WRITING TO READ: AN EVALUATION OF A CANADIAN INSTALLATION OF A COMPUTER-SUPPORTED INITIAL LANGUAGE ENVIRONMENT*

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ABSTRACT

Writing to Read (WTR) is an approach to initial language arts instruction which involves a multisensory learning environment including computers. The first Canadian installation of WTR began in two British Columbia school districts in 1985. This article focuses primarily on one of those districts and describes an evaluation of the WTR experience from the time of its planning (1984) until the conclusion of its second year of full operation (1987). The evaluation shows the WTR experience to have a positive impact on some aspects of writing achievement. However, the evaluation also suggests the value of closer scrutiny of the WTR system from more than the criteria of achievement scores.

There is no doubt that initial language instruction is a key component of basic education. Vigorous research activity takes place in the language education community over issues involving how to increase the effectiveness of this instruction. Some issues are theoretical: Should instruction be based on a "whole language" or on a "discrete skills" perspective [1]? What is the relationship between the acquisition of reading and writing skills [2]? Other issues relate more to strategies of instruction: How are individual differences among children accommodated in

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the classroom organization of language instruction? How can modern technology be used with young children to improve the effectiveness of initial language instruction [3]? The early language experience program, *Writing to Read* (WTR), relates to all of these issues.

WTR

WTR has been of considerable public interest since IBM began sponsorship of the program in the early 1980s. WTR was developed by an educator named John Henry Martin who, over a number of years, refined and tested it as an approach to initial language instruction. This approach is based on various assumptions: 1) that writing development is the key component of language development; 2) that a phonemic approach to language will allow young children to write whatever they can say even before they begin to read, 3) that these phonemic tools can be acquired through the child learning to recognize and write forty-two letter-sound combinations, and 4) that children benefit from a multisensory learning environment [4]. There is another assumption in WTR which is not explicitly stated but which is implicit in the system. This is that at least some aspects of initial language instruction should be experienced in a highly structured and routinized way.

IBM became involved with the program, first through the donation of selectric typewriters and later through the integration of IBM PCjr portable computers into the WTR system. Eventually IBM and Martin have become collaborators in the design, development, and marketing of the complete WTR system. WTR is organized around a "station" approach which reflects the multisensory assumption of the system. There has been some evolution in the system. However, at the time of the first Canadian installation the stations included:

1. A computer station where children work in pairs and interact with a highly structured drill program. Each program is the same in design: a new word is introduced, in phonemic spelling rather than "book" spelling. Children listen to the word and its phonemes through earphones attached to computers. (The software makes use of speech synthesizers in the computers.) The children type what they are asked to enter, either phonemes in isolation or the entire targeted word. They are also instructed, via their earphones, to clap or stamp rhythmic patterns in the words and to spell the words aloud. Each computer drill requires between twelve to fifteen minutes.
2. A typewriter station where children work independently at IBM selectric typewriters. They use the typewriters to enter their "stories." Creativity and expression are the focuses of this station.
3. A "work journal" station where children again use earphones to listen to instructions. However, at this station the earphones are attached to cassette tape recorders. The instructions reinforce the learning of the computer-introduced phonemes by having the children print the letter representations of the phonemes in traditional style workbooks.

4. A "listening station" which again employs earphones and cassette tape recorders. At this station, children select a tape from a collection, each member of which features a narrative reading of a book available at the station. The children listen and follow along in the book as its text is read to them.
5. A "writing station" where children use pencil and paper for creative writing activities, writing whatever they can say by using phonemic spelling.
6. A "word games" station where children and their teacher "play" with words and letters using various manipulatives.

According to the WTR Teacher's manual, children's movement through these stations is highly organized and structured. For example, after every twelve or fifteen minutes everyone changes stations in a prespecified order.

THE BRITISH COLUMBIA INSTALLATION OF WTR

Through a collaborative project involving IBM Canada, the University of Victoria, and the Ministry of Education in British Columbia, Canada, two complete WTR systems were donated for a first Canadian installation of WTR. Two schools—one in each of two British Columbia school districts and each with two first-grade classes and teachers—were chosen for the installation. Although the number of children in the four classrooms varied over the time period of the study, the year chosen for data analysis for writing and reading achievement (1985/1986) involved fifty-one children at one school and twenty-nine at the second school. Each of the classes included children of different abilities, as described by the previous year's kindergarten teachers. In one of the schools, children were rank-ordered on perceived ability by the kindergarten teacher and alternately assigned to the two Grade 1 classes. In the other school, although rank ordering was not done, there was no apparent ability difference in the two classes. The socio-economic status of the schools could be described as lower-middle class situated in areas characterized by higher unemployment (18%) compared to the Canadian national average. Most children were Caucasian (80%) with the remainder being Chinese, Vietnamese, East Indian, or native Indian. The classes were evenly divided by gender, and student ages ranged from five years ten months to seven years five months (mean age, 6.4 years). The school selection process was informal and based on the strong interest expressed by the leaders of those schools to be involved in the "Canadian pilot testing" of the system. (Although this is not a desirable sampling procedure from an experimental perspective, it is a realistic reflection of the way that long-term collaborative arrangements evolve in the field.)

