition would have been the same for both groups. Surprisingly, most of the children were familiar with the Cinderella story, no matter which cultural background they were from and a number mentioned that they had seen the Disney version.

In the print group one child stood out in regard to his language skills. This participant, a Francophone in his first year of English schooling, read surprisingly well without hesitation in 3.37 minutes. Despite being a good fluid reader, he had low posttest scores in all areas. Such a total contradiction is difficult to explain, as it was clear to the researcher that little comprehension had taken place. Nevertheless, this raises interesting questions regarding the use of computer-based programs in second language training and this could provide a future area of study.

No formal data was collected as to how much the participants in the computer group enjoyed using the electronic storybook. Researcher observations, nevertheless, indicate that children in the Experimental Group (computer group) were the more

enthusiastic participants in the project. The disappointment among the children who discovered they had been randomly assigned to the Control (print) Group was perceptible. Many of the participants in the Experiment Group asked if they could play with the program once the testing was complete. Anecdotally, one school principal told the researcher that he knew which group, the computer group, was enjoying the process the most. Such enthusiasm was not detected among the print group participants, although in general they did not seem to mind being taken out of the classroom to do something different. Without exception, the children were cooperative and most were very attentive.

Time constraints posed a major problem for the study, in that the researcher had a one-time access to the participants, the ramifications of which are addressed in the summary section below.

Summary

To summarize, the study set out to show how the application of a computer-based multi-media storybook could benefit reading and word comprehension in 7 to 9 year old children. In doing so, particular emphasis was placed on a feature of the computer program, an easy to access glossary. The experiment was unable to produce educationally significant results, despite the slightly better scores incurred by the those who received the treatment via print materials. The negligible differences between the two groups could lead one to conclude that both experimental conditions were more or less equal.

To reaffirm this point, the presentation of the material, both on computer and in print form was visually colourful and attractive with an easy to access glossary.

Glossaries are rarely provided in children's storybooks, and where existent, they are usually relegated to a back page, not placed opposite the text and image. The fact that all participants had access to the word definitions was equally advantageous to both groups. Although the print group participants did not benefit from voice-over, something that seemingly did not influence the outcome.

The multi-racial and multi-ethnic composition of the sample population was, no doubt, a microcosm of elementary schools in most large cities across the country. The participants had a variety of mother tongues although this cultural and ethnic diversity appeared to have no effect on the results of the study.

Cultural and economic differences were apparent throughout the study although overall the researcher found no evidence that such differences impinged on outcomes. Across the board, the groups were balanced and evenly divided. Anecdotally though, cultural differences did provide the researcher with interesting observations particularly in terms of vocabulary use.

As has been mentioned, the children in the computer group frequently asked when they could play with the computer program or read the rest of the story on their own. One might conclude from the anecdotal evidence that electronic storybooks provide a greater motivational factor, especially to children with reading difficulties. The benefits from computer based educational programs such as electronic storybooks may prove to be statistically elusive but the anecdotal evidence remains compelling for further research initiatives. Such observations are consistent with those made by other researchers (Standish, 1992; Matthew, 1997).

A major constraint for this study was both time and access. Gaining access to enough subjects within a broad school population was time-consuming and required tact and patience. Allowable time with subjects was normally less than an hour and somewhat dictated the design utilized by the research. Similar studies, with positive outcomes, cited in this document (Thuy, 1992, Gretes & Green, 1994, Matthew, 1997) all had access to multiple sessions with their subjects.

Time and access factors would not have allowed for a pre-test in this instance and a pre-test was not part of the design. Nevertheless, in designing future studies of this nature, having a firm point of comparison for the posttest score should be considered.

Further, the question arises: can learning via computers be successfully measured by traditional means? Contrasting the instructivist and constructivist approaches to learning, Reeves & Reeves (1996) point out that constructivist proponents believe that a learner already has pre-existing knowledge, aptitude and motivation that is difficult to assess by standard means of testing, particularly in a medium that seems increasingly less didactic.

Roblyer, (1996) has pointed out that the mere presence of technology alone is not sufficient to expect differences in achievement, as this study seems to have shown. Factors that might make a difference are more specifically related to how technology is employed. Kozma (1991) suggests that technology is used because it is often the most efficient and modern tool on hand. This research, however, was not a debate about technology *per se* but more about how children may benefit from a burgeoning tool provided by technological change. The experiment as carried out, found no perceivable

advantages in the use of computer technology. Neither did it find sufficient evidence to the contrary.

Recommendations

There is much in the literature to substantiate the usefulness to educators of electronic storybooks in the acquisition of reading and word comprehension skills, particularly as it relates to computer-based interactive learning programs. Many teachers and media specialists are enthusiastic users of electronic storybooks in the classroom and feel these represent a valuable use of technology to provide a different reading experience (Kahn, 1997). Such attitudes are likely to become more prevalent over the next few years. Some educators are especially positive in terms of their use with handicapped children and others in inclusion facilities (Barnes, 1997) and with "at risk" students who might be prone to failure (Kozma, 1993).

Computer-based learning programs such as ***"Has Anybody Seen My Umbrella?"*** are designed for both home and school use. Children who have access to a computer at home possibly have advantages over those who do not. Encompassing more activities than just that of an electronic storybook, the program also provides word games and quizzes, music activities that encourage rhyming, story-writing and other complimentary activities that help in the development of various literacy related skills. A further advantage to computer-based reading programs is their ability to provide spoken definitions, allow the user to record their own voice and have their pronunciation corrected, as suggested by Reinking (1994). Such bells and whistles could provide innumerable advantages for second language users (Thuy, 1992), learning disabled children, distance education and many others (Matthew, 1997). While this study is inconclusive it offered some positive insights into the use of electronic text in the

classroom. A recommendation is that a longitudinal study be undertaken, perhaps incorporating all available activities and modalities from the program to see if benefits can be more conclusively determined. An important element of such a study would be prior establishment of a range of subjects' language skills, so that various devised posttests might have a greater point of comparison. Conversely, it is important to determine if the right questions are being asked.

Kozma (1991) concludes that computers allow us a "unique opportunity to examine learning processes and how these interact with the capabilities of the medium" (p 206). In characterizing the link between learning, computers and language use Vygotsky (1978) suggests that computers need to be integrated into the social fabric of the classroom. Pursuant to this, an important element to keep in mind is the collaborative nature of shared resources in the computer environment. In designing future studies, such factors should clearly be incorporated, perhaps working with subjects in small groups rather than individually could also be useful.

From observations the researcher noted that the children in the computer group had the more enjoyable experience. Perhaps this alone tells us something. There is a paradigm shift that is taking place in education from teacher-centred to student-centred learning. As the use of computer-based programs in learning broadens so does the debate that surrounds electronic literacy. So too, will the question of how this mode of learning can be effectively measured and whether new assessment philosophies and tools of measurement need to be developed. Herein lay a number of questions that could form the basis for further research.

REFERENCES

Abbott, C., & Masterman, L., (1997) Media literacy, information technology and the teaching of English. Working Papers on Literacy. Working Paper No. 2. (ISBN: 0-9681034-3-X). Montreal, QC. The Centre for Literacy.

Abrahmason, C. E. (1998). Storytelling as a pedagogical tool in higher education. Education, Vol. 118, No. 3, 441-451.

Anderson, J. (1990). New technologies and literacy. Paper presented at the World Congress on Reading (13th), Stockholm, Sweden.

