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ABSTRACT

Differences in traditional student performance measures were examined following a computer assisted instruction (CAI) or a hypertext approach for mastering concepts related to intellectual property (i.e., copyright and patent) law. Seventy-six undergraduate business majors at a midwestern state university received CAI or hypertext instruction. Both the CAI tutorial and the hypertext system were developed using HyperCard and its authoring language. Learner control over the number of informational screens was not found to be a factor in overall performance, and there was no significant difference in the number of subject matter screens viewed by the two treatment groups. Neither treatment was found to achieve a greater measure of learning about intellectual property law. There are indications from the study that ability plays a major role in assessing the effectiveness of a tutorial versus hypertext instructional systems. The tutorial appears most effective for high-ability subjects. Six tables and two figures illustrate study findings. (Contains 14 references.) (SLD)

Title:

An Assessment of the Effectiveness of a Hypertext Instructional Delivery System When Compared to a Traditional CAI Tutorial

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An Assessment of the Effectiveness of a Hypertext Instructional Delivery System when Compared to a Traditional CAI Tutorial

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More than 40 years ago, Vannevar Bush, science advisor to President Roosevelt, proposed a hypothetical machine, the MEMIX, that would allow individuals to browse through information, photographs, maps, and sketches by using links connecting any two source documents. The visionary image provided by Bush coupled with significant advances in computers, software, and high capacity fast access digital storage devices have given rise to databases that today contain documents, graphics, sound, speech, and animated sequences. A database containing information in these varied formats which supports the non-sequential access of information by the user has been coined hypertext.

Hypertext can be visualized as a 'semantic' network of nodes and links. In this model, nodes represent information units (e.g. documents, graphics, sound, etc.) while links serve as the cross-reference threads connecting related nodes. The links connecting nodes are usually denoted by highlighted words, phrases or graphics and are activated by using a mouse or arrow keys to select it. Depending on its purpose and location, a link can: transfer the reader to a new but related topic, show a reference or serve to move from a reference to the article, provide ancillary information, display a related illustration, schematic, photograph or video sequence, display an index or access and run a related application program.

The development of hypertext systems has grown rapidly during the last decade. Today, applications which utilize hypertext include: online help and documentation resources, software engineering tools, encyclopedias, reference manuals and books, and computer assisted learning in numerous educational disciplines.

Hypertext has three characteristics that are not present in traditional instruction which relies heavily on a highly directed flow of information. First, hypertext systems allow huge collections of information in a variety of mediums to be stored in an extremely compact form and accessed easily and readily. The stored information can be linked both explicitly and implicitly. Explicit links can be used by authors to suggest paths through information which learners may or may not choose to follow. Implicit links can be included which support glossaries, dictionaries, and navigational aids to be used as needed by the learner (Marchionini, 1988).

Second, hypertext is an enabling rather than directive environment. Hypertext systems encourage the user to probe information sources. By selecting the order, number, and composition of the nodes accessed, one can acquire and process information in ways that capitalize on their individual cognitive and experiential framework (Schneiderman, 1990). Learning theorists contend user initiated movement also increases the number of retrieval pathways available to access encoded information from the user's own long term memory (Jonassen ,1988). Not only does hypertext offer a new way to learn course content but also offers a new way of learning how to learn.

Third, hypertext offers the potential to alter the roles of teachers and learners and the interactions between them. The flexibility of hypertext enables students to create unique paths and interpretations of the paths which later can be shared with teachers or other students (Marchionini, 1988).

Conversely, others argue that hypertext is less than optimal. Learner control, aptitude-treatment interaction (ATI), disorientation and cognitive overhead are problems often associated with hypertext.

