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EFFECTS OF OVERVIEWS AND COMPUTER EXPERIENCE ON LEARNING FROM HYPERTEXT

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ABSTRACT

The purpose of this study was to investigate the effects of overview mode and computer experience in a hypertext learning environment. College students read a hypertext unit that included a structured overview, an unstructured overview, or no overview. The study examined the effects of overview mode and computer experience on achievement, attitude and instructional time. Results indicated that participants with high computer experience learned more from the hypertext program than those with low computer experience. Furthermore, participants who received either the structured or unstructured overview spent significantly more time using the hypertext program and had significantly more positive attitudes than participants who did not receive an overview. However, overview mode did not influence achievement.

The proliferation of Internet-based instruction suggests that learners will have increasing opportunities to use hypertext. One advantage of using hypertext for learning is its flexibility for accessing and linking topics and information. However, the advantage of flexible access to information may be offset by difficulties with navigation and remaining oriented within the structure of hypertext [1-4]. Disorientation in hypertext due to poor organization represents a significant educational problem, as cognitive resources devoted to navigation reduce the resources available for learning [1, 4, 5].

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One means for limiting the disorientation associated with hypertext involves the inclusion of some type of content overview to provide the hypertext with a level of structure [6]. Research has examined a variety of forms of overviews including advance organizers, graphic organizers and headings. In a meta-analysis of advance organizer research, Mayer documented an interaction between the use of advance organizers and printed text organization [7]. Advance organizers enhanced learning outcomes for poorly organized text or text presented in an unfamiliar form, while having no effect on learning from well organized text or text presented in a familiar form. Graphic organizers have also been shown to be effective. In a meta-analysis examining the efficacy of orienting activities in computer-based instruction (CBI), Kenny reported that graphic organizers could be effective in enhancing learning from CBI [8]. Headings represent another means for providing structure to poorly organized text by explicating the relationships between superordinate and subordinate topics. Various studies have reported positive effects of headings on recall with text-based materials [9-13].

The efficacy of overviews such as advance organizers, graphical organizers, and headings is generally attributed to schema theory, where links between informational nodes serve as cues to recall. According to schema theory, recall of expository text represents a top-down search of memory structures [14-16]. By highlighting major text topics, overviews support construction of links between related topics [17].

Overviews such as organizers and headings can represent content topics in a variety of arrangements such as alphabetical or hierarchical. Researchers have compared the effectiveness of differing overview organizations. Brooks and Dansereau found recall of hierarchically formatted text superior to that of non-hierarchical text [18]. Willerman and Harg reported higher levels of recall for subjects given a hierarchically organized concept map [19]. Dee-Lucas and Larkin compared the effects of a hierarchically organized interactive overview to an unstructured overview where topics were listed alphabetically and found recall levels higher with the hierarchical overview [20]. The superiority of hierarchically structured overviews is thought to result when recall of superordinate nodes spurs recall of subordinate nodes [16, 17, 21 22].

These results suggest that the educational efficacy of hypertext may be enhanced by the inclusion of some form of hierarchically organized orienting activity designed to reduce problems with navigation and orientation. However, while the studies cited above support use of organizers and headings as orienting activities, most were conducted with print media. The degree to which those findings transfer to a hypertext setting remains unclear.

In addition to the use of organizers, the amount of computer experience a student has may influence navigation and learning from hypertext. Swan, Bowman, Vargas, Schweig and Holmes examined how people make sense of electronically presented information on the World Wide Web and found that

more experienced hypertext users navigated through electronic texts with greater ease than those with less experience [23] This implies that learners who are familiar with hypertext may expend fewer mental resources on navigation and orientation than learners who are less familiar with hypertext. Thus, experienced hypertext users may have more resources available for knowledge assimilation. Beyond simple navigational expertise, increased computer experience may contribute to an increased ability to recognize the organizational structure of hypertext. Schema theory suggests that recognition of the organizational structure of a hypertext may support comprehensive recall as superordinate concepts spur recall of the associated subordinate concepts [16, 21, 22].