Barnes, S. (1997). Integrating technology and media into regular classrooms to facilitate inclusion: Preservice/inservice training of rural educators. In: Promoting progress in times of changes: Rural communities leading the way. (ERIC Document Reproduction Services No. ED 406 124)

Barab, S. A. , Hay, K. E., & Duffy, T. (1998). Grounded constructions and how technology can help. TechTrends Vol. 43 No. 2 , 15.

Blank, D. D. (1993, April). Ten truths about developing interactive multimedia. Multimedia & Videodisc Monitor. 26-27.

Blattner, M. M. (1992). Messages, models and media. Multimedia Review. Vol. 3, No. 3, 15-21

Bloodgood, J. W. (1995). Exploring a model for reading proficiency. Paper presented at the Annual Meeting of the National Reading Conference, New Orleans, LA. (ERIC Document Reproduction Services No. ED 400 508).

Brackeen, D., Grits, D., Mackraz, B., & Tognazzini, B. (1989). Apple® Human Interface Checklist. Apple Computers Inc: Cupertino, CA.

Brownlie, F., Close, S. & Wingren, L. (1988). Reaching for higher thought: Reading writing thinking strategies. Edmonton, AB: Arnold Publishing Ltd.

Cambre, M.A. (1982). Formative evaluation and the new technologies. Unpublished manuscript.

Campbell, D. T., & Stanley, J. C. (1966). Experimental and Quasi-Experimental Designs for Research. Boston: Houghton Mifflin Company.

Carlson, P. A., & Larralde, V. (2000). Combining concept mapping and adaptive advice to teach reading comprehension. J.UCS Vol. 1. Issue 3. 1-8. HTML Paper.
Chen, M. (1995). A method for characterizing computer-based learning environments. Instructional Science 23. 183-220.

Chirwa, A. S. (1997). Knowledge acquisition in computer-based learning environments among elementary children. J. Educational Technology Systems. Vol. 26(1). 19-25

Clarke, R.E. (1983). Reconsidering research on learning from media. Review of Educational Research (1983). Vol. 53. No. 4. 445-459

Computers as cognitive tools. Literacy across the curriculum. (1997). Vol. 12 No. 4. 6

Daigneault, D., Matthias, J., .& Churchill, J., (1996). "Has Anybody Seen My Umbrella? CD-ROM": Preliminary Functional Specifications. Unpublished Manuscript, National Film Board of Canada, Montreal, QC.

Dick. W., & Carey, L. (1990). The systematic design of instruction. Scott, Foresman/Little, Brown Higher Education: Glenview, Illinois.

Duffy, T.M. & Jonassen, D. H. (1992). Constructivism and the technology of instruction: A conversation. Hillsdale, NJ: Lawrence Erlbaum Assoc.

Eden, C., Jones, S., & Sims, D. (1983). Model building in teams. Messing about in teams. 69-103. London: Perganon Press.

Feathers, K., Reasor, V., & Beauchamp, D. (1988). Analyzing retellings to assess comprehension. Paper presented at the Annual Meeting of National Reading Conference, Tucson, AZ. (ERIC Document Reproduction Services No. ED 308 461)

Ferguson, M. (1985). Has Anybody Seen My Umbrella? (1985) Toronto, ON: Scholastic Press Ltd.

Flagg, B. N. (1990). Formative Evaluation for Educational Technologies. Hilldale, NJ: Lawrence Erlbaum Associates.

Fredrickson, S. (1997). Interactive multimedia storybooks: integrating technology into the language arts curriculum. Learning and Leading with Technology. Vol. 25 No. 1. 6-10.

Freeley, J. T. & Wepner, S. B (1986 October). Rate improvement in college: The computer vs. traditional text. Paper presented at the annual meeting of the Collage Reading Association, Knoxville, TN. (ERIC Document Reproduction Service No. ED 282 182).

Gay, L. R. (1992). Educational Research: Competencies for Analysis and Application. New York: Merrill.

Gillette, J. E. (1992). The new language of Images: Observations of computer multimedia form. Multimedia Review Vol. 3, No. 2, 20-29.

Glasgow, J. N. (1996). It's my turn! Motivating young readers. Learning & Leading With Technology. Nov. 1996, 20-23.

Glasgow, J. N. (1997). Keep up the good work: Using multimedia to build reading fluency and enjoyment. Learning & Leading With Technology. February 1997, 22-25.

Gonzales, C., & Roblyer, M. D. (1996). Rhetoric and reality: Technology's role in restructuring education. Learning & Leading with Technology Vol. 24, No. 3, 11-15.

Gretes, J . A., & Green, M. (1994). The effect of interactive CD-ROM/digitized audio courseware on reading among low-literate adults. Computers in the Schools. Vol. 11 (2), 27-35.

Haag, B. B., & Grabowski, B. L., (1995). The design of CD-I: Incorporating instructional design principles. Educational Technology. Vol. 35, No. 2, 36-39

Harper, J. A., & Ewing, N. J. (1986). A comparison of the effectiveness of microcomputer and workbook instruction on reading comprehension performance of high incidence handicapped children. Educational Technology. Vol. XXV1, No. 5, 40-45.

"Has anybody seen my umbrella?", (1999). Resource Links, Vol. 4 No. 5, 29.

"Has anybody seen my umbrella?", (1999). Today's Parents, September, Vol 16, No 8, 17

Hedberg, J. Brown, C., & Arrighi, M. (1997). Interactive multimedia and web-based learning: Similarities and differences. In B. H. Khan (Ed.) Web-Based Instruction. Englewood Cliffs, NJ. Educational Technology Publications. Inc.

Helfeldt, J. P., & Henk, W. A. (1985). Differentiating reading practice: A methodological comparison of microcomputers and student selected reading. In G.H. McNinch (Ed.) Reading research in 1984: Comprehension, computers, communication. Fifty yearbook of the American reading forum. 118-1120 (ERIC Document Reproduction Services No. ED 290 135).

Heinrich, P. (1997). Multimedia in action. Educational Computing & Technology. November 1997. 15-17.

Hodes, C. L. (1997-98). Developing a rationale for technology integration. Journal Educational Technology Systems, Vol. 26 (3), 225-235.

Hybrid CD-ROM/online Titles Will Surge in 1996. (1996). NewMedia Canada 11(7), 5.

Discis books: Interactive computer books for children. (1990). Tech Trends Vol. 35, No. 5, 36-39.

Jackson, E., J., Ewald, N., & Roller, C. M. (1993). Reading with young children. 8-43 (ERIC Document Reproduction Services No. 366, 157).

Jonassen, D. H., Carr, C, & Yueh, H. P. (1998). Computers as mindtools for engaging learners in critical thinking. TechTrends, Vol. 43 No. 2, 24.

Kahn, J. (1997). Scaffolding in the classroom: using CD-ROM storybooks at a computer reading centre. Learning & Leading With Technology, Vol. 25 No. 2, 19-21.

Kearsley, G., Hunter, B. & Furlong, M. (1992). We teach with technology: new visions for education. Wilsonville, Oregon: Beedle and Assoc.

Keppel, S., Saufley, W. Jr., & Tokunaga, H. (1992). Design and analysis: A student's handbook. New York: W.H. Freeman & Co.

Kozma, R.B., (1991) Learning with media. Review of educational research, Vol. 61, No. 2, 179-211.