For some learners, the degree of control afforded by hypertext may negatively affect learning. Tennyson and Rothen's (1979) research on learner, adaptive, and program control strategies employed in computer based instruction concluded that learner control consistently yielded lower post-test scores than other control strategies partially because students terminated instruction too early. Because of the richness of the medium, learners may not know what sequence or content area of hypertext are best for themselves to reach desired learning objectives. Some suggest that the less familiar subjects are with the content of the unit to be mastered, the greater the need for support in the form of clearly stated learner objectives. Such objectives provided to the learner could serve as a 'checklist' indicating to the learner what must be learned while using the hypertext system. Objectives used in this manner provide additional guidance and direction as learners utilize hypertext for instruction.

Other issues related to instructional control appear to be directly related to the learner himself. Hannafin (1984) concluded from reviewing relevant research that learner control is favored over program control when: (1) learners are older and more mature; (2) learners are more capable; (3) and higher order skills rather than factual information are being taught. Stated another way, hypertext may not be the best mode of instruction for all learners or content areas.

Aptitude-treatment interaction phenomenon may be also be aggravated by the lack of structure in such a learning environment. Research by Clark (1982) indicates low-ability students have higher achievement from more structured instructional methods whereas they prefer less structured methods. On the other hand, high-ability students, he claims, will generally prefer more instructional support but may actually perform better when given leaner, less elaborated material where they must take more responsibility for generating encoding strategies. Lower ability students, who need the additional support, may decline to seek it. He hypothesized that both groups prefer what they perceive will demand the lowest 'mental workload' for themselves.

Additionally, Steinberg (1977) addressed the issue of ATI. She suggested that while high achievers seem capable of using most forms of learner control effectively, low achievers seem much less able to make decisions about instructional properties (what, how, or how much information) than from those decisions involving variations in presentational aspects (how information is formatted or delivered). Her research findings suggest when instructional decisions need to be made, better learning is likely to occur with external coaching or advisement regarding which resources to select. Aptitude-treatment interaction research suggests hypertext may not be the most effective environment for low achieving learners. Perhaps a strategy which prescribes closer assessment of learning by the instructor may be necessary.

Disorientation is the result of more degrees of freedom, more dimensions available in which one can move. Technical solutions to disorientation are: (1) graphical, map-like models which depict the current hyperspace and identify the user's position within the space; (2) and providing a means for the learner to backtrack.

Graphical models termed context webs and local maps are used in Brown University's Intermedia system. In this hypertext system, nodes consisting of documents, graphics, sound, and animation related to the same context are grouped to form a web. Using this model, every node belongs to one or more web. When the user activates a node belonging to a web, they can visually see the other links and nodes which also belong to the active web. In addition, a local map can be activated which only shows the present active document and its closely related neighbor nodes (Conklin, 1987).

HyperCard and other developmental shells offer a back-tracking function. By clicking on an icon representing a prior screen, the user is able to move directly to that screen thus enabling a rapid review of previously encountered information.

The additional mental effort and concentration required to make choices about which paths to follow and which to leave alone can result in 'information myopia' or cognitive overhead (Conklin, 1987). Cognitive overhead may be reduced if the usr . able to more effectively organize and integrate the new chunks of information extracted from the hypertext medium with existing prior knowledge.

To date, little research has been conducted to support or resolve the above mentioned issues related to hypertext systems. Research performed by Egan, et. al. (1987) and Landow (1989) support the contention that hypertext systems do in fact support a richer learning environment. Other studies conducted by Covey (1990), Lanza and Roselli (1991), Mays, Kibby, and Watson (1988), and Tripp and Roby (1990) indicate hypertext delivery systems were less effective than other instructional systems.

This study examines differences in traditional student performance measures following a CBI tutorial or a hypertext approach for mastering concepts related to intellectual property (copyright and patent) law.

Method

Subjects

Seventy six voluntary subjects in the study were enrolled in an undergraduate introductory business law course required by all majors in the College of Business at a midwestern state university. The subjects were divided into two treatment groups: one group received instruction using a CBI tutorial and the other group received instruction delivered in a hypertext format which utilized graphical maps. When queried prior to treatment, all participants indicated they had a general awareness of the topic of the instruction, copyright and patent law, but knew nothing about the legal issues and implications related to the subject area.