Materials supplied to the schools included, in total, eight IBM PCjr computer systems with color monitors and speech synthesizers; twelve IBM selectric typewriters; two complete sets of WTR material (including software, teachers' manuals, students' work journals, "make words" games, sets of "listening library

tapes", and various miscellaneous items, such as wall charts); twelve cassette tape recorders; and thirty-six pairs of earphones. The schools also were provided with various teacher training sessions organized by IBM and involving personnel brought in from U.S. installations of WTR. Researchers from the University of Victoria were involved in the installation from its planning in 1984 to its follow-up assessment in 1988. Each of the two schools committed itself to supplying a room outfitted for the WTR systems.

EVALUATION FOCUSES

The British Columbia WTR team were familiar with the ETS Evaluation Study [5] of WTR which had just been completed in the United States as the planning for the Canadian installation began. It was decided to design the evaluation of the British Columbia experience partly as a replication of the ETS study, but also to expand the focus of the evaluation in a variety of ways. Thus the evaluation questions chosen for the British Columbia study were:

1. Will the WTR system function as intended in a Canadian classroom? What are implementation issues?
2. Does WTR appear to be associated with larger gains in Grade 1 children's reading and writing achievement than would be predicted based on past experience with traditional instruction?
3. What are other overall issues and results associated with WTR?
4. What are critical characteristics of the individual components of WTR?
5. What do we suggest in terms of further use of the WTR system?

RESULTS AND DISCUSSION

Question 1: Implementation in Canada

The British Columbia installation of WTR did not proceed fully as intended. There were a number of situations that influenced the implementation of WTR. These can be discussed under resources and personnel.

Resources — The project was delayed many months due to the unavailability of the speech synthesizer cards in Canada and difficulties in acquiring them from the United States. This meant that much of the impact of an initial teacher training experience faded with the passage of time. Another delay occurred because the books which were to accompany the tapes at the listening station were not included as part of the WTR materials. Most of the books were not available in local libraries and no procedure could be identified for getting the books as a set and conveniently. Finally, a local solution was achieved—the teachers chose books appropriate for their classes and made their own cassette tapes of themselves reading the books. It was unclear whose responsibility it was to spend time trying to locate and purchase the books—the teacher? the researchers? IBM?

This was the first of a number of examples of implementation problems that occurred when responsibility for an issue was not clear. Another such issue was responsibility for ribbons for the typewriters. Perhaps the major example, however, was the issue of teachers' aides.

Personnel — The WTR system very clearly specifies the need for a teacher's aide in each WTR classroom. With so many different types of equipment in use by very young children at the same time, an aide is necessary (especially, we found, with respect to the tape recorders). In the original WTR project in the United States, around which the ETS evaluation was based, funding for aides had apparently been part of the project. In the British Columbia installation it was not part of the donation. The schools had no available funds to pay for aides so the strategy was chosen of enlisting parent volunteers who would sign up to help the teachers on a week-by-week basis. The schools initially felt this was an excellent opportunity to involve more parents in the life of the school. It involved many difficulties, however. Parents needed training or at least some orientation—whose responsibility was it to deliver it? Also, because it was a volunteer system, new parents were continually needed. The teachers found themselves having to pay a disproportionate amount of attention to new and sometimes awkward parent volunteers. For example, the phonemic basis of WTR requires children to write as they hear, with a corresponding spelling which is often not the same as "book" spelling. Frequently, parents would not be sensitive to this and would correct children's spelling, which proved confusing to the children. It was difficult for the teachers to monitor the interactions between parent volunteers and children. The inability of resources to pay for a trained aide remained a serious implementation issue in the project.