Other studies provide support for the idea that computer experience may contribute to the recognition of hypertext structure. Ayersman and Reed, and Reed, Ayersman, and Liu examined learners' ability to identify the underlying organizational structure of hypertext and reported that participants with higher levels of computer experience showed greater facility for recognizing hypertext structure than those with less experience [24, 25]. These researchers suggested that learners with more extensive hypermedia experience might be able to utilize nonlinear presentations more effectively than those with less experience.

The purpose of the current study was to investigate the effects of overviews and computer experience on learning from hypertext. Participants read a hypertext unit that included a structured overview, an unstructured overview, or no overview. The study examined the effects of overview mode and computer experience on achievement, attitude and instructional time.

METHOD

Design and Participants

A 3 2 factorial design was used for this study, with overview mode (structured, unstructured and none) and computer experience (high versus low) as the independent variables. The dependent variables were achievement, attitude and time in program.

Seventy-nine undergraduates (50 females, 29 males) enrolled in an instructional methods course at a large southwestern university participated in this study. The course was offered through the College of Education; it fulfilled program requirements for education majors while representing an elective course for the remaining participants. Seventy-seven percent of the participants were education majors, while the remaining 23 percent spanned majors from accounting to real estate. While representing all undergraduate levels, participants were predominantly juniors and seniors (71 percent).

Materials

Materials used in this study included a computer-based, hypertext program and a demographic survey. The hypertext program—*Writing Objectives Using the Outcomes of Learning*—was an original, self-paced CBI developed specifically for the study. The program was designed to provide information on the types of learned performances described by Robert Gagné [26] and how they might be used to support the writing of instructional objectives. The main topics included the five categories of learning outcomes: motor skills, attitude verbal skills, intellectual skills, and cognitive strategies. Subtopics comprised the five types of intellectual skills (discriminations, concrete concepts, defined concepts, rules, and higher order rules) and the three types of verbal information (names/labels, facts, and bodies of knowledge). While the use of Gagné's learning outcomes to support the writing of instructional objectives related directly to the course content, Gagné's learning outcomes are not normally covered in this, or any other, teacher education course and thus represented new learning for all participants.

Three versions of the hypertext program were developed representing the three treatment conditions under study (structured overview, unstructured overview, and no overview). All versions covered identical content: a description of the navigational aspects of the program, an introduction to the material delineating program content and the relationship between the outcomes of learning and the writing of effective instructional objectives, information concerning the five categories of learning outcomes, and action verbs suitable for instructional objectives reflecting each of the learning outcome categories. Additionally, all versions of the program included a 22-item, untimed posttest.

Information was presented for each category of learning outcome through text and graphics. The structured overview and unstructured overview versions contained 18 introductory screens and 56 informational screens, while the no overview version contained 14 introductory screens and 51 informational screens. The program permitted selection of topics in non-linear, random order. Within each section of the program, participants could opt to return to previous screens, switch to an alternate topic, or begin the assessment portion of the program at any time.

While the instructional content was identical in each version of the program, informational screens were accessed differently in each of the three overview conditions. In the structured and unstructured overview conditions, all program screens included a navigational sidebar allowing direct access to any instructional node at any time. Navigation within an instructional node was achieved by clicking on next or back buttons. Location within the program was indicated within the sidebar through changes in the color of selected text, from black to blue. When an alternate topic was selected, the previously selected blue text returned to black. Sidebar topics were arranged hierarchically, from least to most complex, in

the structured overview and alphabetically in the unstructured overview. Figure 1 shows how the navigational sidebar was arranged for the structured overview condition. The no overview condition had no sidebar, relying instead on text imbedded hotlinks to access informational nodes. Once activated, hotlinks changed color to indicate their use. Access to instructional screens was achieved either by clicking on additional hotlinks embedded in the instructional text or clicking on a next or back button.