Each subject received an ability ranking by their current business law professor prior to the study. The levels were based on eight weeks of observations which included assignments and tests.

Each system also contained a HyperCard script which created an audit trail which recorded the movement of each subject as he moved through the the HyperCard stack.

Programs

Two computer based applications, a tutorial and hypertext system, were developed using HyperCard and its authoring language HyperTalk. Both contained identical subject matter but varied in the amount of personal control and structure offered to the user.

In the tutorial, students were presented with a main menu listing the topics in the proper order of study. Once a topic was selected, the subject was required to move through all the related instruction prior to selecting another topic. No restrictions were placed on the number of times a topic could be selected for study.

The hypertext system presented the same topics for study but made no attempt to identify or impose an order in which the topics should be studied. In this system, once a subject area was selected, the student was presented with a graphical map which served to identify the informational nodes associated with the topic as well as depicting how they were related. To move to a node shown on the graphical map, the subject was required to click on the node. A subject using the hypertext system had three control options at any given time: continue to move linearly through the information associated with the selected node; return to the graphical map of the topic and select another related informational node; or return to the list of topics presented and select another topic.

An example of the menus available for both the tutorial and hypertext systems (Figures 1 and 2) are appended at the end of the paper.

Embedded within both systems were numerous opportunities for students to check their comprehension of the subject matter through the use of 'what if' applications. In each situation where responses were solicited and obtained, diagnostic feedback was provided.

Facilities

Both groups used equipment in an academic computing center at a state university in southern Minnesota. The equipment consisted of Macintosh SE computer systems with internal hard drives.

Instruments

The instrument used to measure the students' performance was composed of 30 multiple choice questions reflecting both recall and and application of the concepts presented in the software. One point was allocated to each question. This instrument was used as both the pre-test and post-test assessment instrument.

The reliability of this instrument as determined by a KR-20 analysis was .688.

Procedure

The procedure used in this study was as follows:

1) Two days prior to the study, subjects unfamiliar with the Macintosh platform used to deliver both forms of instruction received an intensive two hour training session.
2) Treatments were assigned randomly. Detailed instructions on effective use of the assigned treatment as well as a practice period using software similar to the assigned treatment was implemented for each participant.
3) After the practice period, subjects were administered a pre-test and given objectives reflecting the subject material to be mastered.
4) Participants were administered a treatment consisting of either the tutorial or hypertext system and post-test under supervision of the researcher. No time limit was placed on viewing the software.

Results

Table 1 reports the t-test analysis which was applied to the results of the post-test to assess the difference in performance between the tutorial and hypertext treatments. No significant difference was found at the .05 level.

Table 1. Tutorial vs. Hypertext Group Post-Test Results

	N	Mean	S.D.
Tutorial group	37	20.158	3.6865
Hypertext group	39	18.313	3.6160

t(74) df=.45 p=.643

A t-test for paired samples (pre-test, post-test) analysis when applied to the two treatment groups is represented in Table 2. Significance was found at the .05 level for both treatments.

Table 2. Tutorial vs. Hypertext Group Paired Pre-Test, Post-Test Results

	N	Mean	S.D.	p
Tutorial group				
Pre-test	37	12.4054	2.544	.029
Post-test	37	1[illegible].5405	4.018	
Hypertext group				
Pre-test	39	13.0513	3.268	.005
Post-test	39	18.8205	3.546	

Table 3 depicts the t-test for paired samples (pre-test, post-test) analysis when applied to the three ability groupings. Significance was found at the .05 level for both low ability and medium ability groups.

Table 3. Ability Groups Paired Pre-Test, Post-Test Results

	N	Mean	S.D.	p
Low ability				
Pre-test	21	11.8571	3.321	.036
Post-test	21	17.0000	3.987	
Medium ability				
Pre-test	36	12.7500	2.951	.030
Post-test	36	18.1389	3.217	
High ability				
Pre-test	19	13.6842	2.212	.902
Post-test	19	21.5789	2.893	

A one-way analysis of variance (Table 4) showed no significance at the .05 level between ability and the pre-test scores but significance at the .05 level between ability and the post-test scores. Further follow up with the Scheffe procedure indicated ability groups one and two (low and medium ability) and groups two and three (medium and high ability) were significantly different at the .05 level.