Finally, the installation suffered a major personnel problem at one of the two schools. The two Grade 1 teachers at this school—who had been enthusiastic participants in the planning of the project in 1984-85 school year and recipients of the teacher training in the first part of 1985—did not return to the school for the 1985-1986 school year, the year when the project was to be finally running smoothly and when data gathering for the achievement aspects of this evaluation study was planned. One teacher was pregnant, the other shifted elsewhere in the district because a teacher with seniority who had been on an extended leave of absence decided to return to the school. The two new teachers at the school were not only untrained in WTR but unenthusiastic about WTR or about altering their teaching procedures. The principal promised to personally provide inservice (the formal sessions organized by IBM could not be repeated) and the project continued, but the consequence was that the system was only used as a resource or supplement to traditional instruction at that school. Thus data from those children were not included in the achievement evaluation (also because the new teachers were not comfortable with the pretesting schedule and therefore did not adhere to it).

The last point is a critical one. The WTR system is highly organized. Its teacher materials and teacher training sessions are built on the assumption that teachers will follow the prescribed plans. The British Columbia teachers all had many years of experience teaching Grade 1. They were professionals, used to their autonomy in the classroom. To tell them that they had to follow a preset routine, where some kind of sound goes off every fifteen minutes to signal the children to move from one station to the next, was not compatible with their view of their classrooms or of themselves as professionals. The teachers in one of the schools responded by quietly making some modifications in the WTR procedure to better suit their own perceptions of the children's needs. The teachers in the second school were more resistant, saying "give us the materials, let us see what we can do with them, but don't tell us how to teach." The educators IBM brought in to deliver teacher training emphasized the intended routines of the system in a way that reinforced the impression that using WTR required giving up one's professional independence to "the system" and the computers. This is not an approach likely to be successful with many experienced teachers; something we learned with attempts to deliver programmed learning in the 1960s. It is an important point for computer-based learning in general, not just WTR—how much is the teacher able to control and adapt the materials to his or her own teaching style and assessment of students' needs? Pieces of the WTR system could be used in this more flexible way, but is it still WTR?

So, in summary, implementation was more difficult than expected. Issues relating to costs, procedures, and personal relationships made a critical impact on the implementation procedure.

Question 2: Impact on Achievement

Comparison group — Because of the obvious Hawthorne effect as well as many other educational difficulties involved in comparing the small, non-randomly selected sample of intact WTR classes with other classes in order to make a comment on the impact of the WTR experience on achievement, an innovative approach to comparison was used. The two classes at the school that adhered reasonably closely to the WTR methodology (and which did not experience a change in teachers) were able to be compared to their "expected" levels of writing and reading achievement through a fortunate circumstance. The two teachers involved had been active professionally for many years, attending various inservice courses and workshops during those years, had been teaching at the same school for thirteen years using an approach which emphasized early writing, and had been collecting standardized predictive data on their first grade students in September of each school year since 1979. They had also collected achievement data on reading and writing performance at the completion of Grade 1 for each of these school years [6]. These data allowed us to compare student achievement with the WTR program with achievement in the same school, with

the same teachers, before the WTR program. Based on interviews with the teachers and the school administration, there was no evidence to suggest that any pertinent demographic characteristics of the school or student body had changed over the time that data had been collected on Grade 1 children in the school, and so we had reasonable confidence that the major change in the school environment for these two Grade 1 classes compared to other years was the WTR program. Thus students in the 1983/84 year (prior to WTR) were used as the comparison group for children in the 1985/86 (the first year of full implementation of WTR). We recognize that there may be time-related changes in these two cohorts of children. Therefore we compared various sets of test scores to support the equivalence of the children relative to their potential for reading and writing achievement.

Measures — The measures used for the comparisons are:

1. *Reading Readiness*. The predictors of readiness for Grade 1 instruction were the variables included in the *Canadian Readiness Test* (CRT). This test was developed in 1973 [7] and has been extensively validated as an effective predictor of Grade 1 language achievement [8]. The CRT consists of six scales: 1) Technical Language of Literacy, 2) Word Matching, 3) Beginning Sounds, 4) Semantics, 5) Letter Recognition, and 6) Noun Learning Rate. The CRT was administered during the second week of September, 1983, to the two comparison classes and during the second week of September, 1985, to the two classes at the same school who subsequently took part in the first full-year implementation of WTR. The tests were administered by the classroom teachers and testing periods varied in length from thirty to forty-five minutes. Kuder-Richardson reliability coefficients ranged from .78 to .95 for the six subscales. In a pilot study, it was established that the CRT serves as an effective predictor of the reading and writing achievement variables used in the WTR evaluation for Grade 1 children [9].
2. *Reading Achievement*. Reading achievement was measured at the end of Grade 1 with the Primary Level I Battery of the Stanford Achievement Test. A Total Reading score and a Word Study Skills score were obtained for each child. These achievement tests have been comprehensively validated over more than ten years of use in North America. Kuder-Richardson reliability coefficients are high, .93 and .95. Word Study Skills involves identifying a word which is given orally within a set of three printed words. Total Reading includes choosing an appropriate word to go with a given picture and choosing a correct word to insert in an unfinished sentence.
3. *Writing Achievement*. Writing achievement was measured with both syntactic and holistic approaches. Previous research identified six syntactic measures as being appropriate and effective measures of Grade 1 writing achievement [9]. These syntactical measures include Number of words used in a story, Number of syllables, Number of *t*-units (*t*-units are

