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ABSTRACT

A comprehensive evaluation of a hypertext model for teaching process writing at the junior high and high school level was conducted over an 8-week period. The purpose of the study was to determine how two teachers and three different age groups of students used and reacted to the model, specifically, its embedded design features of model stories, note cards, idea buttons, mini-lessons, branching buttons, and cut-and-paste tools. Researchers sought to investigate the extent to which the embedded features facilitated the process approach, the degree to which their usage improved writing products, and any age of gender differences in patterns of use or reactions. Data collection instruments used in the study included: observer notes; frequency of embedded feature usage (automatically collected by the computer from every student during each session); holistic writing assessment; student questionnaires and interviews; teacher interviews; problem-solving analysis; and weekly records analyzing student writing. Students were asked first to use the model to compose an ending to a familiar story, then to write two stories of their own over the next 5 weeks. Results showed that applications of the embedded features varied based on teacher attitudes, feature attributes (e.g., ease of use and appeal), and student characteristics. The high school teacher and students made more usage of many of the features, and they were more likely to offer criticism of navigational aspects of the model and of the model's value as a writing aid. No significant writing improvement or gender difference was detected. The implications of the results are discussed regarding the instructional design and classroom implementation of new technologies for teaching process writing strategies. The continuing challenge for instructional designers is effectively integrating the new delivery strategies to fit classroom conditions and curriculum needs. Possible system improvements include incorporation of more word processing elements as well as security and networking arrangements for safer and easier file management. The model might also be revised to allow more instruction from the teacher and to restrict access to certain features to those students who have mastered relevant skills. (Contains 41 references.) (SWC)

Title:

Using a Hypertext Environment for Teaching Process Writing: An Evaluation Study of Three Student Groups

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Abstract

The present research consisted of a comprehensive evaluation of a hypertext model for teaching process writing at the junior high and high school level. Interests were to determine how two teachers and three different age groups of students used and reacted to the model, specifically, its embedded design features of model stories, note cards, idea buttons, mini-lessons, branching buttons, and cut-and-paste-tools. Results showed applications of the embedded features to vary based on teacher attitudes, feature attributes (e.g., ease of use and appeal), and student characteristics. Older students made more usage of many of the features, but were less positive about the hypertext model given their greater involvement with completing writing assignments rather than with exploring new forms of writing. The implications of the results are discussed regarding the instructional design and classroom implementation of new technologies for teaching process writing strategies.

Using a Hypertext Environment for Teaching Process Writing: An Evaluation Study of Three Student Groups

Several reports have recently documented the decline of writing skills of American students (National Assessment of Educational Progress, 1990; Walton, 1990). Although basic composition skills appear "adequate," students show limited success with writing tasks that involve higher-order thinking and reasoning (Applebee, Langer, & Mullis, 1990). Directly relevant to the focus of the present research is the difficulty today's students experience in using imaginative writing skills to create original stories (Stein, 1986; Walton, 1990).

One approach to the challenge of improving students' higher-order writing ability is "process" orientations to teaching writing. In contrast to "product" orientations that emphasize mechanical skills such as punctuation, spelling, and grammar, process orientations stress writers' personal construction of meaning and structure (Resnick, 1987). The process orientation also emphasized a social context of student conferencing during the various non-linear writing stages of planning, generating, revising, and evaluating (Bereiter & Scardamalia, 1986; McGee & Richgels, 1990).

The following four assumptions underlie the design of process writing strategies: (a) writing is a process of constructive problem solving, and through writing practice, students develop thinking and writing skills; (b) experts and novices approach the process differently; (c) writing is recursive, drawing on many stages of writing randomly rather than linearly or sequentially; and (d) the strategy the writer takes is dependent on the purpose and nature of the writing task (Hildyard, 1992). Most school-based process models of instruction describe the following five stages (Calkins, 1986; Hillerich, 1985; Madden, Wasik, & Petra, 1989; McGee & Richgels, 1990): (a) rehearsing or planning, (b) drafting, (c) revising, (d) editing, and (e) publication. However, a well formulated theory does not guarantee a successful application. The effectiveness of such approaches in improving students' writing skills is yet to be established. Probably the most widely stated criticism is that process approaches are applied too superficially (Applebee et al., 1990; Calkins, 1985; Resnick, 1987; Stein, 1986). Frequently cited consequence is that students may not be able to transfer process skills instruction to the types of writing tasks they confront in real-life contexts.

The problems encountered with applying theoretical models to everyday situations are not unique to writing instruction. Incorporating thinking skills within specific disciplines remains an important challenge for educators in the domains of problem-solving (Resnick, 1987) and addresses the need for the development of prescriptive research methodologies (Clark, 1989).

Computers and Process Writing

Word-processing technology is generally believed to support process orientations because it carries the potential to remove many of the mundane and time-consuming barriers to writing (Bruce, 1991; Daiute, 1992). A typical claim is that students who spend less time in mechanical activities of rewriting, revising, and restructuring can spend more time problem solving, thinking, and planning. Although there is a widespread belief that word processing facilitates writing, research has yet to show that it directly fosters writing improvement (Cochran-Smith, 1991).

An increasingly used computer application, hypertext, is intuitively promising because its non-linear structure suggests an ideal environment for writing instruction within a process framework. Hypertext is the label for computer-driven displays of information that can display information in various combinations. In a hypertext environment, information can be connected or linked to any other information contained in that environment. Because of linking and branching capabilities, the structure of hypertext is frequently compared to the structure of human memory (Conklin, 1987; Jonassen, 1991; Warren, 1989), and as such can be designed for a multitude of instructional uses.

Features of hypertext that may enhance traditional word-processing capabilities include the capability to revise and restructure; to branch to alternative arguments and/or descriptions (Bolter, 1991); to embed notes, tips, and elaborations; to store writing sequences from past sessions (Neuwirth, Kaufer, Chimera, & Gillespie, 1987); and to model expert decisions (Jonassen, 1991). All of these features may facilitate non-linear aspects of writing and suggest that hypertext may be an attractive tool for supporting the decisions of writers while they are structuring knowledge.

