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ABSTRACT

The purpose of this study, unique in that it centered on students as creators rather than users of programs, was to determine whether collaboratively creating HyperCard stacks that presented information on four decades (i.e, the 1920s, the 1930s, 1945-60, and the 1960s) affected the amount of knowledge and the interrelatedness of informational units students had on the assigned decades. Specifically, this study was an investigation of the effect of a month-long instructional unit focusing on HyperCard and factors influencing the values of different decades on knowledge development and the interrelatedness of those knowledge structures. Thirteen upcoming high school seniors participated in this study as part of the 1991 West Virginia Governor's Honors Academy, a 4-week, summer residential, academic enrichment program attended by 165 students from throughout the state. The 13 students self-selected a strand of instruction called "Hyper-Humanities" from a list of 11 instructional strands. The students received both HyperCard and humanities instruction. Results indicated that students engaging in the development of HyperCard-based programs featuring the various factors affecting the values of certain decades promotes an increased awareness of the interrelatedness of these factors; and these changes in perceptions were due to the linking nature of the HyperCard authoring language. (Contains 23 references.) (ALF)

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The Effect of HyperCard Programming on Knowledge Construction and Interrelatedness of Humanities-Based Information

by

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RESEARCH FRAMEWORK

A considerable amount has been written on the usefulness of hypermedia-based learning environments (i.e., Conklin, 1987; Hammond, 1989; Heller, 1990; Jonassen, 1989, 1990). The concept has existed for quite some time, as indicated by an early reference by Nelson (1967), who provided the following definition: "[It] is a combination of natural language text with the computer's capacity for interactive branching . . . [or the] dynamic display of a nonlinear [processing]" (p. 17). According to Jonassen, a hypermedia system consists of fragments of information that can be text, graphics, or video. The fragments of information are considered ***nodes*** that are linked to other nodes. A user of a hypermedia system can navigate through the knowledge structure and determine which path to follow as well as the sequence and length of viewing. Hypermedia knowledge structures are typically considered to be similar to how information is stored in the human memory system, structures created so that the user can "jump around" within a program—that is, access more detailed information if desired or access a graphic display of information or access totally unrelated information. The majority of the literature, thus far, is descriptive or theoretical and, almost without exception, addresses users of hypermedia systems, rather than the effect of engaging in the construction of hypermedia environments on the students' knowledge structures.

To-date virtually every Hypermedia-related publication has centered on educational applications, rather than based on systematic, data-based inquiry. The different content-areas in which HyperCard has been applied include (a) language and learning (i.e., Campbell, 1989; DiPardo & DiPardo, 1990; May, 1990); (b) history (i.e., Crane & Mylonas, 1988); (c) science (i.e., Barba & Merchant, 1990; Hall, Thorgood, Hutchings, & Carr, 1989; Miller & Radziemski, 1988); (d) computer science (i.e., Gustafson & Reeves, 1990; Percival, 1990); and (e) social studies (i.e., Horton, Boone, & Lovitt, 1990). Categories other than content-area were (a) multimedia and hypermedia (i.e., Ashworth & Stelovsky; Campbell; Jonassen, 1989; Lanz & Roselli, 1991; Tripp & Roby, 1990) and (b) learning disabilities (i.e., Horton, Boone, & Lovitt).

HyperCard has been found to be an excellent tool for creating prototypes of some more complicated and comprehensive projects (i.e., Boyle & Snell, 1990; Duhrkopf, 1988; Harris & Cady, 1988; Jonassen, 1989, 1990; Monk, 1990). Likewise, it has been used extensively and effectively in illustrating instructional design principles and multimedia and hypermedia theories and concepts (i.e., Boyle & Snell; Gustafson & Reeves, 1990; McKnight, Dillon, & Richardson, 1990).

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A few HyperCard-based studies focusing on the use of already-developed software have been conducted. For example, Lanza and Roselli (1991) investigated the effects of a structured approach versus a hypertextual approach for teaching Pascal. The study, with Information Science undergraduates, involved comparing the effect of a HyperCard-based, non-linear and less structured program versus a linear and more structured CAI program on the learning of Pascal. Although there were no significant performance differences, 63 percent of the CAI group considered the structure program to be boring whereas 76 percent of the HyperCard group considered the hypertextual approach to be stimulating.