Kozma, R. B., (1993) Will media influence learning? Reframing the debate. Educational Technology Research and Development, Vol. 42, No.2, 7-19.

Kucan, L. & Beck, I. L. (1997) Thinking aloud and reading comprehension research: Inquiry, instruction, and social interaction. Review of Educational Research Vol. 67, No. 3, 271-299.

LaGuardia, C. (1995, July). CD-ROM review Library Journal, 130-132.

Lambert, M-H. (1996). "Has Anybody Seen My Umbrella? CD-ROM: Report of formative research. Unpublished Manuscript. National Film Board of Canada, Montreal, QC.

Manzo, A. V. (1985). Influences of three concurrent remedial practices, on computer assisted, upon comprehension, verbal reasoning, distractibility and self-monitoring. In G.

H. McNinch (Ed.), Reading research in 1984: Comprehension, computers, communication. Fifty yearbook of the American reading forum. 66-68 (ERIC Document Reproduction Services No. ED 290 135).

Mason, G. E. (1985). Research on computers in reading. In G.J. McNinch (Ed.), Reading research in 1984: Comprehension, computers, communication. Fifth yearbook of the American reading forum. 29-31 (ERIC Document Reproduction Services No. 290 135).

Mason, J. M. (1990). Reading stories to preliterate children: A proposed connection to reading. (Technical Report No. 510) Cambridge, MA: Center for the Study of Reading. (ERIC Document Reproduction Services No. ED 322 494).

McKenna, M. C., Reinking, D., Labbo, L. D., & Watkins, J. H. (1996). Using electronic storybooks with beginning readers. National Reading Research Center. Instructional Resource No. 39. 3-5 (ERIC Document Reproduction Services No 400 521).

McLoughlin, C., & Oliver, R. (1998). Maximising the language and learning link in computer learning environments. British Journal of Educational Technology. Vol. 29 No. 2. 125-136.

Morrison, G. R., & Lowther, D. L., (1998). Learning with computers in the K - 12 environment. TechTrends. Vol. 43 No. 2. 14.

Mullan, A. (1984). Children and computers in the classroom. London: Castle House Publications

Multimedia wipeout (1996, June 15th). The Economist. 12.

Nikkelsen, N. (1990). Cultural context and the classroom literacy program: The power of children's storymaking. Paper presented at the Annual Meeting of the American Educational Research Association. Boston, MA. (ERIC Document Reproduction Services No. ED 316 882).

Northrup, P. T. (1995). Concurrent formative evaluation: Guidelines and implications for multimedia designers. Educational Technology/ November-December 1995. 24-31.

Nurss, J. R. (1989). PALS evaluation Project. Atlanta GA: Georgia State University, Centre for the Study of Adult Literacy. (ERIC Document Reproduction Services No. 313 573).

Olson, R., Foltz, G., & Wise, B. (1986). Session 11, nontraditional human-computer interfaces: reading instruction and remediation with the aid of computer speech. Behavior Research Methods, Instruments, & Computers, 18 (2), 93-99.

Popham W. J. (1975). Educational evaluation. Englewood Cliffs, New Jersey: Prentice-Hall Inc.

Polson, P. G., Lewis, C., Riemant, J., & Wharton, C. (1992). Cognitive walkthroughs: a method for theory-based evaluation of user interfaces. Int. J. Man-Machine Studies. 36. 741-773.

Poncelet, G. M., & Proctor, L. F., (1993). Design and development factors in the production of hypermedia-based courseware. Canadian Journal of Educational Communication. Vol. 22. No. 2, 91-111.
Ralls, C., & Murray, L. (1997). Twelve children's perception of reading. New Era in Education. Vol. 78. No. 3, 70-77.

Ragsdale, R. (1982). Evaluation of microcomputer courseware. Computers in Education Series. Toronto: OISE Press.

Rath, A., & Gaudet, C. H. (1998). Converting existing curriculum to multimedia: Portrait of university-based CD-ROM developers. Int'l J of instructional Media Vol. 25(2). 139-150.

Reeves, T. C., & Reeves. (1997). Effective Dimensions of interactive learning on the world wide web. In B. H. Khan (Ed.). Web-Based Instruction. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Reigeluth, C. M. (1997). Instructional Theory, practitioner needs, and new directions: Some reflections. Educational Technology Vol. 37. No. 1. 42-47.

Reinking, D., (1987). Computers, reading and a new technology of print. In D. Reinking (Ed.). Reading and computers: Issues for theory and practice. (pp. 3-15) New York, NY: Teachers College Press.

Reinking, D. (1994). Electronic literacy. Perspectives in Reading Research No. 4. Athens, GA; National Reading Research Center.

Reitsma, P. (1988). Reading practice for beginners: Effects of guided reading, reading while listening and independent reading with computer-based speech feedback. Reading Research Quarterly. 23(2). 219-235.

Roblyer, M. D. (1996). The constructivist/objectivist debate: Implications for instructional technology research. Learning & Leading With Technology Vol. 24. No. 2. 12-16.

Romiszowski, A. J. (1997). Web-based distance learning and teaching: revolutionary Invention or reaction to necessity? In (B. H. Khan Ed.). Web-Based Instruction. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Salomon, G., (1994). Interaction of media, cognition, and learning. Hillsdale, NJ: Lawrence Erlbaum Associates.

Schuyler, N. (1996). From concept to gold master disk. Illustration Annual, 190-195.

Schwartz, S., & Bone, M. (1995). Retelling, relating, reflecting: Beyond the 3R's. Toronto, ON: Irwin Publishing.

Sherry, A. C., (1998). Evaluation of multimedia authoring instruction based in a behaviorist-cognitive constructivist continuum. Int'l J of Instructional Media Vol. 25(2), 201-216.

Slavin, R. (1985). Learning to cooperative, cooperating to learn. New York: Plenum Press.

Smith, S. (1990). Interactive computer books for children. Tech Trends, Vol. 35, No 5., 35-38.

Sprague, D., & Dede, C., (1999). Constructivism in the classroom: If I teach this way, am I doing my job? Learning & Leading With Technology, Vol. 27 No. 1, 6-17.

Standish, D. G. (1992). The use of CD-ROM-based books to improve reading comprehension in second-grade students. Practicum paper, Wilmington College, (ERIC Document Reproduction Service No. ED 352 605).

Strickland, D. S. (1989). A model for change: Framework for an emergent literacy curriculum. Emerging literacy: Young children learn to read and write. Strickland, D.S., Morrow Mandel, L. (Eds.) Newark Del: International Reading Assoc. (ERIC Document Reproduction Services No. 305 602).

Thuy, V. G. (1992). High-tech for effective ESL/family literacy instruction. Final Report. Harrisburg, PA: University of Pennsylvania, Dept of Education. (ERIC Document Reproduction Services No ED 356 683).

Tuckman, A. (1979). Evaluating Instructional Programs, Boston: Bacon Inc.

Vaughan, T., (1994). Multimedia: Making it work. Berkeley, CA: Osborne McGraw-Hill.