Although hypertext promises great potential for writing instruction, its effectiveness in this area still remains in question. Several development projects illustrate varied applications of hypertext writing environments, but have not encompassed systematic investigations of learner processes and outcomes. These projects include (a) Notecards, a collaborative writing project (Trigg & Suchman, 1989); (b) the Writing Environment, featuring planning, writing, and editing modes based on cognitive learning principles (Smith & Lansman, 1988); (c) Hyperstories, a combination of HyperCard™ and a videodisk program used for teaching and story writing on ecological issues (McLellan, in press); (d) Multimedia Stories, a multimedia composing tool (Daiute, 1992); (e) and the Apple Classrooms of Tomorrow study of children using multimedia software, StoryShow, in co-authoring stories (Reilly, 1992).

Purpose of the Present Research

Problems with implementing general design models, such as process writing, are widely reported in many academic disciplines (Resnick, 1987) and have become a challenging issue for the field of instructional design and technology. Hypertext may be a promising tool for addressing the problems related to implementing the strategies of processing writing within a classroom structure. One advantage would be incorporating, within the hypertext design, strategies that handle many of the sizable management tasks associated with the process approach. Additionally, the modeling of expert knowledge structures important to story writing suggests an effective way to teach specific thinking skills.

The present study investigated the effectiveness of a hypertext writing environment specifically designed to facilitate process model instruction. The program contained several embedded features to stimulate and support usage of task-relevant problem solving and thinking skills during writing activity. Included were note-taking, mini-lessons, teacher- and student-generated writing suggestions, sample stories, branching cards, and teacher- and student-modeled writing samples. The basic writing model consisted of six-week writing unit in which students were trained on using hypertext, read sample stories, and wrote original stories using the embedded features. Research outcomes of interest were students' usage of the embedded features, students' and teachers' experiences during the implementation period, and the nature and quality of process writing products. The research orientation represented an applied descriptive study or an evaluation study (Ross & Morrison, 1994). Despite its emphasis on a particular instructional model, findings were also expected to suggest general principles for improving the effectiveness of similar applications (i.e., hypertext contexts) for writing instruction and other curriculum areas. Specific research questions were as follows:

1. To what extent do the embedded features of hypertext facilitate process model instruction in the categories of: (a) problem-solving and writing, (b) expert modeling, (c) non-linear/recursive writing, and (d) story writing strategies?
2. Is usage of the above features associated with improved writing products?
3. Are there age and gender differences in embedded feature use and attitudes toward the process writing model?

Method

Design and Subjects

We employed a descriptive, naturalistic evaluation design in which a hypertext process writing model was implemented with 16 junior high and 22 high school students over an eight-week period. The model was implemented as part of the students' regular curriculum and classroom activities. Students attended a private school with strong liberal arts orientation and that serves a mostly upper-middle class student population. As a function of the naturalistic design, special characteristics of the student population, and relatively small sample sizes, multiple data sources, both quantitative and some qualitative, were used in conjunction with intensive study of student activities during all phases of the study. For the qualitative elements, we followed suggestions in the literature for achieving high internal validity by incorporating prolonged engagement (an eight-week study), persistent observations, triangulation of data sources, peer debriefing (discussion with the observer about motives, rationales, possible biases, etc.), and member checking (confirmation of results by participants) (Lincoln & Guba, 1985; also see Gallo & Horton, in press).

The junior high group consisted of a 7th-grade microcomputer class, taught by the computer teacher, that met for four 50-minute sessions a week. Eight males and eight females were in the class. The high school group was a combined 9th- to 12th-grade class that also met for four 50-minute weekly sessions. There were 13 males and 9 females in that class. All students participated in the researched writing tasks as part of their normal class activities which included computer-based writing as a component. Ninth graders ($n = 10$) were enrolled in a microcomputer class emphasizing writing, while the 10th-12th graders were enrolled in a "Writer's Workshop" course also focusing on writing. (For clarity, we will henceforth refer to this group as the WW students.) The ninth-grade and WW classes were taught by the same high school teacher who specialized in English and computer-based writing.

According to the high school teacher, most of her students were familiar with the process model of writing as a function of its being practiced informally by most language arts teachers in the school. The microcomputer teacher described her students as being less familiar with the process approach, but as having basic computer skills (e.g., using a mouse, opening and saving files, etc.). For purposes of examining how students differing in age, experience, and course orientation would react to and use the hypertext writing model, we felt that the most appropriate breakdown for comparison would consist of three groups: 7th-graders, 9th-graders, and WW students.

Instructional and Evaluation Materials

The hypertext writing program was implemented over an eight-week period, of which two weeks were used to field test the program using individual students and small groups of students, and six weeks were used for classroom story writing. The six-week session included one week for an introduction to writing in hypertext with a practice activity, and five weeks of story writing in which students wrote two original stories.

The Hypertext Story Writing Environment

Students were given a HyperCard stack that contained five embedded strategies (accessed through HyperCard buttons) to facilitate usage of elements of the process model. Figure 1 illustrates the incorporation of the strategies; a brief discussion of each strategy follows (for more detailed descriptions, see Lohr, 1993).

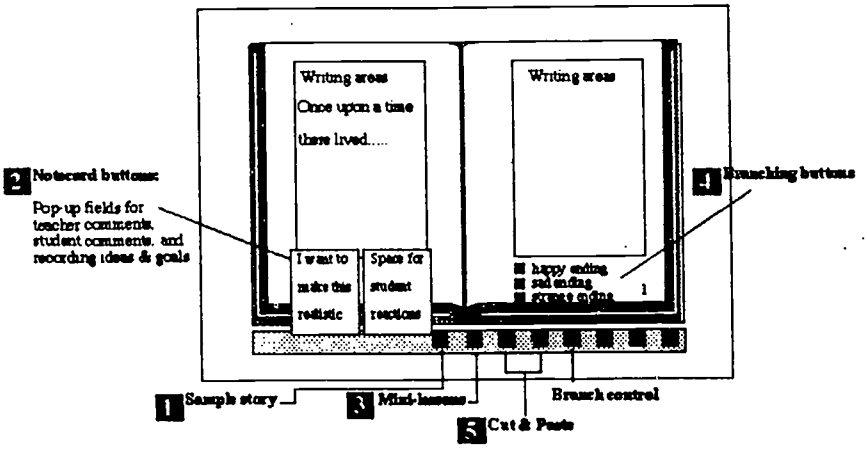

Figure 1. A view of the hypertext writing page with embedded features.

