Willing is president of the Canadian Society of Children's Authors, Illustrators, and Performers. She is an educational consultant with Education In Progress in Toronto, Ontario, and she has field tested software programs for Interactive Image Technologies, an organization that designs educational software for the Grant Eligible Microcomputer System (GEMS) authorized by the Ontario Ministry of Education.

Computer simulations: Activating content reading

Kathlene R. Willing

■ The primary goal of reading instruction in content areas is to help students learn from text. This requires both an effective text and student motivation.

One way to achieve the two has grown out of computer culture: interactive fiction, which is altering the meaning of reader response. Combined with the study of history, interactive fiction has great potential for teaching students to learn actively from reading.

Simulations

To be effective, a text must maintain the content as its primary focus while actively engaging readers (Herber, 1978). Although it is often difficult to engage students actively in reading history, the subject has great potential, as will be shown here.

Another critical factor is motivation. When student motivation is high, reading achievement tends to be high as well (Briggs, 1986; Chall, 1983), and computers do motivate students. Especially stimulating are computer simulations like interactive fiction.

In the literature, computer simulations are seldom considered as reading programs (Layton, 1986), but

interactive fiction is altering the meaning of reader response. In it, setting is the environment in which readers move. Sorting out significant details is a matter of survival. Characterization becomes a series of encounters. Readers become actively involved in the reading process (Costanzo, 1986).

Instructional research suggests that social context is also important for the acquisition of meaning (Tama, 1986). Providing an appropriate environment such as discussion groups is a way to ensure that meaningful talk will take place. Included in that environment should be exciting content material to encourage students to talk and think about information and ideas.

Findings from a series of field tests for the Ontario Ministry of Education's Formative Evaluation Plan for Exemplary Software on a series of historical computer simulations support the concept that well designed computer simulations can provide students with historically correct content while actively engaging them as readers (Willing, 1987). Although not designed for reading, the programs provided a structured, exciting reading environment. The students' reading behaviours and comments, along with the teachers' and observers' comments, demonstrated such an environment's strengths in teaching reading in a content subject.

These field tests took place from January 1986 to February 1987. Four programs, The Bartlett Saga Series, covering Canadian history from the United Empire Loyalist period to the settling of the Plains, takes the Bartlett family and their descendants through history. Like interactive fiction, it requires students to read text and make decisions. The choices students make then branch to various outcomes which are realistic in the context of a historical event. This article reports on findings from the observations of over 200 students in 9 schools.

The Bartlett Saga software

The series was produced by an independent educational software developer, Interactive Image Technologies (IIT) of Toronto, in response to the Ontario Ministry of Education's call for exemplary educational materials for computers. IIT followed the Curriculum Guideline for the Intermediate Division in History.

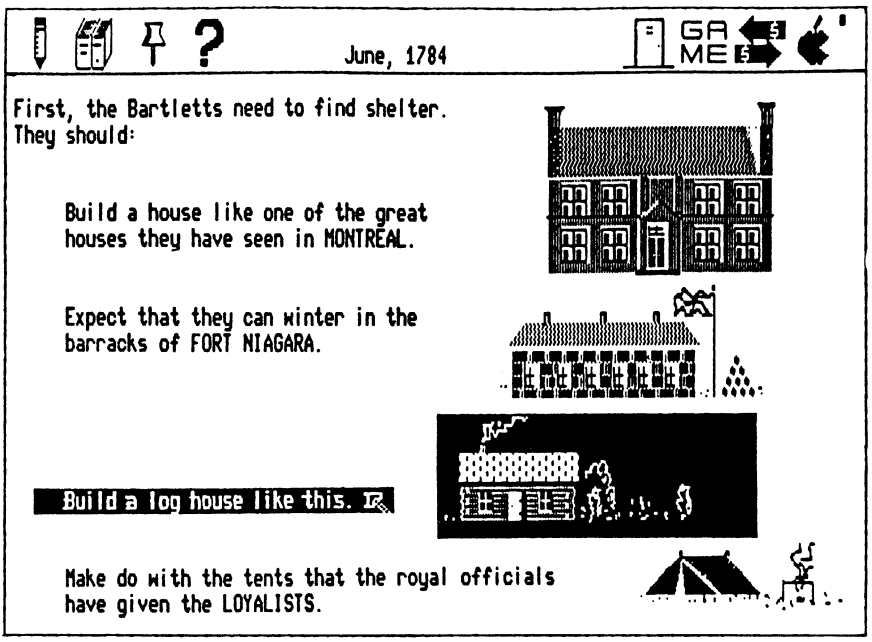
The Bartlett Saga Series has 4 parts to date: "Refugees in the Wilderness: United Empire Loyalists 1784-1793," "The Rebels: Rebellion in Upper Canada 1830-1844," "United We Stand: Confederation 1864-1873," and "The Golden West: Settling the Plains 1897-1911."