The demographic survey consisted of eight questions, four focused on general background information and four focused on computer experience. General questions solicited information on age, gender, class standing, and major. Computer experience questions were the following: how many years have you used a computer; how may hours per week do you currently use a computer; how do you rate your computer skills; and when you work with a computer, how confident are you that you will succeed in your task(s). For each of the four computer experience questions, students selected from three or four possible choices. Individual responses were then combined into an overall computer experience score for each participant. A median split then divided participants into two groups, those with high versus low computer experience scores.

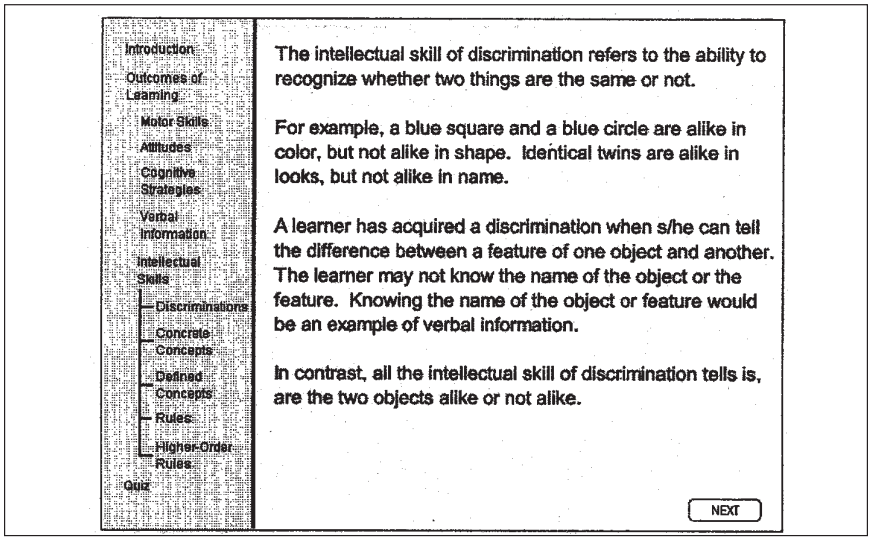

Figure 1. Structured overview.

Procedures

During the first week of regularly scheduled class meetings, the vocabulary portion of the Nelson-Denny Reading Test: Form H [27] was administered to all participants. The vocabulary section has a time limit of 15 minutes for the completion of 80 items. Students recorded their answers on scantron sheets that were scored by computer. Test results produced an overall mean score and standard deviation of 60.53 (*SD* = 17.00). Descriptive data for the Nelson-Denny standardization sample indicates a range of mean scores from 59.08 (*SD* = 13.97) to 63.20 (11.98) for four-year college juniors and seniors, the demographic group comprising over 70 percent of study participants. The reliability estimate for the vocabulary portion of the instrument is .89 [27]. Using scores from the Nelson Denny Reading Test, participants were blocked by reading level (high versus low) and randomly assigned to one of the three treatments.

One week later, participants were told that part of the course curriculum would be delivered via computer-based instruction as a homework assignment. Participants were then given a CD-ROM and floppy disk, along with directions for accessing the hypertext program on the CD-ROM. Participants were also told their results would be recorded on the floppy disk and these scores would constitute part of their course grade. They were informed that 10 points would awarded for completing the assignment, while 15 additional points would be awarded if their posttest score was 70 percent or higher. Participants were given two days to complete the assignment, after which the CD-ROMs and floppy disks were returned to the class instructor.

Criterion Measures

This study utilized two criterion measures, a post-instruction achievement test and an attitude survey. In addition, en-route data for instructional time was measured.