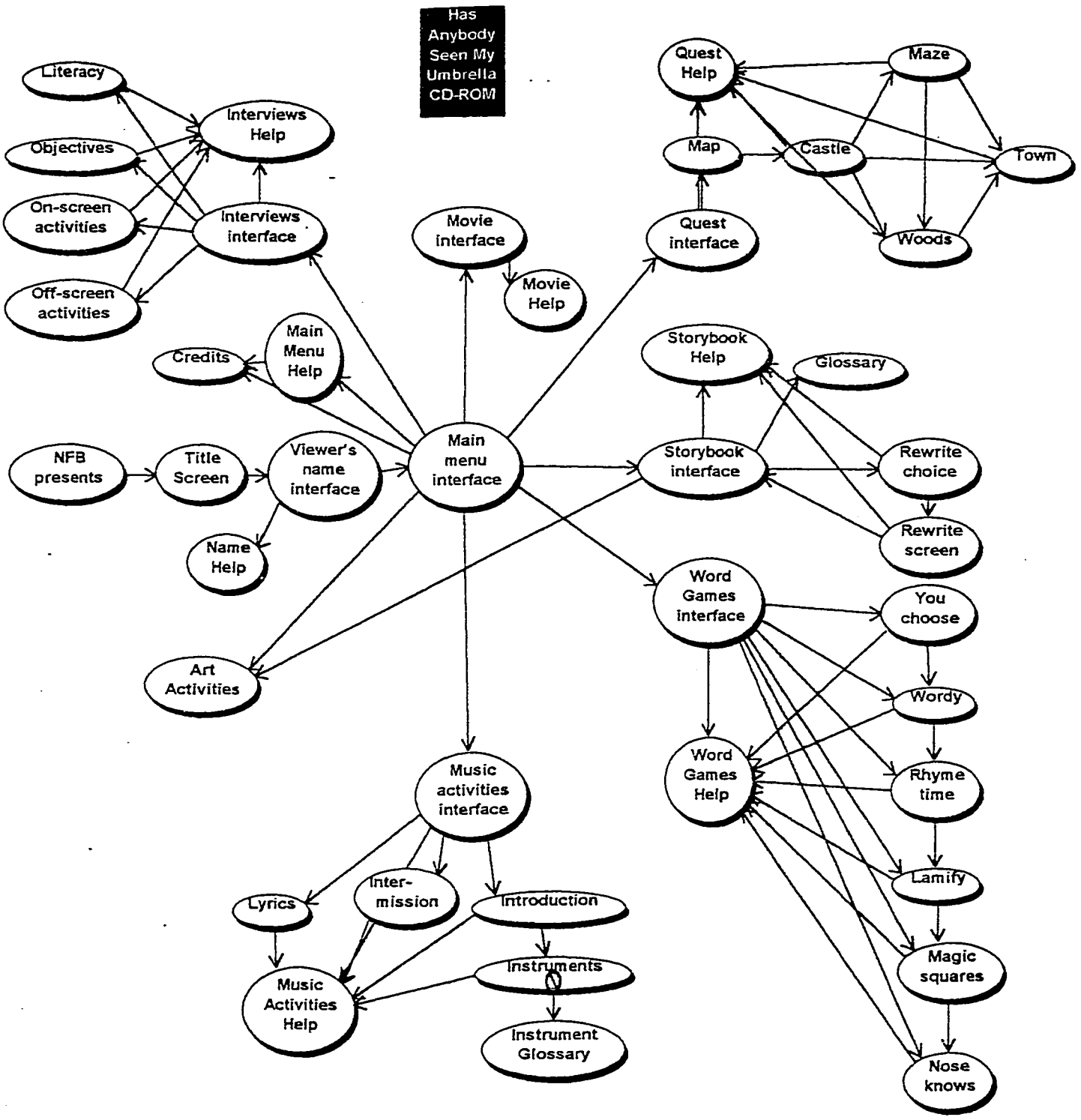
Vygotsky, L. S. (1978). Mind in society. Harvard University Press: Cambridge. MA. Western Canadian Protocol for Collaboration in Basic Education. (1996). Common curriculum framework for English language arts: Kindergarten to Grade 12. (ISBN 3 0-7711-2025-7).

Wimberley, D., Samsel, J. (1996). Interactive Writer's Handbook, Los Angeles: The Carronade Group.

APPENDICES

APPENDIX 1

"HAS ANYBODY SEEN MY UMBRELLA? CD-ROM"
ORIGINAL PRODUCTION FLOW CHART


Has Anybody Seen My Umbrella CD-ROM
Literacy
Interviews Help
Objectives
On-screen activities
Interviews interface
Off-screen activities
Movie interface
Movie Help
Quest Help
Maze
Map
Castle
Town
Quest interface
Woods
Main Menu Help
Credits
Storybook Help
Glossary
NFB presents
Title Screen
Viewer's name interface
Main menu interface
Storybook interface
Rewrite choice
Rewrite screen
Name Help
Word Games interface
You choose
Art Activities
Wordy
Word Games Help
Music activities interface
Rhyme time
Lamify
Inter-mission
Introduction
Lyrics
Instruments
Magic squares
Music Activities Help
Instrument Glossary
Nose knows

APPENDIX 11

NOTES ON PRELIMINARY ONE-ON-ONE TESTING
PROGRESSREPORT: Subject Matter Experts
Field Testing
Revisions to Instrument
Outstanding Questions

Notes from preliminary one-on-one testing

Feb. 26th. Tested two boys at after school program. One was 7 and a ½, the other was about 11. Both children are Anglos who go to school in French. The older boy was not as good a reader as the younger boy but understood the vocabulary too well to be of use as a test. So only results from first child are useful.

When this test was initially set up there was to have been a second seven year old but he was not present on the day.

However, the younger boy was in the age range, did not understand all of the vocabulary and some of the vocabulary that he did not understand, was not in the glossary..

He was not overly interested in the story and found the passage too long. He took quite a long time over it as we stopped to look up words in the glossary and to decode certain other words. Help with decoding would not happen during actual test.

In the end he read most of the passage and we looked up about six words that he did not know.

I was told verbally later by the person who ran the after school program that he was exceptionally bright, brighter than his older brother. Some basic questions about the story was asked to both boys but it was obvious that neither had trouble with comprehension.

A further draw back to this session was that I was unable to take each children into a quiet room individually.

Conclusions:

Reading age seems appropriate but this should be tested further
Passage too long - should consider shortening.
Need to keep a log of which words are looked up, attentiveness, eye-movement, fidgeting, how many time glossary is used, which words not in the glossary give the reader difficulty and allow longer for test as it takes time to look up words.

EXPERT CONSULTATIONS

A number of meetings have taken place with subject matter experts (teachers/tester), a preliminary one-one-one test has been completed and consequently the test instrument refined.

Subject Matter Experts

On March 16th, I met with two elementary teachers at Preville School (St. Lambert) on the South Shore to discuss both testing at the school, number of subjects and go over test instrument. About 15 children will be able to participate in the testing as long as permission slips are returned by parents. Karen Young and her colleague teach in the English stream of a bi-lingual school. Both teach split classes, one has Grade 1 and 2 and the other has Grades 2 and 3. However, subjects will be randomly assigned to either the Control or Experimental Group.

There reaction to the testing instrument was positive but suggested that children of this age do not always verbalize well. Only further pre-testing (one-on-one) will indicate if this will be a serious problem.

Tester

Monique Caron-Bouchard is a Phd. (Psychology) and a professional research focusing on film and media. She has never tested a CD-ROM but was interested in the research undertaken and made several practical suggestions regarding presentation of the print material. I met with her on March 23rd.