"communication" units, a group of words including at least a noun and a verb which cannot be subdivided without loss of their essential meaning), Number of "ands" in a story, Number of other connectives, and Number of adjectives. Communication units and connectives are measures of the complexity of written expression.

Holistic scores on writing samples were determined by three experienced teachers, serving as raters, who independently scored a composition from each child. Raters were given samples of early writing that illustrated each of the seven categories established for the IBM-sponsored evaluation of children's writing in the evaluation study of WTR conducted in the United States [5].

In order to obtain a composition from each child for these analyses, the following story-procedure was followed in May of 1984 and again in May of 1986.

The teacher read this instruction to the class, "Pretend you are walking in the forest and found a large grey rock with the words "wishing stone" printed on it. You touched the stone, closed your eyes, and made one wish. Immediately your wish came true. Write a story about your wish. What did you wish? What happened to you? Don't worry about spelling. Just write the best story you can." The children were given twenty-five minutes for writing the story.

Interrater agreement for holistic scoring was good, $\alpha = .88$. Syntactic scoring was done by the teachers working independently, comparing and rechecking any differences until agreement was reached.

Results — Means and standard deviations of the forty-four children in the 1983/1984 group and the fifty-three children in the 1985/1986 group on the seven subscales of the *Canadian Readiness Test* are given in Table 1. It can be seen that means and standard deviations on the subscales are similar for the two groups with the exception of the standard deviations for the Semantics subscale and the mean values for the Noun Learning Rate subscale. All other comparisons show no significant difference, ($p < .05$), between the two groups. These data support the essential equivalence of the 1983/1984 group and the 1985/1986 group with regard to readiness for language instruction and in prediction of subsequent achievement in Grade 1 language. Similar nonsignificant differences were found when comparing the 1983/1984 group to all other classes beginning at 1979 (data available on request). This supports the selection of the comparison group as a representative class for comparison to the WTR classes in that the school, teacher, neighborhood, and reading and writing readiness of the children are reasonably controlled. We feel the control of the school and teacher variables in this case are much more important than is the two year time difference.

Table 2 shows the means and standard deviations of the two groups on writing achievement variables administered at the end of Grade 1. It can be seen that the WTR group showed a significant positive difference in syntactical measures of writing achievement compared to the Non-WTR group but not in holistic measures. The two groups were not significantly different in terms of reading

Table 1. Comparison of 1983/1984 and 1985/86 Groups on Readiness Variables, Beginning of Grade 1

<i>Subscale</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>t Value of Differences between Means (df = 95)</i>	<i>p</i>
Technical Language				
1983/84 ^a	12.80	2.96	0.55	0.58
1985/86 ^b	12.43	3.52		
Word Matching				
1983/84	15.30	3.28	0.19	0.848
1985/86	15.15	4.14		
Beginning Sounds				
1983/84	17.05	3.48	1.78	0.078
1985/86	15.70	3.96		
Semantics				
1983/84	27.09	6.24	1.02	0.309
1985/86	25.47	9.26		
Letter Recognition				
1983/84	18.00	3.85	0.41	0.681
1985/86	17.70	3.23		
Noun Learning Rate				
1983/84	13.80	3.68	2.32	0.023
1985/86	15.74	4.65		

^a N = 44, Non-WTR comparison group

^b N = 53, WTR group

achievement. In some aspects these results replicated those found for first grade students in the IBM-sponsored evaluation of WTR done in the United States. WTR appears to be associated with an improvement some aspects of writing for Grade 1 children but does not appear to be associated with any "significant" improvement in reading compared to "traditional" classrooms. However, unlike the ETS study, significant differences were not found in the holistic scores of writing achievement. The ETS study did not include syntactical measures so comparisons cannot be made about this aspect of writing performance.

Question 3: What are Other Overall Issues and Results Associated with WTR?