1. Sample story. The Frog Princess, a Russian folk-tale, was adapted to provide a hypertext sample story incorporating the author's embedded notes and examples of computer branching to different endings. Students were given the option to revise the Frog Princess by creating branches to different beginnings, character descriptions, and character actions. The sample story was intended to reinforce a process writing orientation by conveying writing as constructive problem-solving in which the author reflects on and tries out different ideas.

2. Note card buttons. Two types of note cards were linked to each page using HyperCard buttons (see Figure 1). Goal-statement note cards provided an edit field to list one's writing goals. Prompts were displayed to remind students to use the goal statement button for recording their writing plans before leaving the page. Editor note cards provided edit fields for the teacher (or classmates) to record feedback comments for that page. These fields were hidden

from view until the critic or author clicked the appropriate button to view the fields. Students were initially told and intermittently reminded to read an embedded mini-lesson (see below) that instructed them on questions to ask when reading another student's story. The goal statement and editor note cards were used primarily to support four process writing components: (a) problem-solving and (b) planning through the setting of writing goals and recording of writing problems, (c) expert level suggestions through the editor feedback, and (d) revising.

3. Mini-lessons. Six mini-lessons were embedded in the students' writing stack following the suggestion by Calkins (1985) that brief, informally-introduced and well-timed instructional units covering topics important to writing development should be made available as needed during writing activity. Students could directly access any of the following mini-lessons during their writing: (a) basic story structure; (b) effective branching techniques; (c) choosing a topic; (d) conferencing; (e) rehearsal and revision strategies; and (f) "to do today," a list of teacher suggestions and reminders by clicking on the Mini-lessons button (see Figure 1). The stack would then branch to the appropriate mini-lesson. The mini-lessons presented instruction on two major process writing characteristics, writing as a non-linear activity and usage of specific story writing strategies.

4. Branching buttons. Branching buttons, provided as an option on each HyperCard page, allowing the student to create up to three written detours from each writing page (see right page of Figure 1). Branching could be used to tell a story from different perspectives (e.g., a happy or sad ending) or for elaborating and exploring story ideas for possible use in the actual story. The branching component most directly addressed the non-linear nature of process writing, along with problem solving, and planning. After clicking a branching button, the student could write a new section which was linked to the original story. Each branch could subsequently be evaluated by clicking the appropriate branching button which would then display the branch.

5. Cut-and-paste buttons. Cut-and-paste buttons (see Figure 1) allowed students to move sections of text without the need for retyping. This feature directly supported the process writing components of revising and editing. Students could highlight the text they wanted to copy or paste and the click the appropriate button. The cut-and-paste buttons were added as an alternative to the Cut-and-Paste items under the Edit menu.

Data Collection Instruments

Eight types of instruments were employed to collect quantitative and qualitative data relevant to the research questions. An overview of the instruments is provided in Table 1; a description of each follows.

Observer notes. Observer notes were recorded daily by the first author during study writing sessions. These notes contained descriptions and impressions of the activities as well as reactions expressed by students and teachers regarding their experiences with the writing tasks.

Frequency counts of embedded feature use. Frequency counts were automatically collected by the computer from every student during each writing session, indicating uses of note cards, mini-lessons, branching tools, and cut-and-paste procedures.

Holistic writing assessment. Holistic ratings of story quality were made by the two classroom teachers for the two stories written by students. The following holistic scales was used:

0. Not rated: stories were absent, unreadable, or unrelated to the story writing task.
1. Unsatisfactory: stories were abbreviated, incomplete, circular, or disjointed, and did not address the story-writing task.
2. Adequate: some elements of story structure were presented and the story was moderately engaging.
3. Elaborated: story exceeded the essentials, providing additional coherence and detail to create an interesting and coherent theme.

To establish inter-rater reliability and refine the rating scale, the two raters initially selected at random three student stories from the entire set, scored that selection, and compared their ratings. Variations in scores were followed by discussion, which initially prompted the decision to combine two categories in an original five-point scale into one category to yield the above four-point scale. Also, additional descriptors were added to categories of the original scale. Following these revisions, eight additional stories were rated independently by each teacher, with a resultant inter-rater reliability of $r = .83$. The teachers again discussed any discrepancies to increase the validity of subsequent ratings. Overall inter-rater reliabilities on the complete story sets were quite high for both Story 1 ($r = .94$) and Story 2 ($r = .93$).

Table 1.
Summary of Data Collection Instruments Used

Instrument	Descriptor
1. Observer Notes	Each day: Written descriptions and impressions of each session were recorded in a journal.
2. Frequency of embedded feature usage	Each Day: Computer-recorded tabulations of the number of times each student used: a) Note cards b) Mini-lessons c) Branching d) Cut-and-paste
3. Holistic writing assessment	Story 1 and 2: 4-pt. rating of the quality of students' stories.
4. Student questionnaires/interviews	a) Week1: 8 ratings (5-pt. scale) on attitudes toward and experiences with writing, computers, process writing. b) Week 6: 22 rating items on attitudes toward and usage of embedded features, reactions to hypetext and its effectiveness. c) Week 6: 11-question interview on attitudes and experiences.
5. Teacher interview	Week 6: 17-questions on experiences with and attitudes toward the hypertext and the writing process.
6. Problem-solving analysis	Each day: 2 or 3 students story stacks were selected for qualitative analysis
7. Weekly records	Each week: Analysis and evaluation of students' modeling strategies, embedded feature use, and teacher-embedded instructions

Student questionnaires and interview. Students completed two questionnaires, both using five-point Likert-type scales (1 = "strongly disagree;" 5 = "strongly agree") for responses. The initial questionnaire, administered during the first week of the study, contained eight items that addressed attitudes about writing and computers, and experiences with the process approach to writing (e.g., "I often share drafts of what I write to see how others react"). The second questionnaire, administered at the conclusion of the study, consisted of 21 items concerning attitudes about writing, computers, and specific hypertext features experienced (e.g., "I liked using the branching buttons").