One-on-one Testing (Report attached)

This took place at a small after school program in Montreal West. Report attached

Additional One-on-one Testing

It is hoped that this can be completed by the end of the last week in March or the first week in April. Hopefully this will take place at either Michael Angelo School in Montreal North or Nazareth School in Anjou. (two to four subjects).

Field Testing

Field testing will take place during April. Permission has been received both from the English Montreal School Board and Westmount Park School to conduct testing there. Optimal number of subjects is 20 - 25 depending on the number of permission slips that are returned.

Preville School - About 15 children but again this depends on the number of permission slips returned.

As both Nazareth School and Michael Angelo both seem open to this type of research. The principal of Michael Angelo is head of the Quebec Literacy Association, I will probably be approaching one of these schools for children that might take part in the research.

Revisions to Instrument

This will take place after meeting with Advisor and one-on-one tests. It is hoped that I can also meet with one or two people who acted as pedagogical consultants during the development of the actually CD-ROM program during the next week.

Specific Revisions

I am still not satisfied with the content of the **Vocabulary Comprehension Test** and I will try to meet with the person who consulted on the design of the glossary during development of the CD-ROM. (as mentioned above) Further, I believe the full one-on-one testing of the instrument will help refine this par- of the instrument and negate the need for a pre-test for which time and access will probably not allow.

Specifically regarding the **Observation Chart** - 'gender' will be noted on this chart and a space added to this for information.

A change to the **Glossary** presentation may be made and will be tested in the one-on-one testing. This would be to have the Glossary word in BLUE and the explanation in BLACK.

Outstanding Questions

What happens if the subject is unable to read the entire passage and how many vocabulary words should each subject be able to respond to obtain sufficient data? Currently there are 20 vocabulary questions?

Methodology Questions
Should vocabulary questions be posed to each subject in the same order?

Time Frame

The original schedule was impossible to adhere to due to the time it took to get permission, especially from the English Montreal School Board.

Methodology

Any changes to methodology will be revised following meeting with advisors.

APPENDIX 111

TESTING INSTRUMENT AND TESTER INSTRUCTION BOOKLET

You are going to be asked to do a short exercise to help me with some research that I am doing. This is going to take about 30 mins. I am going to ask you do four things:

1. to read part of a story from a called *'Has Anybody Seen My Umbrella?'* which I would like you to read out loud. This will only take a few minutes. Then....

2. to summarize the story for me and to answer some questions about the story.

3. to explain some of the words in the story to me and tell me in your own words what they mean.

4. to tell me how you liked the story.

Additional information to subject:

I am also going to use a tape recorder in case I forget to write everything down as we talk.

The story is going to start in the middle of the book so I am going to explain the story to you up to this point.

You may not know some of the words in the story so I am going to show your how you can you look up some of those words. I will give you an example but once we start I will not be able to explain any of the words to you

You are going to be asked to do a short exercise to help me with some research that I am doing. This is going to take about 30 mins. You are going to do this on the computer, where I have a storybook set up.

I am going to ask you do four things:

1. to read part of a story from a called *'Has Anybody Seen My Umbrella?'* which I would like you to read out loud. This will only take a few minutes. Then....

2. to summarize the story for me and to answer some questions about the story.

3. to explain some of the words in the story to me and tell me in your own words what they mean.

4. to tell me how you liked the story.

Additional information to subject:

I am also going to use a tape recorder in case I forget to write everything down as we talk.

The story is going to start in the middle of the book so I am going to explain the story to you up to this point.

You may not know some of the words in the story so I am going to show your how you can you how the computer will give you help to explain the words by following along with the cursor as you read. I will give you an example but once we start I will not be able to explain any of the words to you.

Story Synopsis to this point:

This is a Cinderella story except in this story the prince can't read. When the prince finished Grade 1, he told his father, who was the King, that he knew everything he needed to know. After all, he could now read words like dog and cat and tie his shoe laces. The prince did not think that he needed to go to school anymore. So the prince grew up spending all of his time playing, being lazy and not learning anything at all.

But when it came time for the grown up prince to marry, his father, decides to throw a big party - a birthday ball and invite all of the young ladies to meet the prince.

The prince danced with all of them but at the end of the evening he noticed a lovely young lady, that he had not seen before, sitting in a corner and.....this is where we start reading the story.

In a moment he was telling her how pleased he was to see her at his party. "Thank you, sire," she replied shyly, "though if it hadn't been for my fairy godmother I wouldn't be here at all."

"Fairy godmother?" asked the prince, puzzled because he had never come across such big words in first grade.

"Yes," replied the girl. You see, I live with my stepmother and two ugly stepsisters. They're very mean to me and make my life wretched, so my fairy godmother came to help." "And she brought you here this evening?" asked the prince.

"Well," explained Cinderella, for that, indeed, was who she was, "while I was sitting alone poking the fire she appeared out of nowhere, with a great burst of light."

"She waved her magic wand over my tattered dress and instantly changed it into this breathtaking gown of diamonds and pearls."

"She then commanded me to rush into the garden to find a pumpkin. When I returned, I accidentally stepped on her wand and broke it in two."

"She seemed very upset, but she picked up the pieces and passed them over the pumpkin. There was a puff of smoke and you can imagine my surprise when I saw standing there a shiny red bicycle!"

"She said that was the best she could do with a broken wand. Then she sent me off to the ball."

sire	in the olden days it was polite to call an important man, sire (today we say sir)
replied	to reply is to speak next or answer a question
puzzled	when people are puzzled they don't really understand
stepmother	when a father marries again the new wife is the stepmother (she is like a second mom)
stepsisters	the stepmother's daughters
wretched	very unhappy
explained	when you explain something you tell more about it so people understand better
burst of light	a sudden great flash of bright light
tattered	ragged and torn
instantly	right that minute
breathtaking	so surprising and exciting that you can hardly breathe

glance	a quick look
instantly	right that minute
midnight	twelve o'clock at night, a time when most people are sleeping
puzzled	when people are puzzled they don't really understand
replied	to reply is to speak next or answer a question
sire	in the olden days it was polite to call an important man, sire (today we say sir)
sorrow	sorrow is a feeling of sadness
stepmother	when a father marries again the new wife is the stepmother (she is like a second mom)
stepsisters	the stepmother's daughters
taillight	a back light on a bicycle or car
tattered	ragged and torn
upset	sad or angry or worried
wretched	very unhappy

commanded	when you command you order someone to do something
accidentally	not on purpose
upset	sad or angry or worried
amazement	great surprise
midnight	twelve o'clock at night, a time when most people are sleeping
gracious me	an old-fashioned expression like "my goodness" or "oh dear"
taillight	a back light on a bicycle or car
fading	getting fainter and fainter so it's harder to see
Alas	"Alas" is a way of saying it was too bad
sorrow	sorrow is a feeling of sadness
glance	a quick look
clue	a little hint to help figure out the answer to a puzzle or a mystery
concentrated	when we concentrate we pay very close attention

School_____Name_____Age_____Grade_____Time_____

of the words will be scored with a 0

7 of the 20 words are not in the glossary - these may change to balance

Following treatment, students will be asked to summarize story, then the following questions.