Some overall comments relative to implementation of WTR, such as the unforeseen difficulty with classroom aides, have already been discussed in the context of Question 1. Two other general issues were systematically studied during the WTR evaluation: WTR's relationship with students' gender-related

Table 2. Reading and Writing Achievement Reading and Writing Achievement of Non-WTR (1983/1984) and WTR (1985/86) Students at the Same School with the Same Teachers

<i>Variable</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>t(80)</i>	<i>p</i>
<i>Reading Scores</i>				
Total Reading				
Non-WTR ^a	2.73	1.09	1.79	0.08
WTR ^b	3.18	1.76		
Word Study Skills				
Non-WTR	3.76	1.51	0.03	0.98
WTR	3.77	1.44		
<i>Writing Scores</i>				
Holistic Writing Score				
Non-WTR	3.56	0.76	0.21	0.837
WTR	3.60	1.06		
Syntactic Writing Scores				
Number of Words				
Non-WTR	72.44	30.24	2.89	0.005
WTR	100.56	50.24		
Number of Syllables				
Non-WTR	83.24	32.97	2.38	0.020
WTR	108.04	53.44		
Number of <i>t</i> -units				
Non-WTR	9.24	3.46	2.12	0.037
WTR	11.76	6.23		
Number of "Ands"				
Non-WTR	4.97	3.68	3.21	0.002
WTR	8.89	6.34		
Number of Other Connectives				
Non-WTR	0.56	0.66	1.53	0.129
WTR	1.09	1.93		
Number of Adjectives				
Non-WTR	0.92	0.90	2.27	0.026
WTR	1.78	2.08		

^a *N* = 38, 1983/1984 comparison group

^b *N* = 43, 1985/1986, WTR group

attitudes about computer use, and WTR's relationship to current trends in initial language arts instruction.

Gender and computer use — To investigate students' gender-related attitudes about computer use, we decided to focus upon the aspect of attitude that relates to the children's sense of the gender appropriateness of a concept or area of study for themselves. It is well established that sex-typed labeling of school subjects is

Table 3. Gender-Typing of Grade 1 in Different Language Arts Programs

<i>Subject</i>	<i>Language Arts Program</i>							
	<i>WTR Computer-Intensive (N = 51)</i>				<i>Traditional (N = 40)</i>			
	<i>Pretest</i>		<i>Posttest</i>		<i>Pretest</i>		<i>Posttest</i>	
Reading								
Males	2.25**	(1.21)	2.14	(.98)	2.10	(1.12)	2.00	(1.26)
Females	1.61**	(1.08)	1.87	(1.09)	1.95	(1.10)	1.85	(.81)
Writing								
Males	2.29*	(1.01)	2.27	(1.06)	2.30	(1.03)	2.30	(.98)
Females	1.95	(1.06)	1.96	(1.07)	2.35	(1.18)	1.90	(.64)
Computer-Use								
Males	2.37**	(.98)	2.57**	(.94)	2.60**	(.88)	2.55*	(1.05)
Females	2.09	(1.01)	2.02	(1.03)	1.70	(1.08)	2.20	(1.20)

Note: Scores are means with standard deviations in parentheses. Neutral = 2; More for boys, > 2; More for girls, < 2.

* Indicates response significantly different than neutral, $p < .05$.

** Indicates response significantly different than neutral, $p < .01$.

related to students' attitude and achievement in those subjects [10, 11]. Many educators are concerned about the tendency of older students to see reading as a "feminine" subject [12] and computer use as a "masculine" activity [13]. The *Writing to Read* program would seem to have considerable potential for the prevention of masculine associations with computers because of its daily use of computers within a language context for all children. To study the effect of WTR on these aspects of gender identification, a series of investigations exploring gender stereotypes toward reading, writing, and computer use in various groups of young children including the children involved in WTR was conducted [15]. One study involved forty Grade 1 children at a school demographically similar to the WTR school but with Grade 1 children that had no opportunity to use computers.

An adaption of a picture-instrument developed at the University of Victoria and validated in a number of previous studies was used for these explorations [15-17]. The instrument consisted of a booklet of sixteen sketches—four were of books, four of writing implements, four of microcomputers, and four of various toys. Each child was shown these sketches and asked to indicate if he or she thought a little boy or a little girl was more likely to want to use the item. Responses of the Grade 1 children in the school without WTR were compared to those of the WTR children at the beginning and end of the Grade 1 year. Table 3 shows the results.