All students were interviewed during the final week of writing to determine how they used and felt about the hypertext model. There were 11 interview questions, ranging in focus from general impressions (e.g., "Overall, how did you like the hypertext writing environment?") to reactions about specific hypertext features (e.g.., "What usually prompted you to use the mini-lessons?").

Teacher interview. The two teachers were interviewed at the end of the year. Questions addressing the following categories were asked: reactions toward the writing environment, student attitudes, ease of managing the writing environment, the instructional effectiveness of the writing model, most and least liked features, and suggested changes.

Daily records of problem-solving activity. Two or three student story-writing stacks were selected randomly each day for analysis of problem-solving activity. Based on qualitative analyses of initial samples, the following categories were derived for structuring the subsequent evaluations: generating ideas, expressing ideas, working with story structure, branching, originality, developing appropriate details, organizing, and "other."

Weekly records. Weekly analyses of student writings were conducted using: (a) the observer's analysis of modeling strategies used by the student, (b) frequency counts for the use of each embedded feature, (c) descriptions of how students used embedded features, and (d) an analysis of the nature of teacher-embedded instruction or help on story writing strategies.

Procedure

As described below, the implementation of the hypertext story writing program followed basic methodologies of the formative evaluation model suggested by Dick and Carey (1991). However, since the main purpose of the study was to assess the classroom implementation as it might be used by typical teachers interested in a hypertext process writing application, evaluation procedures evolved according to teacher interest and practical considerations as well as procedures of the formal Dick and Carey model.

Stage One

The first stage assessed ease of program use, employing one male subject (a 7th-grader) who was not part of the participating seventh-grade class. Observer notes were used to record impressions relevant to instructional and mechanical development (e.g., ease of use, perceived effectiveness of different components). Journal entries included the recording of subject responses to the writing environment via "think aloud" procedures (Schriver, 1989) in which the subject orally described his thought processes as he worked with the program. After completing the program, the subject was interviewed regarding his experiences and reactions. Based on the data obtained, appropriate program revisions were made.

Stage Two

Stage Two used a small group of three male students to test the revised program. Procedures were similar to those described for Stage One, except that think aloud procedures were excluded. Additional revisions of the program were made based on these results.

Stage Three

Stage Three was the actual study, conducted with the targeted junior-high and high-school classes. A six-week implementation of the completed hypertext program was organized. Week 1 was initiated with the administration of the questionnaire to assess student attitudes toward story writing. Students received instruction from the first author on using the hypertext story-writing program. Topics included opening the stack and leaving the stack, turning pages, and using embedded features. They then read a hypertext version of the sample story, The Frog Princess. They were also asked to read the mini-lessons on conferencing, branching, and choosing topics, and to use the lesson information in writing a new ending to The Frog Princess.

The students' assignment was to write two stories on any topic during the next five weeks. Students were asked to: (a) record goals and ideas in the goal buttons; (b) use the teachers' and other students' reactions for feedback, and record those reactions in the editor's buttons; (c) use the branching feature for at least one part of the story (WW students were explicitly required to branch); (d) provide feedback to other student authors; and (e) read the mini-lessons as they were introduced during the four-week writing period.

During this period, the first author recorded notes daily using the observer notes form. Copies of student stacks were made at the conclusion of each session. Weekly records of individual student and whole-class usage of hypertext features were also compiled. At the completion of six weeks, the follow-up student attitude survey was administered during a class period and the teachers and students were interviewed.

Results

The results are presented in four major sections addressing: (a) writing activities and products, (b) teacher and student attitudes, (c) hypertext facilitation of the process model, and (d) observer impressions. Where inferential analyses were conducted, the .01 probability level was used to reduce the family-wise error rate.

Writing Activities and Products

Story Characteristics and Use of Branching Applications

A total of 72 stories were written by the 38 student participants. The average story was approximately 10 hypertext pages in length, roughly equivalent to 5 standard double-spaced manuscript pages. The breakdown of story themes included: adventure-fantasy (33%), detective/mystery (24%), folk tale (7%), personal (7%), soap opera (7%), family (7%), futuristic (7%), and "no recognizable theme" (7%).

Branching was included in stories by 69% of the overall sample, 58% of the 7th-graders, 71% of the 9th-graders, and 93% of the WW students. The majority of branches (57%) were used to provide multiple story endings, such as "Click Branch A for the Happy Ending, Branch B for the Sad Ending." The next most common type (35%) was used for elaboration (e.g., "Click Branch A if you want to learn more."). The remainder (7%) comprised briefer forms of embellishment or motivational enhancement.

Story Quality

On the four-point holistic rating scale (0-3), mean scores for all students combined were 2.01 on Story 1 and 1.89 on Story 2. Thus, the typical student wrote a story that included some or most major elements and was "moderately" engaging. Less than 10% received the highest rating (3), indicating a more complete story structure, and sufficient coherence and detail to create an interesting and engaging theme. ANOVAs performed on the holistic scores using class and gender as independent variables showed neither factor to be significant (both p's > .05).

Embedded Feature Use

Table 2 provides a summary of the mean frequencies of embedded feature use for each group. As shown, students tended to use more of the features in Story 1 than in Story 2. The most frequently used options were teacher comments and student comments; least frequently used were cut-and-paste and branches.

Table 2
Hypertext Writing Environment Feature Use Totals

	Story 1				Story 2			
FEATURE	total F	mean	SD	med.	total F	mean	SD	med.
Teacher comments	283	7.44	2.95	.5	100	1.16	4.13	1
Student comments	231	6.08	4.70	5.5	51	1.34	2.55	0
Goal/Idea button	116	3.05	2.61	2	42	1.11	1.74	0.5
Branches	63	1.66	1.73	1.5	43	1.08	1.55	0
Mini-lesson use	114	3.0	2.50	2	26	.68	1.30	0
Cut-and-paste	91	2.40	4.56	0	11	.13	.13	0
Pages written[b]	227	5.97	2.95	5	157	4.13	3.31	5

[a]Mean is calculated by dividing the total frequency by the number of stories.

[b] Note that each hypertext page is roughly equivalent to 1/2 of a standard double-spaced page.