Table 4. One Way Analysis of Variance Pre -Test, Post-test by Ability

Dependent variable	Source of Variation	df	SS	MS	F	p
Pretest	Between Groups	2	33.3102	16.6551	1.982	.1451
	Within Groups	73	616.4267	8.4031		
Post-test	Between Groups	2	229.4839	114.7420	10.081	.0001
	Within Groups	73	830.9371	11.3827		

The data associated with screens viewed per treatment is summarized in Table 5. No significant difference between means was found at the .05 level.

Table 5. Tutorial, Hypertest Screens Viewed

	N	Mean	S.D
Tutorial	37	123.824	26.903
Hypertext	39	118.324	15.813

A one way analysis of variance (Table 6) showed significance at the .05 level between the post-test tutorial scores and ability groupings while no significance was found between post-test hypertext scores and ability groups.

Table 6. One Way Analysis of Variance Treatment Post-test Scores by Ability

Dependent variable	Source of Variation	df	SS	MS	F	p
Tutorial treatment	Between groups	2	210.6237	105.3118	9.5181	.0005
	Within groups	34	376.1871	11.0643		
Hypertext treatment	Between groups	2	31.2526	15.6263	1.0781	.3513
	Within groups	36	507.3000	14.4943		

Discussion

The purpose of this study was to assess, in an undergraduate university setting, the effectiveness of a hypertext instructional delivery system when compared to a traditional CAI tutorial. Several findings which relate directly to problematic issues of learner control and ability were noted.

Learner control over the number of informational screens viewed was not found to be a factor in overall subject performance. Quantitative examination of the audit trail compiled by each subject's treatment indicated there was no significant difference in the number of subject matter screens viewed by the tutorial versus hypertext treatment groups. Subjects in both treatment groups appear to have taken the treatments earnestly. Each treatment group viewed nearly one fourth of subject screens twice. The novelty of the instructional mode should not be ruled out in further studies as a factor which may play a significant role in this aspect of evaluating learner control.

Although learner control in this study did not hinder a subject's ability to navigate through the screens, it did not facilitate a greater understanding of the material as assessed by the post-test instrument. Neither treatment was found to achieve a greater measure of learning of intellectual property law.

There are indications from this study that ability plays a major role in assessing the effectiveness of a tutorial versus hypertext instructional systems. Examination of post-test performance when viewed in relation to treatments and ability groupings revealed variations. No significant differences in post-test scores were found between the three ability groupings in the hypertext treatment. Even though practice using a similar hypertext system was done prior to treatment, the subjects' lack of experience and unfamiliarity with non-linear learning may have been a factor in these results. Another factor may relate to the instrument used for evaluation. Perhaps a different method of assessment which emphasizes the broad scope of potential associations made in hypterext environments may be more suitable. Significant results were obtained between the low and high ability groups as well as the average and high ability groups in the tutorial treatment. These results indicated the tutorial was most effective for high ability subjects.

This study was an attempt to assess the effectiveness of tutorial versus hypertext delivery systems and to identify learner characteristic which may be used to prescribe the most beneficial mode of instruction. Overall, findings indicate learner control was not a factor in the hypertext mode of instruction. Additionally, ability appears to play a key role in the effectiveness of the tutorial as determined by the post-test instrument while it had little if any effect on subject performance as determined by the post-test instrument in the hypertext mode.

This study set forth additional questions to be answered through research. What type of instrument most effectively assesses learning in hypertext environments? Can different learning styles or learner characteristics be used to predict success in a tutorial or hypertext system? Does novelty play a role in tutorial, hypertext, or both forms of instruction systems? Can quantitative analysis of audit trails provide insight to designers of hypertext systems? Answers to these questions and others must be sought to validate the use of hypertext as an instructional system.