It can be seen that for boys the tendency to see computer use as being associated with boys, not girls, was significantly established at the beginning of Grade 1. Unfortunately, participation in a full year of daily computer activities in the WTR program did not serve to change the impression. At the end of Grade 1, the boys

were still significantly more likely to associate boys rather than girls with using a computer, and there was no difference between children in the WTR groups and children in the comparison groups with respect to this impression. There was no tendency to associate gender-stereotypes with reading or writing among the children, WTR or non-WTR.

It is frustrating that the intensive use of computers in the WTR-program did not influence boys to see computer use as being equally appropriate for girls as for boys. The boys may have already learned a culturally transmitted message, "computers are for boys," that school experience apparently was not able to change.

WTR and trends in language instruction — The current emphasis in early language arts instruction in British Columbia involves the so-called "whole language" approach. In this approach, reading, writing, spelling, and other aspects of language are dealt with in an integrated fashion, rather than in isolation. In addition, the personal relevance of language activities for the child is emphasized. Some aspects of WTR reflect this approach. Certainly the emphasis on reading stories that have been written by one's self is consistent with whole-language theory. However, the emphasis on phonemes and the treatment of phonemes and words as isolated entities in the computer drill and in the work journals can be strongly criticized by those who advocate a whole-language approach [18]. Context-independent word coding and decoding activities are generally criticized in current language arts theory in British Columbia as well as in much of North America. In addition, the selection of targeted words based on phonemic criteria rather than on relevance to first grade children (snake, vase, yard, smoke, turtle, oil and uniform, for example) has been strongly criticized by a number of language specialists. Zurn, for example, in a more recent U.S. study of WTR, noted that only 13 percent of the word-processed writing and 6 percent of the handwritten samples produced by children in her study contained more than one of the set of forty target words extensively drilled in WTR [19].

While it is true that there are different approaches to initial language arts instruction, each of which has its advocates in the classroom, there are likely to be many teachers and curriculum coordinators who will not want to incorporate the strict phonemic emphasis found in the WTR software and work journals into their early language arts procedures. However, these same teachers are likely to endorse the emphasis on free expression in writing that is also part of WTR.

Question 4: What are Considerations Related to Components of WTR?

The ETS evaluation of WTR, plus other reports and advertising of WTR, always treat the system as an entity. However, the fact remains that the system consists of various parts, each of which is a legitimate focus of consideration in its own right. In an eventual cost effectiveness consideration of the system for example, relative to adoption decisions, if it could be supported that certain

aspects of the overall costly system could be effectively eliminated without substantially diluting the positive impact of the remainder of the system, then the core of the system and its benefits might be available to more children. To make this analysis properly, many different installations of WTR would have to be established, each with a different subset of components of the overall system. This scope of intervention was entirely outside of our resources (although we regret the ETS Evaluation, with over 10,000 students, did not consider anything but the full system). However, based on our observation of the system, we are able to contribute some observations about the individual components of WTR.

Besides our own interpretations, there are two other sources of data for this question. One source is the results of a questionnaire sent to parents of WTR children and the other is interview material from the teachers involved in the project. Both these sets of data were obtained during the 1985/1986 school year.

Comparisons of stations — Parents of WTR children at one of the WTR schools were surveyed in order to find out their impressions of the various aspects of their children's WTR experience. In particular, they were given a list of the six WTR stations and asked which of the stations their children "talk about most" at home. The computer station was mentioned more frequently than the other stations. Parents were also asked to rank-order the six stations in terms of how valuable they perceived each to be for their child's language experience. The computer station was given top ranking by the parents, followed by the typewriter station and the writing station. The other three stations were seen as less valuable by the parents.

Teachers were asked this same ranking question. Their responses were different from those of the parents. The teachers ranked the writing station as having the most learning value for their students. The teachers were less impressed than the parents by the computer station, ranking it fifth among the stations in learning value.

Comments on individual stations — Each of the stations was criticized by the teachers. The typewriting station presented many management problems, mostly related to getting paper in and out of the machines and sitting comfortably at the typewriters. Not being able to correct miskeying, not allowed in the WTR philosophy as children were not supposed to be distracted by "surface" aspects of writing production, was frustrating to the children rather than liberating in cases where they knew immediately they had struck a key they didn't intend. However, in general, the children liked producing "neat" copy and showed their typed stories with apparent pride. Once the children were introduced to word processing, (after the WTR experience was over when the computers were available for word processing instead of drill use), the children "totally forgot" the typewriters (according to the teachers). As an aside, it is interesting to note that the children, successfully, used an "adult" word processor (Writing Assistant), as multiple copies of this had been supplied to the project.