Comparisons between student classes, using one-way ANOVAs, showed significant effects on Story 1 for mini-lessons, $F(2, 35) = 8.14$, $p < .01$; cut-and-paste, $F(2,35) = 4.46$, $p < .01$; and branching, $F(2, 35) = 5.35$, $p < .01$. Follow-up analyses indicated that the WW students ($M = 4.75$) more frequently used mini-lessons during Story 1 than did the 7th-graders ($M = .50$). The WW students also used cut-and-paste tools ($M = 5.33$) and branching ($M = 4.08$) more frequently than did 9th-graders (M's = .50 and 1.50, respectively). No gender differences were found. Nor were there any class or gender effects on Story 2.

Pearson correlations between embedded feature scores and holistic writing scores were computed to explore whether writing quality was related to usage of any of the 6 features on either story. The resultant correlations ($n = 12$) were all positive in direction but nonsignificant and weak to moderately weak in strength, ranging in magnitude from .05 (cut-and-paste with Story 1 score) to .38 (student comments with Story 2 score).

Student and Teacher Attitudes

Initial Student Survey

Student responses on the initial survey showed moderately positive reactions to writing, with 75% of the sample agreeing that they liked writing, 60% agreeing that they liked using the computer for writing, only 20% agreeing that writing was difficult for them, and 10% agreeing that writing is difficult for others. About half of the students reported sharing drafts of writing with others and thinking about reader reactions while writing. Relatively few (from 10-25%) responded that they used the work of others while writing or experimented with different ways of writing a story. None of the chi-square analyses for class or gender was significant (all p's > .01).

Final Student Survey

Table 3 summarizes the percentages of students, broken down by class, agreeing with the individual item statements on the final survey, and the item chi-square probabilities for class and gender analyses. The only significant chi-square (at $p < .01$) result was for class ($p < .001$) on Item 1, "I like writing stories." Ninth-graders (19%) were less likely to agree with this statement than were 7th-graders (75%) and WW (75%) students. In general, students of both sexes in all grade levels had a high degree of confidence in their own and other's writing abilities, as indicated by the strong majorities (about 80%) who disagreed with the statements, "Writing is difficult for me" (Item 3) and "Writing is difficult for others" (Item 4). Approximately two-thirds (although only 30% of 9th-graders) agreed that they liked using the computer for writing.

Medium preferences. Across all classes, less than 40% of the students agreed that they would rather use HyperCard than word-processing (Item 5). On the other hand, only about 25% agreed that they would rather use a pen-and-pencil (than a computer) to write stories (Item 6) and about 60% agreed that they liked writing with hypertext (Item 7).

Ease of using embedded features. Although there were no statistically significant patterns, WW students tended to be slightly more positive than their younger counterparts regarding the use of most HyperCard features (branching, editor buttons, idea/goal buttons, and cut-and-paste). Five survey items asked students to rate the ease of using the individual embedded features (Items 8-12). Overall responses indicated that from about 60% (for mini-lessons) to 80% (for branching) of the students agreed that the features were easy to use.

Reactions to embedded features. Branching was the most liked embedded feature (about 55% overall agreement; Item 13). Editor buttons, goal buttons, and especially, mini-lessons were disliked by the majority of students (see Table 3, Items 14-16). The cut-and-paste feature was viewed positively by 75% of the WW students but by only 50% of the 9th-graders and 31% of the 7th-graders (Item 17).

Frequency of using embedded features. In responding to Items 18-22, students indicated generally infrequent use of the comment buttons (15% agreement), goal buttons (17%), and mini-lessons (14%); Slightly more frequent use of branching buttons (43%) and cut-and-paste (55%) was reported.

Attitude changes over time. Paired t-tests were performed comparing attitudes toward writing before and after the study. The first four ratings items (see Table 3) were used in these analyses. None of the comparisons of means approximated significance (lowest $p = .20$)

Table 3.
Percentages of Agreement by Class and Chi-Square Results on Final Student Survey

Item	Class			Chi-Square Probabilities	
	7th	9th	Writer's Workshop	Class	Gender
1. Like writing stories	75	10	75	.001	.05
2. Like using computer for writing	67	30	70	.36	.94
3. Writing is difficult for me	19	20	25	.92	.51
4. Writing is difficult for others	63	20	42	.07	.10
5. Rather use HyperCard than word processing	44	40	33	.26	.41
6. Rather use pen or pencil	25	30	22	.94	.19
7. Like writing with HyperCard	63	60	50	.79	.92
8. Easy to use branching	88	80	83	.87	.20
9. Easy to use editor buttons	44	60	75	.25	.59
10. Easy to use goal buttons	81	60	75	.48	.32
11. Easy to use mini-lesson	56	50	70	.44	.68
12. Easy to use cut-and-paste	69	70	58	.80	.14
13. Like branching	56	60	67	.85	.69
14. Liked editor buttons	25	20	58	.10	.19
15. Liked idea/goal buttons	25	20	58	.98	.59
16. Liked mini-lessons	25	0	17	.23	.38
17. Liked cut-and-paste	31	50	75	.07	.14
18. Frequently used branching	31	50	67	.17	.28
19. Frequently used comment buttons	25	10	33	.43	.35
20. Frequently used goal buttons	38	0	25	.09	.15
21. Frequently used mini-lessons	18	10	33	.39	.49
22. Frequently used cut-and-paste	44	50	75	.25	.02

Student Interview

Interview responses corroborated the survey results in all cases. In discussing their prior experiences, few students indicated any familiarity with process writing, while about 50% (more so for WW students) indicated having prior computer writing experience. About half indicated that they liked writing stories.

Positive aspects of hypertext. The most frequently given reasons for liking HyperCard were branching ($f = 12$), followed by ease of feature use ($f = 10$), and the visual aspects of the environment ($f = 8$). Comments about branching generally described the experience as creative, a good way to explore, and unique: 6% of 7th-graders, 50% of 9th-graders, and 42% of WW students made positive comments about branching.

Ease of use was described mainly in terms of liking the tools that were immediately accessible on the page, not hidden in pull-down menus. Positive comments were made by 31% of 7th-graders, 18% of 9th-graders and 0% of WW students.

Visual aspects were addressed in terms of how the environment resembled a book or page, or how the page sizes were small and unintimidating. Positive comments were made by 19% of 7th-graders, 30% of 9th-graders, and 0% of WW students.