Achievement was measured by a 22-item, fill-in-the-blank and multiple choice posttest conducted by computer immediately following the instruction. The first two questions were recall items worth 5 points each for listing the five outcomes of learning and five types of intellectual skills. The next nine questions were application items requiring subjects to supply an appropriate action verb for the given instructional objective. An example of an application level, fill-in-the-blank question is shown below:

> Click on the colored box, then type in an appropriate verb for the objective below:
> Students will _____ pictures of sea creatures as mammals or nonmammals.

The remaining 11 application questions were multiple choice items. An example of a multiple choice item is shown on the following page:

An English student correctly defines the term meter in poetry.
Which of the following does that illustrate?
a. higher-order rules
b. concrete concepts
c. defined concept
d. verbal information

The researcher scored fill-in-the-blank items, while the computer scored the multiple-choice items. The maximum possible score was 30 points. The alpha reliability of the posttest was calculated as .86. Content validity was established based on the alignment of assessment items, instructional objectives, and the instructional content of the hypertext program.

Attitudes toward the program were measured using a 13-item, paper-based survey. Eleven attitude items used a 5-point Likert scale ranging from 1 (strongly agree) to 5 (strongly disagree). Questions focused on such things as the difficulty of, value of, and feelings toward the program, as well as the student's level of confidence about deciding where to go within the program. Example questions included, "I liked having the option to move around in the program" and "The navigation bar made finding information easy" for the structured and unstructured overview conditions or "The hotlinks made finding information easy" for the no overview condition. The survey also included two constructed response items that asked participants what they liked best and least about the program. The alpha internal reliability estimate of the attitude survey was .85.

En-route data for instructional time was collected on the computer floppy disc as the number of minutes and seconds each participant spent on the hypertext program.

Data Analysis

A separate 3 × 2 analysis of variance (ANOVA) was conducted on data for achievement and instructional time. Independent variables were overview mode (structured overview, unstructured overview and none) and computer experience (high and low). A 3 × 2 multivariate analysis of variance (MANOVA) was performed on data for attitude. The MANOVA for attitude included each of the 11 survey items as a dependent measure. Follow-up univariate analyses (ANOVA) were conducted if significant multivariate results were found. Alpha was set at .05 for all initial statistical tests. Alpha was reduced to .01 for follow-up univariate analyses of all significant multivariate attitude results.

RESULTS

Achievement

Mean scores and standard deviations for the posttest are shown in Table 1. These data reveal that the average posttest score was 18.08 for participants in the

Table 1. Posttest Means and Standard Deviations by Overview Mode and Computer Experience

Overview mode		Computer experience		
		Hi	Low	Total
Structured (n = 25)	*M*	18.62	17.50	18.08
	SD	6.37	5.02	5.67
Unstructured (n = 27)	*M*	20.92	17.73	19.15
	SD	6.36	5.30	5.90
None (n = 27)	*M*	18.08	13.79	15.85
	SD	6.87	4.63	6.11
Total (n = 79)	*M*	19.12	16.32	17.68
	SD	6.48	5.21	5.99

Note: Maximum possible score = 30.

structured overview condition, 19.15 for participants in the unstructured overview condition, and 15.85 for those in the no overview condition. Table 1 also shows that the average posttest score for participants with high computer experience was 19.12 and 16.32 for those with low computer experience.

A 3 × 2 ANOVA (overview mode and computer experience) identified a significant main effect for computer experience, $F(1,79) = 4.799$, $p < .05$, ES = .47. Students with high computer experience performed significantly better on the posttest than those with low computer experience. ANOVA did not reveal a significant effect for overview mode, $F(2,79) = 2.352$, $p > .05$, nor a significant interaction between overview mode and computer experience, $F(2,79)$ 0.499, $p > .05$.

Attitude

Means and standard deviations for each attitude survey item are shown in Table 2. Each item was scored on a 5-point Likert scale, ranging from 1 (most positive) to 5 (least positive). A 3 × 2 MANOVA indicated a significant main effect for overview mode, $F(22,120) = 2.21$, $p < .05$, but not for computer experience $F(11,60) = 1.00$, $p > .05$. Furthermore, there was no interaction between overview mode and computer experience, $F(22,120) = 1.004$, $p > .05$.