The three stations that involved earphones and listening were frequently a problem. The quality of sound production coming from the speech synthesizers was poor and even the researchers had difficulty understanding some of the words being spoken. The different accents on the tapes (Southern U.S.) were also inappropriate for the Canadian children. The teacher-made, substitute tapes at the library station (done out of necessity, as the books to accompany the tapes were not available) worked well.

The "make words" game was felt to be "overly restrictive" by all the teachers and presented considerable management and clean-up problems. Its use was discontinued at both schools.

The children and, as was noted above, their parents appeared to be more interested in the computer stations than any of the other stations. However, the programs supplied for the computers can be criticized on a number of points. First, the individualization in the programs is of a highly primitive nature—if you touch a wrong key, you go back. There is no way to move more quickly if sounds are mastered, and no possibility of differentiated presentation of drill. No attempt at discrimination of input errors is considered, and every program is exactly the same in terms of its repetition of drill activities on isolated sounds and words. Three "special treat" programs were available and much enjoyed by the children. However, these occupied only a small portion of the computer-use time. The software does do what it sets out to do—provide undifferentiated drill to mastery of isolated words and sounds—but does it in a way that reflects very few of the recommendations made over many years for the design of drill-type software. On a positive note, with the exception of problems with the speech synthesizers, the software was bug-free and could be used without difficulty by the students with little or no adult help.

The issue of keyboarding was given special attention during the study. A special program was written [20], and administered to the WTR children at the beginning of the WTR-year. The program presented each of the letters of the alphabet, in large print, on the computer monitor, waiting with each letter until the child typed it correctly from the keyboard. The program collected data on each keystroke, recording both time and errors. Children in the WTR schools and in two Grade 1 classes in a third (non-computer-using) school interacted with the special keyboarding program in both September and May. All children showed significant improvement over the year on the keyboard test. However, the WTR group scored significantly higher ($p < .01$) than the control group on each of the speed and accuracy tests.

Question 5: What Do We Suggest in Terms of Subsequent Use of WTR?

This question was directly focused on the situations in the two British Columbia school districts at the time of the final evaluation report (1988). It would not be

appropriate, therefore, to comment more broadly on an overall recommendation. However, various elements of the British Columbia *WTR* experience do merit wider discussion.

First, the different results relative to holistic writing achievement in our sample compared to the larger ETS sample need consideration. One of the participating teachers offers the following perspectives:

It may be the differences in emphasis placed on writing by the Canadian teachers and United States teachers in their regular instructional program. Children in the Canadian sample were given much writing instruction and spent time writing as part of their regular (1983/84) program. United States studies report small amounts of time given to Grade 1 creative writing instruction [21]. It may be therefore that *any* program emphasizing writing would have a greater impact on the writing achievement of children in the United States compared to children in a Canadian control group who were already in a program of creative writing instruction [6].

Second, the multifaceted aspects of the system are good in concept but not as successful in implementation—at least as specified by the instructions in the teachers' manual. It would seem highly appropriate to not only describe strategies for integrating the full system but also to rewrite the teachers' materials, as well as the inservice procedures, so that a flexibility of usage combinations is suggested. In particular, it would be desirable if components of the system could be purchased individually rather than as an overall package, which is expensive if teachers do not plan to make use of all the components.

Third, some procedure to compare the cost-effectiveness of the system, or of components of the system, to variations in traditional instruction should now be attempted. The value of the gains in writing achievement, above and beyond those which could come from word processing use in an environment where writing is given the same time and emphasis as in *WTR*, should also be considered.

There is one thing more, however, that needs to be considered, and perhaps the analytic, subset approach described above does not take this enough into account. The whole, in the case of *WTR*, may indeed be greater than the sum of the parts. There is no doubt that a palpable air of excitement was generated by the overall impact of participating in the project and even by the "look" of the *WTR*-laboratories: Many parents who had not been much involved in school events became involved as *WTR* volunteers and the schools (not usually the focus of particular attention) were featured on television and other media on a number of occasions. The children appeared to all observers to respond with care and pride and enthusiasm to the overall process. Moving every fifteen minutes at the sound of a bell did not seem to offend them; instead they appeared to accept the routine in a brisk and cheerful way. They became poised in dealing with visitors and the many adults who were observing or "helping" them. Probably this aura somehow reflected being part of the whole experience. The "make words" part could be removed without apparent impact, but how much else could be replaced by more

"cost-effective" substitutes before the energy generated by the experience would return to "normal" levels? There is no way to say.