Negative aspects. The most frequently given reason ($f = 4$) for disliking the hypertext writing environment was problems associated with the small page size. As one WW student described it, "The page size was so limiting, rather than being able to just write, you had to continually stop and prepare for the next page." Another student compared the limitations to "being on a slave ship, with too many paddles needed to move things forward." Other negative aspects, all expressed by WW students, were associated with computer problems ($f = 2$), dislike of writing ($f = 2$), and branching

difficulties (f = 2). For example, one student indicated that branching bothered her because it complicated the writing of endings to the stories.

The view that hypertext was not helpful for problem solving was expressed by 75% of 7th-graders, 100% of 9th-graders, but only about 33% of the WW students. Specific comments by the two younger groups conveyed the general feeling that they did not have writing problems that needed attention. In contrast, the WW students were more self-critical and saw the helpfulness of certain features, particularly idea buttons and branching, for developing and incorporating ideas.

Facilitation of the process model. When students were asked specifically about idea development, more 7th-graders (81%) and WW students (55%) than 9th graders (20%) indicated that the hypertext environment was helpful. Several students specifically identified the idea button and branching as useful, but provided no explanation as to how. Negative comments stressed the spontaneous or internal nature of idea development, which reduced the need for external aids.

When asked directly if hypertext facilitated planning, agreement was expressed by one-third of the WW students, but by only one-fourth of 7th-graders and none of the 9th-graders. Almost all students disagreed that the hypertext writing environment facilitated drafting, which was not surprising, given that students were not specifically instructed to begin by writing a quick or "sloppy" copy.

In response to a question concerning how well the hypertext environment facilitated revision, about half of the subjects described it as helpful while the other half described it as not helpful. Positive responses about the helpfulness of embedded feedback were given by nearly all of the 9th-graders, two-thirds of the WW students, but only two 7th-graders. Specific comments suggested that the feedback helped in making editing changes on mechanics and, to a lesser extent, story strategies, clarity, and organization.

Teacher Interviews

Teacher interviews conveyed opinions about the hypertext environment that were similar to those of the students. Specifically, the computer teacher, like her 7th- and 9th-graders, was positive about hypertext writing and cited branching as one of the main reasons. The WW teacher, like her class, conveyed reserved feelings about hypertext and identified the small page size and technical difficulties as the main problems.

Both teachers indicated problems with the small writing space and with the fact that the writing process had to be monitored continually to move the cursor manually to new fields (a limitation of the interface). Thus, teachers' concerns were less with the features of the process writing model than with the ease of using the hypertext writing environment. Other identified problems were the requirement for students to work from back-up disks and the difficulty of generating print copies of stories because of the time required to print the writing story stacks. Operational factors associated with the technology over-shadowed the teachers' interest in the instructional implications of the model for process writing.

Hypertext Facilitation of the Process Model

Writing Samples Analysis

Analysis of the 47 randomly selected writing samples identified eight general categories of problems experienced in all grades. Frequencies and brief characterizations of the categories are summarized in Table 4 (for a more detailed description, see Lohr, 1993). The most common problems concerned the development of story structure and of appropriate details. Despite the problems detected by the analysis, only three students embedded comments (in the idea box or elsewhere) indicating personal awareness of difficulties. Further, there was no incidence of peer feedback, although students had been instructed to provide and obtain it.

Table 4
Categories of Problems Identified in Daily Collections of Randomly Selected Student Writing

Problem Category	Description	Frequency
Story Structure	Story had no conflict or resolution	11
Development of appropriate details	Details included either confused the reader or did not facilitate story development	7
Organization	Story is not focused. Too many characters introduced too quickly	4
Publishing	Inordinate attention to graphic quality over story content. One incident of student changing font to "Script" to maintain privacy.	4
Originality	Story is cliché or too similar to another story.	3
Expressing ideas	Superficial description	2
Getting ideas	Blank pages	2
Branching	Story is not enhanced by branches	2

Modeling

We predicted that students might model or mimic expert writing strategies observed from the teacher's writing from the embedded story, The Frog Princess or from observations of other students. Although some modeling was noted, it tended to be at a superficial level and did not appear to reflect specific writing strategies designed to improve story quality. Both teachers observed that modeling was mostly represented in imitating story themes that others had used.

Embedded Feedback Comments

To determine the nature of the feedback provided by teachers ($f = 123$) and students ($f = 34$), the feedback comments were analyzed for basic theme. Five categories emerged: (1) 72 comments about writing mechanics, (2) 35 comments of encouragement ("Keep up the good work"), (3) 25 comments on basic story writing strategies, (4) 17 comments on improving clarity or organization, and 8 comments (all from students) that were silly or entertaining. The WW teacher was responsible for 75% of the comments on mechanics, but only 8% of the encouraging comments; the computer teacher gave 22% and 35% of the comments in these respective categories.

Observer Impressions

A journal was kept by the first author while observing the five-week classroom implementation. Descriptions of the main highlights of the observations are reported in two sections: Introductory Lessons and the four weeks of story writing (for more detailed descriptions, see Lohr, 1993).

Introductory Lessons

Students in all classes completed the Introductory Lesson and the Frog Princess writing activities in four 50-minute sessions. Most of the problems encountered during this period concerned the interface. One problem was the need for the teacher to access each student's computer to check individual work, a time-consuming task. This was remedied by requiring students to save and submit their work on 3.5 in. back-up disks.

Overall, observations indicated that most students had little trouble learning to use the system. While nearly all were successful in writing endings to the Frog Princess, as a rule, the older the class, the less was written. The WW students, for example, often wrote endings consisting of only a few sentences, while 7th- and 9th-graders typically wrote several pages. Although students were reminded each day to read the appropriate mini-lessons, most seemed to ignore these aids.

Hypertext Story Writing

At the start of the four-week hypertext writing phase, qualitative differences across grade levels were immediately noticed. Within a few days, 7th-graders were focused on writing and only occasionally needed disciplinary reprimands. This self-directed behavior persisted for a majority throughout the four weeks. Frequently, 7th-graders stayed after class to complete their work and many made comments about their progress when they saw the teacher outside of class. The 7th-graders, however, were not very active in or successful at providing feedback and assistance to peers.