1. Which special person was the prince pleased to see at his party?
2. Who helped that special person (Cinderella) get to the party?
3. Why was the prince puzzled by such big words as Fairy Godmother?
4. Who did the special person (Cinderella) live with?
5. What was Cinderella doing when the Fairy Godmother appeared?
6. What did the Fairy Godmother do to dress Cinderella for the party?
7. What did the Fairy Godmother ask Cinderella to get from the garden?
8. How did Cinderella break the Fairy Godmother's magic wand?
9. What did the Fairy Godmother make from the pumpkin for Cinderella?
10. What happened when the clock struck midnight?
11. What did the Prince do when the clock struck midnight?
12. What did the Prince find on the steps after Cinderella left?
13. What was the clue that Cinderella left the Prince?
14. What big mistake did the Prince make when he found the clue?

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

VOCABULARY WORD TEST* currently selected directly from the story in sequence.

			Score 2,1,0
1.	sire		
2.	fairy godmother	*	
3.	puzzled		
4.	wretched		
5.	magic wand	*	
6.	tattered dress		
7.	diamonds	*	
8.	pumpkin	*	
9.	accidentally		
10.	surprise	*	
11.	midnight		
12.	taillight		
13.	sorrow		
14.	glass slipper		
15.	doorstep	*	
16.	concentrated		
17.	clue		
18.	upset		
19.	amazement		
20.	commanded		
		Total	

Scoring:

Each subject will be asked to explain as many of the words as possible.
The tester will write down the answer for later analysis of complete or incomplete.
Both text and word list will probably be shortened.

A complete explanation will be scored with a 2

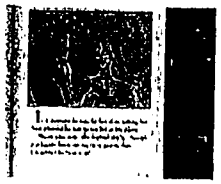
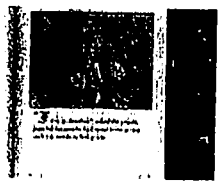
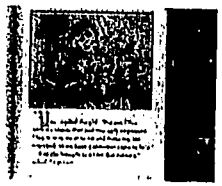
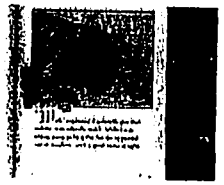
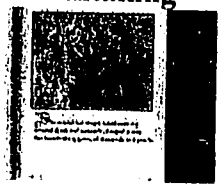
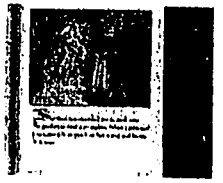
A incomplete explanation but with some understanding of the word will be scored with a 1

No explanation or a complete lack of understanding

1
2
3
4
5
6
7
8
9
10
11
12
13
14

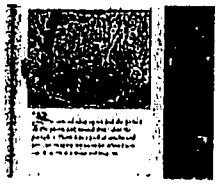
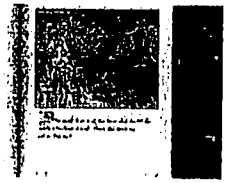
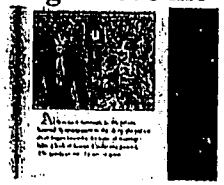
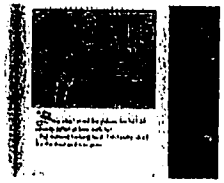
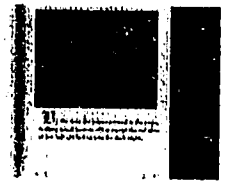
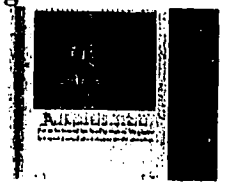
HAS ANYBODY SEEN MY UMBRELLA CD-ROM - Observation Chart

School_____ Name_____ Age_____ Grade_____ Time required for test_____

	Prince/Cinderella	Prince puzzled	Step Mom/Sister	Cinder by fire	FGM/Cinder/Dress	Garden magic
Page number and glossary words **Number of glossary uses by page (indicate words by tick)**	**Sire** 1. **Replied** 	**puzzled** 2. 	**stepmother** 3. **stepsisters** **wretched** 	**explained** 4. **burst of light** 	**tattered** 5. **Instantly** **breathtaking** 	**commanded** 6. **Accidentally** 
difficulty with words not in glossary (indicate words)						
general reading difficulties none/or if yes indicate						
attentiveness/ eye movement						

HAS ANYBODY SEEN Y UMBRELLA CD-ROM - Observation Chart

School_____ Name_____ Age_____ Grade_____ Time required for test_____

	Bike appears	FG bids adieu	Midnight	Cinder runs off	Bike disappears	Sad Prince
Page number and glossary words Number of glossary uses by page (indicate words by tick)	**upset** 7. 	**no glossary words** 8. 	**amazement** 9. **midnight** **Of gracious me** 	**no glossary words** 10. 	**taillight fading** 11. 	**Alas sorrow glance** 12. 
general reading difficulties none or if yes indicate						
general reading difficulties none/or if yes indicate						
attentiveness/ eye movement						

APPENDIX 1V

SUMMARY OF RAW DATA

SUMMARY OF RAW DATA
EXPERIMENTAL GROUP (COMPUTER)

	Subject No	Name	Age	Gender	Home Lang	Time on Task/Min	No of Gloss Use	10 Text ExpQuest	Word Comp(26)	Free Recall 22 units
	1	Chris	8	M	English	11.45	7	6	9	3
School #1	2	Hillary	7.75	M	Chinese	5	4	8	7	14
Preville	3	Sara-Anne	8	F	English	3.04	2	10	15	4
April 15&2	4	Stephanie	7.5	F	Greek	8	11	6.5	13	4
	5	David	8	M	English	10	9	8	18	6
	6	Anne	7.5	F	Bengali	4.43	6	6.5	8	4
	7	Nathan	7.5	M	English	11.28	13	9.5	12	2
	8	Samantha	8	F	English	10	8	8.5	19	2
	9	Ebony	8	F	English	10.44	8	6.5	6	0
School #2	10	Richard	8	M	English	10.34	8	9	15	1
West/Park	11	Amara	8	F	English	7.51	7	9	13	0
	12	Ashley	8	F	Fr/Eng	7.47	6	9.5	17	4
	13	Sahana	7	F	Tamil	4.52	8	9.5	9	6
	14	Ribi	7.75	F	Eng/Span	4.01	3	10	8	6
	15	Shane	8.5	M	Korean	8.37	12	5.5	9	2
	16	Amanda P	8	F	Eng/Fr/Ita	5.07	3	10	7	5
School #3	17	Rachel G	8.5	F	Eng/Fr/Ita	11.15	5	9	10	4
Mich/Ange	18	Christophe	8	M	Eng/Fren	7.08	9	6	12	4
May 19&20	19	Carlo	8	M	Fr/Eng	5.53	3	5	7	0
	20	Masimo	8	M	Eng/Fr/Ita	4	2	9	13	6
	21	Amanda	7.5	F	Eng/Italia	2.36	0	10	25	3
	22	Jamie K	8	M	missing	9.4	2	4	6	1
	23	Vincent D	7.75	M	Italian	3.3	0	10	10	0
	24	Amanda L	8	F	Eng/Italia	4.03	3	8.5	7	8
	25	Krystina	8	F	English	6.51	9	9	15	5
	26	David B	8	M	French	3.2	3	6.5	7	7
	27	Alex B	8	M	Eng/Italia	5.05	3	9	14	8
	28	Jennifer B	7.5	F	Eng/Italia	3.25	4	9.5	15	missing
	29	Nadia T	3	F	Eng/Italia	7.55	1	8.5	9	1
	30	Francesca	7.5	F	English	6.45	8	8	17	12