They recreate the experiences of several generations of the Bartlett family during events in Canadian history that are covered in the curriculum at the intermediate level (grades 7-9). Though designed for students of average ability and knowledge, they were used successfully by all—especially when students worked in groups.

The core of each simulation is a sequence of graphics and text based scenarios selected randomly by the computer. In 3 of the simulations, students play the roles of Bartlett family members as they face decisions in their everyday lives over 10 years in the context of the historical events. In the 4th, the student plays a reporter on a newspaper owned by a female Bartlett descendant and is sent on assignments interviewing historic figures. All simulations use a complete branching sequence determined by the students' choices and decisions.

Figure 1
Main simulation screen

Decision screen with ever-present top row icons



Reprinted with permission from Interactive Image Technologies, Toronto, 1986.

The design of the simulation encourages research skills by placing necessary tools at the touch of a finger, using the ever present "icons" at the top of the screen (Figure 1). To assist students with decision making required by the scenarios, a dictionary and an atlas can be easily accessed throughout the simulation. Students can read, discuss, and research information immediately when questions arise. An electronic notebook and bulletin board allow them to record and share observations with fellow students.

Depending on the program, 2 to 3 interactive educational games can also be accessed throughout the simulation, to provide added challenge, learning, and fun.

By helping the Bartletts, students experience life in early Canada and learn about events that helped create the country as they know it now. They interact with history, perceive the circumstances of people in the past, and make comparisons between the past and present. And to do all of this, they must read.

To be sure that the level of reading was appropriate, each program was rated on the Fry Readability Scale. Each one tested at the grade 7 level.

Tested in Toronto

The programs were taken to 9 schools in and around the metropolitan area of Toronto—7 in the public school system and 2 in the Separate school system. The schools were situated in diverse neighborhoods—4 in the city and 5 in the suburbs. In 3 schools, the computers were in the classroom; in 2, they were in a library/resource room; in 4 they were in labs.

Of the 222 students who used the program, 102 were female and 120 were male. The majority of those observed were 8th graders, but 18 were 7th graders and 19 were in 10th grade.

Reflecting the multicultural mosaic of Toronto, the students represented a wide variety of ethnic backgrounds. The majority (51%) were Southern European, 24% were Anglo Saxon, 9% Asian, 9% West Indian, and the remaining 7% were Middle Eastern, North American Indian, East European, European, East Indian, and South American. Their socioeconomic levels were as diverse as their cultural backgrounds.

Reading levels, ranging from grade 4 to grade 11, as well as their abilities, were similarly varied. Although the majority of the students were considered average, a number were learning disabled, gifted, or special education students. Many, but not all, had studied the particular historical period before using each of the programs.

Most of the students were familiar with computers and about a third reported having one at home. About half of the classes used them regularly in school; the others used them occasionally.

The 7 male and 2 female teachers were all experienced, with a range of 10 to 18 years in the classroom. Their exposure to computers was varied. Some had taken inservice workshops or minicourses and 2 were classroom computer specialists. Two had previously field tested software. Four were trained for elementary level and 4 had B.A.s (3 in history, 1 in Canadian studies).

One month before the observations, teachers were supplied with a package of materials including a diskette of the program, background content information, and instructions on preparing and organizing the class for field test observations. This gave the teachers time to preview the program and formulate its use with their class. They were asked to introduce the program to the students by having them go through its tutorial.

Seven of the 9 teachers were able to integrate the software into their unit of study—5 were teaching that period in history and 2 treated it as a special unit. Several were quite creative in their approach. such as integrating the software into the teaching of Canadian geography and multicultural studies.

During actual field observations, 2 people, including the evaluator, spent an hour a day for 3 days over a week's time observing and interviewing groups of students using the software. In addition, for the fourth field test, students were audiotaped.