The high school students were more restless and more difficult to engage in the writing program. In direct contrast to the 7th-graders, these older students continually engaged in conferencing with others, so much so that the teacher eventually banned conferencing, feeling that such interactions were exploited too frequently for social exchanges. The 9th-graders were the only group to request working on stories in pairs. The teacher allowed this activity for one of the two stories. Its effectiveness was difficult to determine, although there was much talking between the students as they worked.

Teacher Behaviors

The computer teacher was clearly more positive about the hypertext writing environment than was the high school teacher. The former took a more open approach to the program, allowing rules to evolve as needed. She imposed few requirements on students, treating branching, for example, as an option rather than a necessary story feature. Rather than requiring students to write in a folk-tale adventure theme consistent with the Frog Princess, she felt that students should be able to choose their own theme and genre. The computer teacher was very communicative about her impressions and feelings. She made frequent comments that the writing environment was working well.

When the first author visited classes, the high school teacher rarely volunteered comments about the program and generally seemed somewhat negative in her attitudes toward the program both in class and in interviews. She set more rules than did the computer teacher, and displayed a strong commitment to monitoring adherence to the rules. Her basic rules, which promoted a relatively mechanized approach to process writing consisted of requiring 10-page stories, creating branches, and featuring a certain number of characters in the stories. She started every class by listing the rules and reminding students that their work would be graded. Compared to the computer teacher, she spent more time carefully reading students' stories and making comments about their construction and quality.

Problems

Throughout the hypertext writing experience, various problems occurred. Major types consisted of:

Limitations and "bugs": lack of spelling check, writing fields were too short, cut-and-paste tools could move only four lines.

Disk and computer failure: 3 out of 22 computers needed repair; 6 out of 37 floppy disks went bad (several students lost their only copies of work).

Interface: did not permit floppy disk backups to be made from files stored on the hard drive, did not show the date or time of last use on stored files, the system locked when disk became full.

Unplanned teacher activities: Too much time devoted to Story 1, leaving less time for Story 2; limited use of embedded comments; insistence on students' producing print copies of all work, which took considerable time due to graphics; failure to follow procedures of process writing; failure to require/encourage reading of the mini-lessons.

Discussion

Findings are discussed below in relation to the three major research questions.

Embedded Feature Use

Overall, most students felt that the embedded features (branching, goal/idea buttons, editor buttons, mini-lessons, and cut-and-paste) were easy to use. Their usage of those features, however, tended to be limited. Three reasons are suggested. The first was lack of classroom writing time. For example, when students were asked why they did not use the mini-lessons, a typical response was "deadlines/too busy."

A second probable reason was lack of familiarity with the process writing concept and procedures. Contrary to teacher claims, almost all students indicated that the hypertext experience was their first exposure to a process orientation. Most also indicated that they received more feedback in the hypertext writing program than in any other school writing experience.

A third probable reason for the low feature use was lack of metacognitive skills to assess learning needs. When learning tasks are difficult, as in the case in writing, which depends heavily on metacognitive skills (Brown, 1987), learners may select less instructional support to complete the task earlier or because they don't see its value (Ross & Morrison, 1989).

Problem-solving. There was little evidence that students capitalized on the hypertext embedded features to solve problems while writing. Specifically, few students used branching as a way to develop or explore different arguments in the form of alternative plots or story endings. Further, with the exception of several students in the WW class, little attention appeared to be given to problem-solving in general, a main component of process writing.

Expert modeling. Overall, modeling was limited in frequency and restricted to superficial features, such as story theme. Based on our observations and the interview responses, students apparently found it too time-consuming and difficult to try to model actual story writing strategies.

Non-linear recursive writing. Findings did support, at a relatively superficial level, facilitation by the embedded features of planning, revising, and editing components of non-linear writing. With regard to planning, students' embedded comments in idea/goal buttons tended to be summary descriptions of story content rather than insights into dilemmas or plans of the writer. The implication is that students may not have known how to proceed with communicating their ideas, or they may have lacked generation and development skills. According to Resnick (1987), problem-solving models often fail because students don't know how to apply the models in specific contexts.

The high school students made greater use of embedded feedback for revision than did 7th-graders. This result is not surprising, since the high school teacher used the feedback more for task-oriented guidance and correction, whereas the computer teacher used it more for reinforcement. Based on student reactions, the former type (academically-oriented) feedback was viewed as more valuable.

For all classes, none of the students' embedded comments offered help to others in story writing strategies. Some story-writing comments were made by the computer teacher and especially by the high school teacher. Again, the latter's expertise in composition appeared to be the critical factor.

As the above results convey, although the embedded features were logical instructional design components, they were not utilized as anticipated to support the process writing model. The mere packaging of powerful instructional strategies in technologically-sophisticated media presentations does not guarantee that such strategies will be accepted by teachers or learners. For example, in a study of student uses of data-bases, Neuman (1993) found that numerous inappropriate design features of the data-bases prohibited easy access to material and created resistance to using the data-base systems. Gallo and Horton (in press) found similar problems in teachers' usage of Internet for educational functions. For new media applications to be effective, the status and needs of learners (and their teachers) must be considered as strongly as the content design features (Jonassen, Campbell, & Davidson, 1994). Two important factors are therefore likely to be time for users to become familiar and experienced with the application and sufficient front-end and ongoing training to facilitate skill acquisition.

Writing Improvement

Moderate to low writing scores in the holistic evaluation indicated that, in spite of hypertext-based efforts to improve the more nebulous qualities of writing (e.g., complexity, organization, clarity, and style; see Hillerich, 1985), student writing in this study tended to reflect the types of problems suggested in prior research (Applebee et al., 1990;

McGee & Richels, 1990; Stein, 1987). Such problems included lack of complex plots or analyses of different points of view, use of stereotypical solutions, and limited use of planning and writing strategies.

Analyses of writing scores indicated that the quality of stories did not improve over time, as might be expected from an environment designed to facilitate the writing process. One consideration is the possible insensitivity of the writing assessment for detecting changes in quality over an eight-week time frame. Limited interventions, like the process strategies taught here, may provide useful orientations and beginning experiences that, with additional practice and "incubation" time, engender improved skills. Further research that evaluates the strategies over an extended time period is therefore suggested.