						SUMMARY OF RAW DATA CONTROL GROUP (PRINT)						
		Subject No	Name	Age	Gender	Home Lan	Time on Task/Min	No of Gloss use	10 Text ExpQuest	Word Comp(26)	Free Recall 22 units	
	School #1	1	Anoush	7	M	Eng/Iran	6	7	10	12	10	
	Preville	2	Vipasa	8	F	English	3	0	4	2	2	
	April 15&21	3	Andrew	8	M	English	8	3	10	11	13	
		4	Buena	7	F	Eng/Iran	4	6	8	16	3	
		5	Jason	7.5	M	Eng/Greek	6	5	7	12	7	
		6	Randy	8	M	English	5	9	7.5	10	4	
		7	Stacy	8	F	English	4	1	10	11	1	
	School #2	8	Kimia	9	F	Persian	3.2	3	7	14	0	
	West/Park	9	Patrick	8	M	Eng/Fr	7.45	4	7.5	14	1	
	26-Apr	10	Victoria	8	F	English	2.59	2	9	21	0	
		11	Rebab	8	F	Urdu	5.15	4	9	6	3	
		12	Catherine	8	F	Chinese	4.21	4	6.5	7	2	
	School #3	13	David	8	M	English	2	0	9.5	13	14	
	Mich/Ange	14	Holly	7.5	F	Eng/Yugo	3.45	3	7.5	18	2	
	May 19&20	15	Jessie	9.5	M	English	7	1	9.5	19	12	
		16	David	9	M	Eng/Fr	9.43	6	9	15	7	
		17	Sabrina	8	F	missing	13	4	7.5	9	11	
		18	Erica	8	F	English	8.02	8	9	9	0	
		19	Alexander	9	M	missing	11.06	4	9	12	10	
		20	Cedric	8	M	Fren/Eng	3.37	2	2	7	2	
		21	Anita	7	F	missing	13	2	7	9	7	
		22	Joseph	8	M	Eng/Fr/Ita	3.35	4	8	12	6	
		23	Stephan	8	M	English	2.28	1	8.5	18	2	
		24	Bryan	8	M	English	4.08	1	9.5	16	13	
		25	Samantha	8	F	Eng?Fr	6.16	8	10	12	5	
		26	Kevin	7.5	M	Eng/Philip	2.37	1	7	18	3	
		27	Samantha	8	F	Eng/Fr	9.53	6	10	18	5	
		28	Marie-Olive	7.5	F	Eng/Fr/Ita	6.07	3	9.5	17	6	
		29	Jacklyn	8	F	Eng/Fr/Ita	2.45	2	10	17	3	
		30	Michelina	8	F	missing	5	3	10	16	missing	

APPENDIX V

FREE RECALL: Breakdown of Semantic Units

FREE RECALL SEGMENT - Semantic Units`

1. Prince and Cinderella meet at party.
2. Tells Cinderella he is pleased to see her there.
3. Cinderella **replied** and thanks him. Calls him **Sire.**
4. She mentions she was helped by Fairy Godmother.
5. Prince **puzzled** as he does not know what a Fairy Godmother is.
6. He never came across such big words in Grade 1.
7. Cinderella explains that she lives with **Stepmother** and two ugly **Stepsisters.**
8. **Explained** that they are mean to her/make her life miserable and **wretched.**
9. Fairy godmother intercedes and gets Cinderella to the ball
10. Prince asks quizzically if the Fairy Godmother brought Cinderella to the ball?
11. Cinderella's identity revealed.
12. Cinderella explains the she was sitting alone poking the fire.
13. Fairy Godmother appeared in a **great burst of light.**
14. Cinderella explains that she waved her magic wand over her **tattered** dress.
15. She changed it into a **breathtaking** gown of diamonds and pearls.
16. She **commanded** Cinderella to rush into the garden and find a pumpkin.
17. On returning, Cinderella **accidentally** steps on the wand and breaks it into two pieces.
18. Fairy Godmother **upset** but picks up pieces.
19. She passes the pieces over the pumpkin.
20. After a puff of smoke, a shine red bike **instantly** appears.
21. Godmother tells Cinderella that was the best she could do with a broken wand.
22. She sends Cinderella off to the ball (on bike).

GLOSSARY WORDS IN SECTION (highlighted in text)

Sire	**Replied**	**Puzzled**	**Stepmother**	**Stepsister**
Wretched	**Explained**	**Burst of light**	**Tattered**	**Instantly**
Breathtaking	**Commanded**	**Accidentally**	**Upset**	

APPENDIX V1

LETTERS OF REQUEST TO SCHOOLS
SAMPLE CONSENT FORM

Tamara Lynch
4687 Westmount Ave.,
Westmount, QC.
H3Y 1W9.

January 19th, 1999.

Karen Young,
Preville School,
139 d'Alsace,
St. Lambert,
Quebec,
J4S 1M8.

Dear Ms Young,

We spoke before Christmas about the possibility of my conducting some testing of a CD-ROM program at Preville School and it was agreed that I should outline in writing exactly I would like to do. Although I was the producer and one of the developers of the CD-ROM, the testing is actually part of my thesis requirements for a Masters degree in Educational Technology at Concordia.

The CD-ROM is called "HAS ANYBODY SEEN MY UMBRELLA?" and was developed at the National Film Board. The program is based on a Canadian children's story and is aimed at 5 - 9 year olds to enhance the acquisition of literacy skills. It contains an electronic storybook, word games, music activities, a movie of the original story and a writing activity. The disk works on either PC or MAC.

The portion of the CD-ROM that I actually want to use is the electronic storybook and I would like to conduct the testing with Grade 2 children. The purpose of which is to see if there is any significant difference in the vocabulary comprehension between children who have experienced the electronic storybook with an on-screen glossary and other aids to those children who have only read the print version with no additional help. Studies and the academic literature indicate that there is a benefit to the early reader when on-screen, easy access help, is available on a CD-ROM or computer program.

As mentioned, I would like to work with a Grade 2 class. You mentioned on the phone that there was the possibility of working with the Grade 2 children in two split classes which would be perfect as I would prefer to conduct the study with children who are not in French immersion. Students would be assigned to either the 'computer group' or the 'text group' on a random basis but split as evenly as possible between girls and boys. The testing would take place individually and take about 15 minutes per child. Each child would be asked to read a short portion of the story and then asked to explain the meaning of certain words in the story. The words would be selected from the story, some of which

will also be in the computer glossary. The children in the 'computer group' would also be asked some additional questions about how they liked the CD-ROM.

No personal questions other than their age would be asked of the students taking part in the study and all responses would be considered confidential. The study would take one day or could be conducted over two half days. When we spoke, I had mentioned doing this in late January but due to a heavy work load this month, I believe I will not be ready to do so until after Spring Break. However, I will wait to hear from you as to which time might be most convenient.

If you, or the principal need further information, I can be reached during the day at 283-9513 (at the NFB) or in the evening at 481-4138. As you mentioned parental consent is required, I have also included two different sample parental consent forms. Some schools prefer to send these out themselves, in which case you will have the basic information.

In terms of equipment, I could use a school computer if one is available in a quiet area or bring the disk already installed in a laptop.

Please also find enclosed a copy of the CD-ROM and a User Guide for you to review. This CD-ROM can be kept by the school.

I very much look forward to hearing from you.

Yours very truly,

Tamara Lynch.