Follow up univariate ANOVAs revealed that overview mode had a significant effect on the following attitude items: The (navigation bar/hotlinks) helped me keep track of where I was in the program, $F(2,76) = 10.29$, $p < .01$; The (navigation bar/hotlinks) made finding information easy, $F(2,76) = 11.09$, $p < .01$; The (navigation bar/hotlinks) made moving through the program easy, $F(2,76) = 16.89$, $p < .01$; I felt confident about deciding where to go in the program,

Table 2. Mean Scores for Attitude Items by Overview Mode

	Overview mode		
Item	Structured	Unstructured	None
I liked this program.	2.76	2.74	3.01
I would recommend this program to other students.	2.64	2.96	3.00
I preferred learning about verbs for objectives with a computer program rather than in a lecture format.	2.76	3.00	3.37
This program was easy.	2.52	2.96	3.37
I learned a lot about choosing verbs for objectives.	2.76	2.62	3.15
I tried hard to do well in this program.	2.24	2.19	1.85
The (navigation bar/hotlinks) helped me keep track of where I was in the program.*	1.88	1.63	2.74
The (navigation bar/hotlinks) made finding information in the program easy.*	1.80	1.59	2.78
The (navigation bar/hotlinks) made moving through the program easy.*	1.60	1.41	2.73
I felt confident about deciding where to go in the program.*	1.80	1.89	3.07
I liked having the option to move around in the program.*	2.04	1.56	2.50

Note: 1 = strongly agree and 5 = strongly disagree; *$p < .01$.

$F(2,76) = 9.09$, $p < .01$; I liked having the option to move around in the program, $F(2,76) = 8.18$, $p < .01$.

Post hoc Tukey analysis revealed that the means for participants in both the structured overview and unstructured overview conditions were significantly higher than the means for participants in the no overview condition for all items

listed above, with the exception of "I liked having the option to move around in the program." For this item the unstructured overview mean was significantly higher than both the no overview mean and the structured overview mean.

Instructional Time

Examination of instructional time data revealed two outliers with values two to four times that of any other data points. As the hypertext program was completed by participants individually on their own computers, these outliers were eliminated from subsequent time-in-program analysis on the assumption that they likely represented instances where participants left the program running while otherwise engaged before returning to complete it.

The average time-in-program for the three treatment groups was 16 minutes 30 seconds for participants receiving the structured overview, 14 minutes 44 seconds for participants receiving the unstructured overview, and 9 minutes 28 seconds for participants receiving the no overview condition. A 3 × 2 ANOVA (overview mode and computer experience) identified a significant main effect for overview mode $F(2,77) = 3.46$, $p < .05$. Post hoc Tukey analysis revealed that the mean for participants in the structured overview condition was significantly higher than the mean for participants in the no overview condition. ANOVA did not reveal a significant effect for computer experience $F(1,77) = .88$, $p > .05$, nor a significant interaction between overview mode and computer experience $F(2,77) = .28$, $p > .05$.

DISCUSSION

The purpose of this study was to investigate the effects of overview mode and computer experience on learning from hypertext. Participants read a hypertext unit that included a structured overview, unstructured overview or no overview. The study examined the effects of overview mode and computer experience on achievement, attitude and instructional time.

Results indicated that participants with higher computer experience learned more from the hypertext program than those with less computer experience. Computer experience may have influenced achievement because it reduced the cognitive load associated with learning from hypertext, thereby permitting participants with high computer experience to focus increased mental resources on learning. This explanation is supported by other studies indicating that individuals with increased computer experience show greater facility at recognizing hypertext structure [24, 25] and studies showing that students with Internet experience move more easily through information presented in hypertext form [23]. Recognizing a hypertext's structure may reduce the mental resources needed to remain oriented in a hypertext environment. The capacity to move through

hypertext easily may reflect a reduced need for cognitive resources focused on navigation.