Teachers were allowed to use the program with their classes when not being observed as well. All teachers were interviewed about a week after the last observation.

True reading

With formative evaluation, the development of educational software becomes much more meaningful. When the eventual users test the product, any revisions found necessary can be made at the most opportune time—before it

is officially released for use in the schools.

The following criteria give focus to the evaluation: the suitability of the lesson to the computer, its pedagogical effect, the adequacy of its instructional design, the suitability of its content, its technical reliability, its ease of use, its practical use in the classroom, and the adequacy of its documentation.

Although each of the criteria was examined for all of the programs, the pedagogical outcomes were significantly most exciting. The implications for educators seeking content oriented software that provides an exciting reading environment are far reaching. The students' enthusiasm while using "The Rebels" was such that one teacher, a junior high guidance counsellor, commented "This should be called a reading program."

Because students worked in groups of 2 to 6, the dynamics of the reading process became evident immediately. They exhibited typical reading behaviours. They were observed reading aloud, subvocally, and silently; their eyes scanned the text on screen, and they often mouthed the words as their fingers pointed to the appropriate text.

More importantly, they discussed what they read in order to make the decisions required by the program. The discussions provided insight into their thinking and gave evidence that the reading was meaningful to them. It also provided a natural forum for them to practice making predictions, paraphrasing text, building vocabulary and other important skills that constitute reading.

- **Comprehension and teamwork** Students became involved in the comprehension process. Taped dialogues revealed their delight as well as their use of higher level thinking skills. While working through "United We Stand," one of a group of 8th grade girls joined her previous experience to a newspaper article that plays a role in the program, an article reporting on the new novel Count Leo Tolstoi recently published called *War and Peace.* Midway through reading the text aloud, the student paused and added "Okay, the book is like *this thick.*" This recall of information was followed by a comment at a higher level when she completed the reading with "and his wife had to write it seven times." The girls laughed at these bits of trivia, and continued in a happy mood.

What were the origins of the second comment? Was it feminist rhetoric, encyclopedic information, or "Charlie Brown's Christmas?" It's difficult to say, but at that unique moment she made the connection and shared it with her friends.

Their involvement at a deeper, more emotional level also became apparent when least expected. During the testing of "Refugees in the Wilderness," a group of 4 girls and 2 boys outwardly appeared as if learning were not taking place. For a few scenes they managed to be cohesive, but on the whole they were noisy, argumentative, and at times physically abusive when one student occasionally made the choice without consulting the others. At one point they removed him from the keyboard position and forbade him to touch it.

Midway through the simulation, they ran out of food, animals, and money. A feedback screen informed the group that the Bartletts were forced to leave their home and go back to Montreal and the simulation ended—the students had failed. Staring at the screen and reading the tragic news in disbelief, their stunned silence said it all.

They were devastated. They had "killed off" the Bartletts.

In spite of their behaviour, these young people cared and it was important to them. Sensing the importance of the moment, the teacher met with them in a debriefing session to discuss their feelings and how better to work together for a common goal. He also assured them they had a second chance.

They returned subdued, but with a united purpose—the second time they were successful. As the teacher said later, "To them it was not a game; they took it seriously." It is not too often that teachers get a chance to witness students "getting into the skins of the people" in history.

Reading has that power, and harnessed to a well designed simulation it supplied the motivation to learn more, as the 10th grade teacher discovered when she used "Refugees" with her multicultural studies class—even though they had covered the topic previously, she was amazed at their renewed interest.

> They can read all they like about the difficult times and the threat of starvation. Just as they took in the information about the 13 colonies, the Loyalists, why they left, etc., but they weren't internalizing it at all—"Yes, ma'm, no ma'm, what's going to be on the test, ma'm?" That lack of internalization became evident when they *really* became interested in finding out about the Loyalists after having used the simulation.

The class members began asking her questions about material they had covered before, but this time it was different. They desired knowledge. Their questions generated the follow up activity—to create a Loyalist family. They began bugging her for maps and more resource materials so their families would be well equipped to succeed. She was delighted to supply them with further reading materials knowing that this time they would be read and understood.