References

Clark, R. E. (1982). Antagonism between achievement and enjoyment in ATI studies. Educational Psychologist, 17 (2), 92-101.

Conklin, J. (1987). Hypertext: An introduction and survey. Computer, 20 (9), 17-41.

Covey, Preston K. (1990). Art or forgery? The strange case of Han Van Meegeren A videodisc for aesthetics and art history. Journal of Computing in Higher Education, 2, (1), 3-31.

Egan, Dennis E., Remde, Louis M., Gomez, Landauer, Thomas K., Eberhardt, Jennifer, &Lochbaum, Carol C. (1989). Formative design-evaluation of SuperBook, ACM Transactions on Information Systems, 7, (1), 30-57.

Hannafin, Michael J. (1984). Guidelines for using locus of instructional control in the design of computer-assisted instruction. Journal of Instructional Development, 7, (3), 6-10.

Jonassen, David H. (1988). Designing structured hypertext and structuring access to hypertext. Educational Technology , 37, 13-17.

Landow, George P. (1989). Hypertext in literary education, criticism, and scholarship. Computers and Humanities, 23, 173-198.

Lanza, Antonietta, &Roselli, Teresa (1991). Effects of the hypertextual approach versus the structured approach on students' achievements. Journal of Computer-Based Instruction, 18, (2), 48-50.

Marchionini, Gary (1988). Hypermedia and learning: Freedom and chaos. Educational Technology, 37, 8-12.

Mays, J. Terence, Kibby, Michael R., & Watson, Hugh (1988). The development and evaluation of a learning-by-browsing system on the Macintosh, Computers in Education, 12, (1), 221-229.

Schneiderman, B. (1990). Hypertext hands-on. Reading, MA: Addison-Wesley

Steinberg, Esther R. (1989). Cognition and learner control: A literature review, 1977-1988. Journal of Computer-Based Instruction, 16 (4), 117-121.

Tennyson, Robert D. & Rothen, Wolfgang (1979). Management of computer-based instruction: Design of an adaptive control strategy. Journal of Computer-Based Instruction, 5 (3), 63-71.

Tripp, Steven D. & Roby, Warren. (1990). Orientation and disorientation in a hypertext lexicon, Journal of Computer-Based Instruction, 17, (4), 120-124.