Gender and Class Differences

Generally, the present results revealed no reliable differences between male and female students in their usage of the system, attitudes, or performance. Class differences were more noticeable across the various outcome measures. Although the majority of students were positive about the writing environment, the WW students were consistently less so than the younger students. This outcome appears mostly attributable to two factors, the students' task goals and the teacher's attitudes.

For the WW students, the task goals were more directed toward learning to write than to increasing their experiences with technology. Technical problems, in addition to the small page size which limited writing space and speed, were considered hindrances to efficient composition. Further, the isolation of process model components into separate pop-up buttons and spaces may have inadvertently worked to make the writing process more linear rather than less so. By separating the writing space for goals and ideas, idea generation may have been forced out of its relevant or natural contexts. One 12th-grader, for example, indicated that preparing to record thoughts, rather than just writing the thoughts into his work, served to interrupt writing rather than facilitate it.

The more positive attitudes by the younger students seems to be at least partly attributable to visual features. Several students elaborated about the appeal of the "book-like" appearance and the small page size, which some of the WW students, in contrast, described as "babyish." It also seems important that the younger students had much less experience with word processing and, consequently, had fewer expectancies for features that increased convenience and efficiency.

The contrasting attitudes of the two teachers suggests the importance of social variables in the acceptance and implementation of technology, a major finding in word-processing research (Cochran-Smith, 1991). The high school teacher appeared to focus more on the appropriateness of the hypertext environment for production rather than for the development of writing skills. Accordingly, she viewed the system as less "convenient" than conventional word processing for creating and disseminating student work. This negative attitude toward the technical qualities of hypertext was mirrored by her students, an outcome similar to the one found by Bradley (1993) in her study of factors influencing student attitudes toward Channel One.

The computer teacher, in direct contrast, took great interest in the potential of hypertext to stimulate new, creative approaches to writing. She perceived the various embedded features as tools for exploring different approaches to writing rather than as impediments to efficient production of final drafts. As a result, her students appeared much more open to using the system, although, like the high school students, they quickly abandoned features that they found less relevant to their personal interests and objectives. The clear implication, however, is that for technology to have an impact on classroom instruction, teachers must view the new systems as beneficial, be invested in their application, and be sufficiently trained in their use (Gallo & Horton, in press; also see Garland, 1991). In the present study, what was thought to be reasonable time working with teachers was apparently insufficient for achieving these skills and dispositions.

Recommendations

While technological problems may reduce the success of new computer-based instructional strategies, factors intrinsic to the subject area or strategies themselves may prove just as limiting. In this regard, barriers to the success of the present hypertext environment proved to be problems intrinsic to process writing instruction, as identified in the literature (Applebee et al., 1990; Calkins, 1986; Stein, 1987). Students were unfamiliar with the process orientation, the instruction provided by teachers was superficial, and students' story writing skills were generally poor. While the various support features (idea buttons, editor buttons, branching, etc.) were consistent with process writing strategies, technical problems and teacher inexperience limited their utility. Based on the results, some suggestions for future instructional design in this area are offered below.

As stated by Jones, Li, and Merrill (1992), HyperCard is a type of rapid prototype model designed more for programmers than for designers. Other, more customized prototypes may represent more convenient models because they consist of components related to instructional design needs, and are therefore not only easier to assemble quickly, but address the needs of the content more efficiently. Thus, while the hypertext environment presents new possibilities for creative, non-linear story writing, its lack of adaptive features for supporting such writing applications leads to the typical problems that occur when instruction is driven by the available technology rather than by the needs of the learner (Davies, 1993; Newman, 1993). Since the HyperCard environment had limited text editing procedures, it was not feasible to revise the stack and conduct further testing to refine the product as recommended by Dick & Carey (1991). Ideally, we would have proceeded to the development of an application to address these shortcomings with a more powerful development environment. This development effort, however, was beyond the scope of this project.

In the present study, two major categories of problems related to operational difficulties and weaknesses in the instructional design. It would should also be noted that, even though Stage 1 and Stage 2 of the evaluation model were not as rigorous as their counterparts in the Dick and Carey (1991) formative model, these phases were unlikely to identify many of the problems that actually emerged when the hypertext instructional program was actually integrated with teacher instruction, class goals, and other school or class activities. Possible improvements for process writing applications are suggested below.

1. Make the system operate more like a word processor, to include spell checking, more space for cut-and-paste, and repositioning of the cursor at the end of a page.
2. Improve the security interface (At Ease) to allow for easier file management and protection of individual files.
3. Allow for networking arrangements to facilitate communication exchanges and file access between students and the teacher.
4. Give teachers more control over the writing environment by either requiring students to read the mini-lessons or teaching the declarative and procedural knowledge via other instructional methods. As students gain more experience and demonstrate mastery of process writing skills, they should be given more freedom to experiment freely, even by creating multiple levels of branches. This recommendation of graduated learner-control allowances is consistent with conclusions from other learner-control studies (Ross & Morrison, 1989; Tennyson, 1981).
5. Program the hypertext environment to require students to complete certain units or master certain skills before they are allowed access to certain features. Additional programming might also be used to provide teachers, for monitoring purposes, descriptive summaries of student feature uses and writing activities.
6. Explore means of using branching more effectively. Branching was the most popular program component and the one most frequently cited by students in discussing idea generation and development. Branching also appears a highly appropriate format for introducing complexity and using critical thinking skills in writing (see Resnick, 1987). A possible refinement of the present instructional strategy would be to include more direct teaching and modeling (through story samples) of effective branching strategies.
7. Give more attention to developing teacher expertise and interest in using the hypertext system.

Of all the variables investigated in this study, most critical to the success of the hypertext writing environment appeared to be those relating to teacher and student perceptions of its efficiency. The results also support general findings of other research, which identify the highly influential role of classroom social systems on the success of any new technology (Cochran-Smith, 1991; Reilly, 1992). The implication is that it makes little sense to overlay such technologies on existing instructional systems and expect immediate acceptance and operational efficiency. The continuing challenge for instructional designers is effectively integrating the new delivery strategies to fit classroom conditions and curriculum needs. As demonstrated in this research, systematic evaluation can provide a valuable tool for facilitating this integration over time.

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