Tamara Lynch
4687 Westmount Ave.,
Westmount, QC.
H3Y 1W9.

January 19th, 1999.

Mr. Paul Saunders,
Principal,
Westmount Park School,
15 Park Place,
Westmount, QC.,
H3Z 2K4.

Dear Mr. Saunders,

We spoke before Christmas about the possibility of my conducting some testing of a CD-ROM program at Westmount Park School early in 1999 and I promised to outline in writing exactly I would like to do. Although I was the producer of the program that I am hoping to research, testing is actually part of my thesis requirements for a Masters degree in Educational Technology at Concordia.

The CD-ROM is called "HAS ANYBODY SEEN MY UMBRELLA?" and was developed by the National Film Board. The program is based on a Canadian children's story and is aimed at 5 - 9 year olds to enhance the acquisition of literacy skills. It contains an electronic storybook, word games, music activities, a movie of the original story and a writing activity. The disk works on either PC (486 or better) and MAC (equivalent to PC specs)

The portion of the CD-ROM that I actually want to use is the electronic storybook and I would like to conduct the testing with Grade 2 children. The purpose of which is to see if there is any significant difference in the vocabulary comprehension between children who have experienced the electronic storybook with an on-screen glossary and other aids to those children who have only read the print version with no additional help. Studies and the academic literature indicate that there is a benefit to the early reader when on-screen, easy access help, is available on a CD-ROM or computer program.

As mentioned, I would like to work with a Grade 2 class in which I am assuming there would be 20 or more students. Students would be assigned to either the 'computer group' or the 'text group' on a random basis but split as evenly as possible between girls and boys. The testing would take place individually and take about 15 minutes per child. Each child would be asked to read a short portion of the story and then asked to explain the meaning of certain words in the story. The words would be selected from the story, some of which will also be in the computer glossary. The children in the 'computer group' would also be asked some additional questions about how they liked the CD-ROM.

No personal questions other than their age would be asked of the students taking part in the study and all responses would be considered confidential. The study would take one day or could be conducted over two half days. When we spoke, I had mentioned doing this in late January but due to my own work commitments it would probably be better to leave it until after Spring Break. However, I will wait to hear from you as to which time is the most convenient.

If you need further information, I can be reached during the day at 283-9513 (at the NFB) or in the evening at 481-4138. As I know that parental consent is required, would you like me to draw up a form to send home or is this something the school would normally do?

Please find enclosed a copy of the CD-ROM and a User Guide for you to look at. This can be kept by the school. I believe you mentioned on the phone that I would be able to use a school computer, however, I can bring a laptop if necessary.

I look forward to hearing from you in this regard.

Yours very truly,

Tamara Lynch.

Feb. 8th, 1999.

Mr. Don Reid,
Director of Pedagogical Services,
English Montreal School Board,
6000 Fielding,
Montreal, Quebec,
H3X 1T4.

Dear Mr. Reid,

The principal of Westmount Park School, Paul Saunders suggested that I write to you. This is in regards to my request to conduct some pedagogical research based on an educational CD-ROM program at Westmount Park School as part of the thesis requirements for a Master degree in Educational Technology from Concordia.

The CD-ROM is called 'Has Anybody Seen My Umbrella?' and was developed by the National Film Board. The program is based on a Canadian children's story and is aimed at 5-9 year olds to enhance the acquisition of literacy skills. The CD-ROM contains an electronic storybook, word games and other linked activities. The portion that I am using for my research is the electronic storybook which utilizes an on-screen glossary and other features to see if any significant benefits can be achieved through the easy use of these on-screen aids.

The research would involve a class of Grade 2 children during the course of one day or two half days. The testing would take place individually and take about 15 minutes per child.

I have outlined the research to Mr. Saunders in detail and he seems quite willing to propose this to his school committee as long as it has your approval. Maureen Baron, a former colleague and one of the early developers of the CD-ROM project is also aware of my research and does not object that I mention this in my letter to you.

Should you wish further information, I can be reached during the day at the 283-9513 (NFB). Both Mr. Saunders and Ms. Baron have copies of the disk if you wish to see it. I very much look forward to hearing from you in this regard.

Yours very truly,

Tamara Lynch

4687 Westmount Ave.,
Westmount, QC.
H3Y 1W9.

May 2nd, 1999.

Principal,
Michael Angelo School.

Dear Sir,

As part of my thesis requirements for a Masters degree in Educational Technology at Concordia, I am conducting some research with Grade 2 students regarding the acquisition of literacy skills. This involves a CD-ROM program which I also produced.

The CD-ROM is called "HAS ANYBODY SEEN MY UMBRELLA?" and was developed by the National Film Board. The program is based on a Canadian children's story and is aimed at 5 - 9 year olds to enhance the acquisition of literacy skills. It contains an electronic storybook, word games, music activities, a movie of the original story and a writing activity. The disk works on either PC (486 or better) and MAC (equivalent to PC specs)

The portion of the CD-ROM that I am actually testing is the electronic storybook. The purpose of which is to see if there is any significant difference in the vocabulary comprehension between children who have experienced the electronic storybook with an on-screen glossary and other aids to those children who have only read the print version with no additional help. Studies and the academic literature indicate that there is a benefit to the early reader when on-screen, easy access help, is available on a CD-ROM or computer program.

As mentioned, I would like to work with a Grade 2 class and I am looking for about 12 additional students. Those students participating in the research would be assigned to either the 'computer group' or the 'text group' on a random basis but split as evenly as possible between girls and boys. The testing would take place individually and take about 20 to 30 minutes per child. Each child would be asked to read a short portion of the story and then asked to explain the meaning of certain words in the story. The words would be selected from the story, some of which will also be in the computer glossary. The children in the 'computer group' would also be asked some additional questions about how they liked the CD-ROM.

No personal questions other than their age would be asked of the students taking part in the study and all responses would be considered confidential. The study would take one day or could be conducted over two half days and I would like to complete this research the end of May.

If you need further information, I can be reached during the day at 283-9513 (at the NFB) or in the evening at 481-4138. As I know that parental consent is required, I am enclosing a form that could be used. Some of the research has been completed at Westmount Park School, for which I received approval from Don Reid, Director of Pedagogical Services at the English Montreal School Board.

I look forward to hearing from you in this regard.

Yours very truly,

Tamara Lynch.

PARENTAL CONSENT FORM

Dear Parent/Guardian,

My name is Tamara Lynch and I am a graduate student in Educational Technology at Concordia University. As part of my thesis requirements I am conducting a small research study with about 50 Grade 2 students from schools in the Montreal area. The study involves a new Canadian CD-ROM that was developed to help children acquire literacy skills. The results of the study will help us to understand the benefits of using CD-ROM storybooks in education. It will also provide useful information for the development of future similar programs.

The study will be conducted by me and will take place in April during the school day. I will be working with each child for about 20 to 30 minutes. Some children will be asked to look at the story on the computer and others will see the same story in book form and will be asked some questions about the story.

The purpose of this form is to allow your child to participate in this study. No personal information is required by the researcher. All of the data gathered from the study will be analyzed by group only. If you have any questions about the study, please do not hesitate to call me at 481-4183

Thank you.

CONSENT FORM

I give permission for.....to take part in the CD-ROM research study.

I do not give my permission for.....to take part in the CD-ROM research study.

Signature: Parent/Guardian..... Date:.....