- **Vocabulary gains** The design of the simulations helped students build vocabulary. Through a top row "dictionary" icon (Figure 1), students can access a database of terms whenever needed, and then search for an alphabetically listed word. Even better, they can point to words on the screen that appear in capital letters (Figure 2) and go directly to the definition (Figure 3). Then they can return to the screen they were on by pointing to the "Return" icon in the top row. This "hassle free" design encouraged research.

A number of graphic screens also have this easy access feature. Students can point to a picture, press the question mark key, and get immediate information.

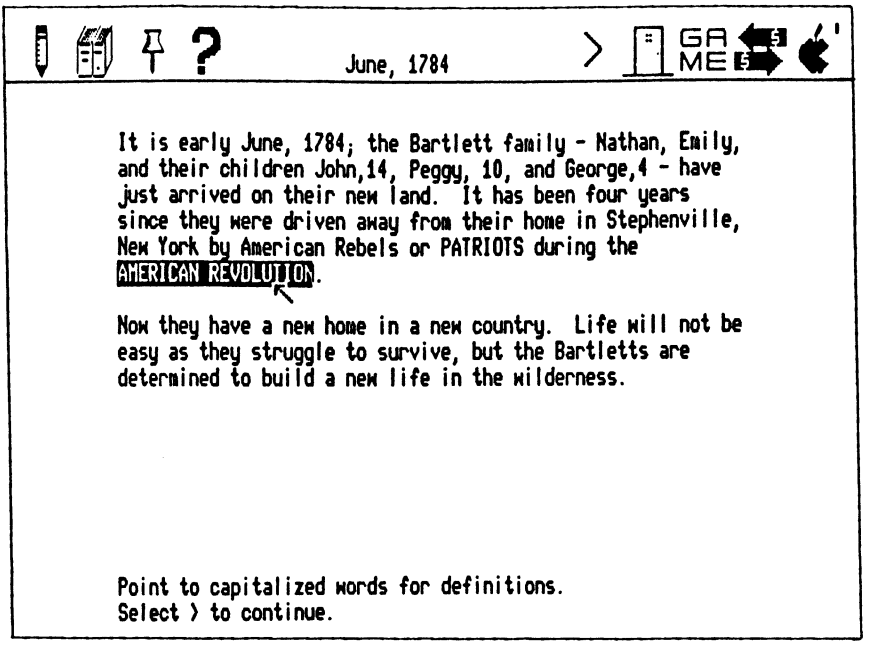
Students were observed using these features. During the field test of "The Golden West," observers kept track of 18 groups of students at 3 schools. Students accessed the dictionary 31 times and screen information 57. One group of boys, who accessed the dictionary 5 times and the screen information 13, were heard to say, "Let's see what it says about chainsaws." Based on what they read about chainsaws, they chose *plough* and *harrow* as their decision. When they read information on *tar paper shack,* one boy said "Too cold—let's go for *log cabin.*"

One boy in this same group never forgot that their simulation crops were destroyed by grasshoppers. When they planted their crops the following year, he was heard plaintively praying "Please, no flying insects."

- **Prediction and paraphrase** The scenarios in the simulations led to numerous predictions about what

Figure 2
Interactive database

Pointing to a capitalized word within the main simulation text...[go to Figure 3]



Reprinted with permission from Interactive Image Technologies, Toronto, 1986.

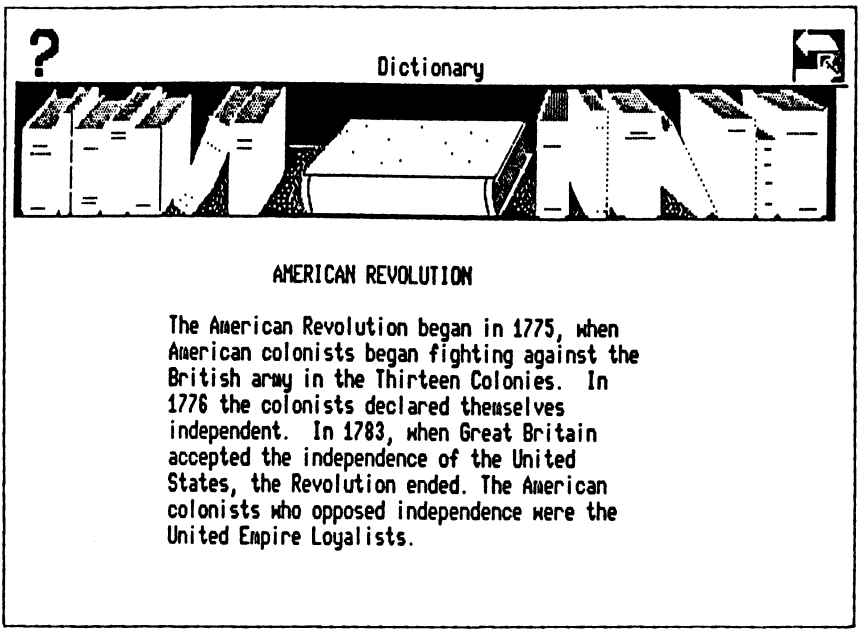
would happen if they made certain choices, often debated heatedly. The more the students argued the pros and cons of their predictions, the deeper they delved into the content. They supported their views, recalled specific details, and then considered nuances of meaning. Their need to reason enhanced their understanding. Other times they would voice their predictions for others to hear when they knew the outcome would be wrong. Observers lost track of how many times they heard "I told you so!"