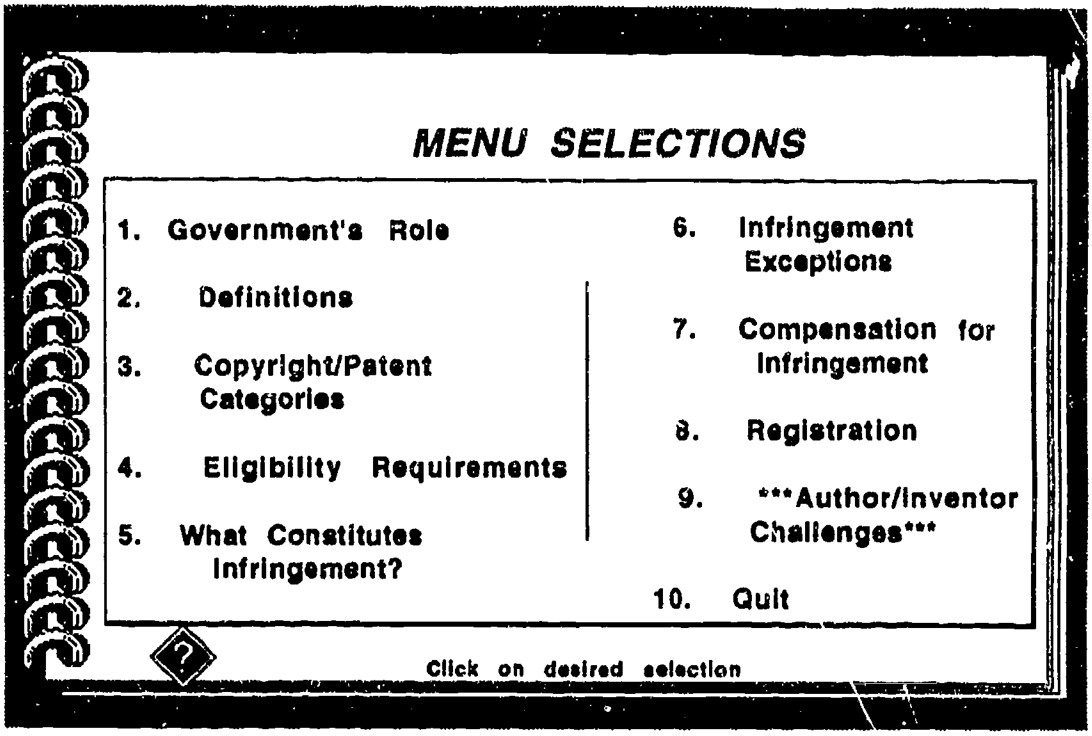

Figure 1. Tutorial Main Menu

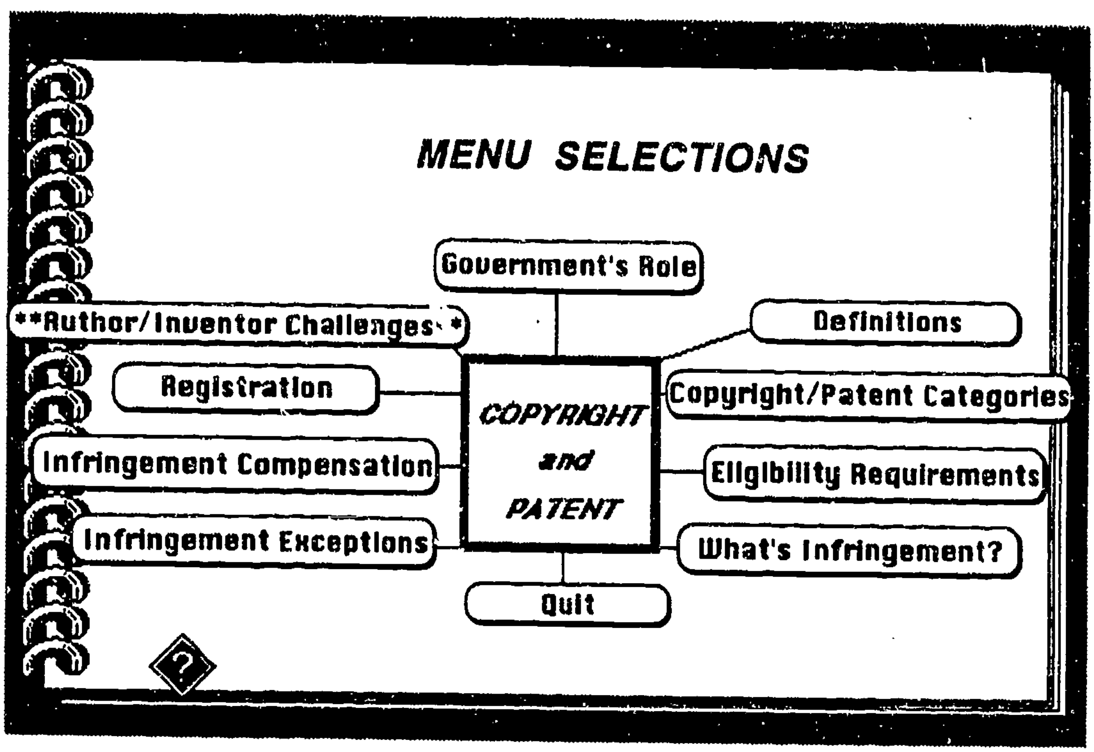

Figure 2. Hypertext Main Menu