While computer experience was significantly related to achievement, overview mode did not influence posttest scores in the current study. A credible explanation for the lack of effect for overviews may be the relatively simple structure of the instructional hypertext. Compared to large hypermedia databases, the hypertext used in the current study contained a relatively small number of main headings and subheadings. This lack of complexity may have allowed subjects to recall hypertext topics regardless of treatment. In a study of the effects of headings, topical overviews and topical summaries on recall, Lorch and Lorch reported that such organizational signaling devices were unlikely to result in increased recall when the topic structure of text was relatively simple to encode and remember [9].

It is also possible that overview mode did not influence achievement in this study because the instructional program was well organized. Each topic was presented within its own section which included instructional content followed by examples. According to Mayer, organizers enhance learning outcomes for poorly organized text, while having no effect on well organized text [7].

Another possible explanation for the lack of effect for overview mode concerns the limited interaction between participants and the overviews. Instructional time for all groups was relatively brief suggesting that time spent interacting with the overviews was minimal. Tovar and Coldevin found the positive effects of orienting activities on achievement was related to time spent in the program [28]. It may be that the instructional time in the current study was too brief for the overviews to support creation of a viable schema capable of enhancing recall.

While overview mode did not influence achievement in the current study, results indicated that participants given either structured or unstructured overviews had significantly higher attitudes toward the hypertext program than those given no overview. Comments made by participants in the constructed response portion of the attitude survey suggest that overview mode may influence attitudes by reducing the level of frustration associated with navigating through the hypertext. Comments by those given an overview included such things as, “The navigation bar made things easier to follow”; “(The program) was easy and efficient to move through at my own pace”; and, “It was easy to access information.” In contrast, those given no overview expressed frustration with navigation, recording comments such as, “I couldn’t figure out where to go”; “I thought if I went through the program I would get all the information.” These responses highlight the difficulty subjects with no overview encountered, supporting previous findings that subjects navigating by use by use of hot links often experience disorientation [2, 3, 29, 30].

The results that overview mode influenced attitude but not achievement supports Clark’s contention that students don’t always learn the most from treatments they like best [31].

Turning to results for time, participants in the structured overview condition spent significantly more time on the hypertext program than those in the no overview condition. This result is consistent with the findings of Tovar and Coldevin [28]. Comments made by several participants in the current study provide some explanation for why those with no overview spent less time on the program. These students indicated they became so frustrated in their attempts to locate and read all the instructional screens using hotlinks that they eventually moved on to the assessment despite feeling they failed to read all program content.

The present study has implications for practitioners who plan to develop and implement hypertext learning environments. The use of hypertext and hypermedia for instruction will expand as a variety of educational institutions offer an increasing number of web-based courses. Results of this study suggest that the establishment of prerequisite technical ability or computer experience for students enrolling in these courses may contribute to learning and achievement. Furthermore, results imply that including an overview may contribute to favorable student attitudes toward navigating and locating information within hypertext environments. While the study did not show that a structured overview was more effective than an unstructured overview, inclusion of a text-based overview did influence outcomes in this study. Deciding what type of overview to include in hypertext may be based on practical considerations. McDonald and Stevenson maintain that graphic organizers aren't practical for large databases because they use too much screen space [29].

With the increased use of hypermedia for instruction, it is important that instructional technologists identify those factors contributing to learning from hypertext. Future research should continue to investigate the role that computer experience plays in a hypertext environment, especially as it relates to reducing cognitive load. Research should also examine which aspects of computer experience may be responsible for supporting learning from hypertext. The effect of overviews and headings warrants further attention given that they are a common feature in many hypermedia environments. The current study used a relatively simple hypertext structure. Future research incorporating more complex hypertext structures may further illuminate the relationship between overviews and learning, thereby supporting the design of more effective hypertext environments.

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