How important is this excitement? Perhaps it does not matter if the excitement results in "higher achievement scores" if we believe strongly enough that the appeal of the system makes a valuable difference to some long-range benefits to students, teachers, school, and community? Is it the computer which makes the special contribution to WTR, rather than the rest of the WTR system? Is some of this "magic" a function of novelty, or are there some intrinsically appealing aspects of the interaction of young children and computers for initial language experiences? We cannot say. We suggest that other users of WTR contribute their own insights to a continuing consolidation of observations occurring from WTR experiences.

REFERENCES

1. J. C. Harste, V. A. Woodward, and C. L. Burke, Examining Our Assumptions: A Transactional View of Literacy and Learning, *Research in the Teaching of English*, 18:1, pp. 84-108, 1984.
2. C. A. Perfetti, Reading, Vocabulary, and Writing: Implications of Computer-Based Instruction, in *Classroom Computers and Cognitive Science*, A. C. Wilkinson (ed.), Academic Press, New York, pp. 145-163, 1983.
3. D. H. Clements, *Computers in Early and Primary Education*, Prentice Hall, Englewood Cliffs, New Jersey, 1985.
4. J. H. Martin, *Writing to Read: Teachers' Manual*, IBM, Boca Raton, Florida, 1984.
5. R. T. Murphy and L. R. Appel, *Evaluation of the Writing to Read Instructional System, 1982-1984*, Educational Testing Service, Princeton, New Jersey, 1984.
6. K. Ollila, "A Comparison of the Effectiveness of the Computer-Based Writing to Read Program with a More Traditional Language Arts Program with Respect to Their Impact on the Development of Writing Skills at the Grade 1 Level," unpublished master's thesis, University of Minnesota, 1987.
7. P. Evanechko, L. O. Ollila, J. Downing, and C. Braun, An Investigation of the Reading Readiness Domain, *Research in the Teaching of English*, 7, pp. 61-78, 1973.
8. P. Evans and L. O. Ollila, Some Linguistic Relationships between Writing and Reading Abilities at the Primary Level—A Longitudinal Study, *Canadian Journal of Reading*, 5, pp. 62-70, 1980.
9. L. O. Ollila, B. A. Collis, and L. Yore, Predicting First Grade Students' Writing Achievement Using the Canadian Readiness Test and Selected Measures of Cognitive Development, *Journal of Educational Research*, 80, pp. 47-52, 1986.
10. J. Kagan, *Personality Development*, Harcourt Brace Jovanovich, Inc., New York, 1981.
11. A. H. Stein, S. R. Pohly, and E. Mueller, The Influence of Masculine, Feminine, and Neutral Tasks on Children's Achievement Behavior, Expectancies of Success, and Attainment Values, *Child Development*, 42, pp. 195-207, 1971.
12. C. A. Dwyer, Influence of Children's Sex-Role Standards on Reading and Arithmetic Achievement, *Journal of Educational Psychology*, 66, pp. 811-816, 1973.

13. M. E. Lockheed, Women, Girls, and Computers: A First Look at the Evidence, *Sex Roles*, 13:3/4, pp. 115-122, 1985.
14. B. A. Collis and L. O. Ollila, The Effect of Computer Use on Grade 1 Children's Gender-Stereotypes about Reading, Writing, and Computer Use, *Journal of Research and Development in Education*, 1990, in press.
15. J. Downing and D. Thomson, Sex Role Stereotypes in Learning to Read, *Research in the Teaching of English*, 11, pp. 149-155, 1977.
16. J. Downing, C. A. Dwyer, D. Feitelson, M. Jansen, R. Kamppainen, H. Matihaldi, D. R. Reggi, T. Sakamoto, H. Taylor, V. D. Thackray, and D. Thomson, A Cross-National Study of Cultural Expectations and Sex-Role Standards in Reading, *Journal of Research in Reading*, 2:1, pp. 8-23, 1979.
17. R. B. May and L. O. Ollila, Reading Sex-Role Attitudes in Preschoolers, *Reading Research Quarterly*, 16:4, pp. 583-595, 1981.
18. S. Ohanian, IBM's Writing to Read Program: Hot New Item or Same Old Stew?, *Classroom Computer Learning*, pp. 29-35, March 1984.
19. M. R. Zurn, "A Comparison of Kindergartners' Written and Word-Processor Generated Writing", unpublished doctoral dissertation, Georgia State University, 1987.
20. S. E. Philips, "Computer Readiness in Grade 1", unpublished master's thesis, University of Victoria, 1986.
21. C. Bridge and E. Hiebert, A Comparison of Classroom Writing Practices, Teacher's Perceptions of Their Writing Instruction, and Textbook Recommendations of Writing Practice, *Elementary School Journal*, 86, pp. 154-172, 1985.

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