In their predictions, students often touched upon the affective domain. Two boys working on "United We Stand" came to the scenario in which they had to make a choice on budgeting. The family was in reduced circumstances because the father suffered an accident at Chaudière Falls. The students were given some hard choices—cut back on food, continue to spend as much on food but don't buy anything else, etc. In trying to reason out what to do, one boy pointed to the screen saying "Maybe this one, because they're having everything [clothes and food]? But this one [points to the other alternative] they're skipping clothes. [He pauses and considers the consequences.] They'd freeze to death!"

Students were also observed paraphrasing text to get the ideas across and even asking clarifying questions when there was confusion. A group of girls were working on a scenario in

Figure 3
Interactive database

...branches student to a definition in the database. Student can return to same screen in simulation from which definition was called by pointing to "Return" icon in top row at far right.



Reprinted with permission from Interactive Image Technologies, Toronto, 1986.

"United We Stand" that required them to select a topic sentence for the newspaper article they had just read on the Rideau Canal. They weren't sure of the task and seemed to be searching. They looked up the definition of *Rideau Canal* and read the alternatives. One girl asked to see the definition of Canada West. They read that. Finally one of them asked "What do we do?"

This question focussed on the problem and clarified the quandary. The first girl paraphrased the text and replied "I think the question is, What should the first sentence be? The main business of the Rideau Canal is...? I wouldn't say *gunboats*."

- **Electronic notepads** While using "The Golden West," students used another feature common to these simulations—the electronic notepad. This allows them to keep notes while working on the program and then get a printout. Like the Dictionary, it can be easily accessed from the top of the screen by an icon anytime during the simulation.

The teacher had given students an assignment requiring them to use the notepad. A group of two boys and a girl worked diligently on the assignment, discussing their findings as they dictated to the person typing. They then obtained a printout for the teacher.

Here we are at Computer Lab, and we are enjoying ourselves. We have learned many things: 1. You make more money on wheat. 2. Weevils and grasshoppers are the main cause of crop loss than any other cause. 3. They lived in sod huts and were called sodders. 4. There were very, very few schools in the 1800s in the prairies. 5. Living in the prairies can be very lonely, for your neighbours can be miles and miles away.

- **Supportive behaviour** Students' supportive behaviour while reading aloud was also encouraging. Because they worked in small groups, they did not appear inhibited about their mistakes. Many would self correct, or if not, others would correct them gently. Teachers commented that even the less able readers felt at ease about reading.

Students often democratically took turns. Sometimes one student would do all the reading. At times they would all read bits of it in chorus. And other times they would all read silently. Whatever fit the group at the time, they found it naturally.

A meaningful environment

Finding content materials for students to read that actively involve them in the comprehension process is difficult. Computer reading programs often focus on isolated skills or ask questions which amount to thinly disguised tests rather than true exchanges of ideas (Geoffrion and Geoffrion, 1983).

Interactive fiction has given educators a glimpse into what is possible in the realm of reading materials that hook readers and engage them in the comprehension process.

Instructional research suggests that the social context is an important influence in students' acquisition of knowledge. But meaningful talk only emerges from an appropriate environment.

In these observations, the computer simulations were seen as that environment. It encouraged students to discuss the ideas they were reading. As students considered the various possibilities, they were required to think more deeply than if they were asked the usual comprehension questions. They thought through problem situations in the context of history, generated meaningful questions of their own, and made the metacognitive leaps necessary to understanding.

In his first principle related to the development of independence in learning, Herber (1987) suggests that independent readers establish purposes for reading, make meaningful connections and judgments, infer meaning, apply new ideas to new situations, and derive pleasure from their efforts. Teachers who are serious about reading instruction search out and provide opportunities for students to practice all this in well structured situations.

Teachers wishing to see students become independent readers and learners can put the power of computers to work for them. Computer simulations that maintain the content and yet engage readers are a reality, and although these particular programs were designed for Canadian students, other well designed simulations can work just as well. When students say "I liked it because I didn't have to read" but were seen and heard actively reading, it is a good sign.

References

Briggs, L.D. "Motivation: A Problem Area in Reading." *Reading Improvement,* vol. 23 (Spring 1986), pp. 2-6.

Chall, Jeanne S. *Learning to Read: The Great Debate.* New York, NY: McGraw-Hill, 1983.

Costanzo, William V. "Reading Interactive Fiction: Implications of a New Literary Genre." *Educational Technology,* vol. 26 (June 1986), pp. 31-35.

Geoffrion, Leo D., and Olga P. Geoffrion. *Computers and Reading Instruction.* Don Mills, ON: Addison-Wesley, 1983.

Herber, Harold L. *Teaching Reading in Content Areas*, 2nd ed. Englewood Cliffs, NJ: Prentice Hall, 1978.
Herber, Harold L. "Developing Independent Learners." *Journal of Reading*, vol. 30 (April 1987), pp. 584-88.
Layton, Kent. "Interactive Text Adventures." *Journal of Reading*, vol. 30 (December 1986), pp. 378-79.
Tama, M. Carrol. "How Are Students Responding in Discussion Groups?" *The Social Studies*, vol. 77 (May/June 1986), pp. 132-35.
Willing, Kathlene R. "A Formative Evaluation Plan of the Bartlett Saga, Part III, United We Stand: Confederation 1864-1873." Field Test Report presented to Ontario Ministry of Education and Interactive Image Technologies, Toronto, ON, February 1987.

§

Syntactic paraphrases

One question which has concerned psycholinguists for many years is why there exist in English (and in other languages) several alternative syntactic options (or paraphrases) for expressing essentially the same information. For example, the following three sentences all express the same basic meaning:

(a) The dog chased the tabby cat
(b) The tabby cat was chased by the dog
(c) The cat the dog chased was a tabby

It was an implicit assumption of much of the early research carried out in psycholinguistics in the 1960s...that certain syntactic forms were exactly equivalent in meaning [and that] passive sentences were constructed by the application of a *passive transformation* rule to an active, and negative sentences by application of a *negative transformation* rule to an affirmative....

However subsequent research has shown that both negatives and passives are used in response to the presence of particular pragmatic factors. In the case of negatives, these factors are different from those associated with use of affirmatives, and in the case of passives these factors are different from those associated with the use of actives.

...Wason (1965) and Greene (1970a; b)...showed that the natural function of a negative is to signal denial or contradiction of a prior assertion....

Turner and Rommetveit (1967) and Tannenbaum and Williams (1968) [showed] that when a subject's attention was on the *actor* a situation would be described using an *active,* whereas when attention was on the *acted-upon* (the recipient of action), greater use would be made of the passive.

...Prentice, Barrett and Semmel (1966), Harris (1977; 1978) and Dewart (1979) have shown that the passive is likely to be used when the acted-upon is more animate than the actor. For example, a collision between a pedestrian and a car is very likely to be described by a speaker as a *boy being run over by a car,* rather than as a *car knocking a boy down*....

Animacy is, however, only one of the factors which influences selection of a passive form to describe a particular situation. In most situations...another important factor affecting use of the passive is whether actor or acted-upon is the **theme** of a discourse (i.e. what the discourse is about). When an acted-upon, rather than an actor, is thematic, use of the passive increases....

[T]here is considerable evidence that it is normal in English to put more animate nouns and thematic information in sentence-initial position.

Margaret Harris and Max Coltheart, *Language Processing in Children and Adults: An Introduction,* London and Boston: Routledge & Kegan Paul Plc, 1986, pp. 223-27. Reprinted by permission of the publisher.