Tripp and Roby (1990) investigated a less structured versus a more structured hypertext environment using HyperCard in terms of their relative effects on the learning of Japanese by graduate and undergraduate students. More structured involved a visual that suggested the structure of the database whereas less structured involved a graphical background that did not reflect the structure of the database. More structure also involved advance organizers describing the structure of the lexicon whereas less structured involved presenting a paragraph on the Japanese language. There were no significant main effects, but there was a significant interaction between visual metaphor and advance organizer with those students receiving only one structured device performing better than those receiving two.

In another study, Horton, Boone, and Lovitt (1990) used HyperCard-based, hypertext software to increase textbook comprehension and compared it to when the students simply read the textbook. The computer treatment was significantly more effective. A fourth study, one by Collourn and Cockerton-Turner (1990), found that pairs versus individuals performed better when attempting a computer-presented physics problem.

The purpose of this study was to determine whether collaboratively creating HyperCard stacks that presented information on four different decades affected the amount of knowledge and the interrelatedness of informational units students had on the assigned decades. Because HyperCard promotes the potential of seeing relationships among knowledge units via the linking of cards to other cards—both within one stack and from one stack to another—as well as incorporating pictures and sounds that engage mental processes other than mere text processing, it was felt that students' knowledge structures via creating HyperCard stacks might be enhanced.

Specificially this study was an investigation of the effect of a month-long instructional unit focusing on HyperCard and factors influencing the values of different decades on knowledge development and the interrelatedness of those knowledge structures. Two research questions guided this study: (a) did the instruction centering on HyperCard and research on the humanities of a decade increase knowledge? and (b) did the instruction on HyperCard and research on the humanities of a decade enhance the interrelatedness of the knowledge?

DESIGN OF THE STUDY

Sample

Thirteen upcoming high school seniors participated in this study as part of the 1991 West Virginia Governor's Honors Academy, a four-week, summer, residential, academic enrichment program attended by 165 students from throughout the state. Three students were selected from each of the 55 counties via a local process; the criteria for selection included both academic and extracurricular achievement. The selection of one male and one female was required; the other student was selected independent of gender. The 13 students self-selected a strand of instruction called "Hyper-Humanities" from a list of 11 instructional strands. All 13 students had had instruction in the BASIC programming language on either the Apple IIe or the IBM PC; four had had additional training in Pascal. Two of the students had had some cursory experience with the Macintosh. None had had any experience with the HyperCard authoring language.

Independent Variable

The "Hyper-Humanities" strand involved 17 two-hour sessions on HyperCard and 13 two-hour sessions on researching the humanities of a certain decade. Each student was assigned to one of four decades: (a) the 20's, (b) the 30's, (c) the years 45-60, and (d) the 60's. Three students were assigned to research and produce a group HyperCard-based program on the 20's; three others, on the 30's; three others, on the years 45-60; and the remaining four, on the 60's. The years 40-44 were not included because it was believed that doing so may have resulted in the students' focusing mostly on World War II, rather than the other factors influencing those years.

The HyperCard instruction involved (a) an orientation to the Macintosh and HyperCard; (b) instruction on HyperCard's five objects: background/foreground, buttons, cards, stacks, and fields; (c) exercises on digitizing pictures and sound as well as producing cards that animated graphics; (d) discussion of summary versus detailed information as a prompt to promote linking cards from one stack to another; (e) scripting; and (f) program construction blocks of time during which the instructor served as a resource person to help with logic issues and debugging problems.

The Humanities instruction involved (a) an overview of the effects of humanities-related factors on the values of a given decade; (b) guest-speakers on the influence of music, art, history, science, literature, and technology on values; (c) library orientations on how to locate resources at a major university; and (d) time for researching information related to their assigned decades.

Dependent Measures

Knowledge Construction. The students responded to six items of an instrument that asked for their perceptions of how the art, history, science, music, literature, and technology of a given decade influenced the values of that decade. For example, the students responded 0 (no influence), 1 (very little influence), 2 (moderate influence), or 3 (considerable influence) to questions such as "To what extent do you

believe art influenced the values of your decade?" They were also to list up to five values, five events, and five social reforms of their decades. Pre-treatment responses were compared to post-treatment responses.

Interrelatedness of Knowledge. To measure how they perceived the interrelatedness of these factors, they responded 0 to 3 (see above for an explanation of numeric values) to 30 questions. Questions included "To what extent do you believe history influenced literature in your decade?" and "To what extent do you believe history influenced technology in your decade?" They also engaged in a 20-minute mapping exercise during which they, in their decade-groups, wrote the phrase "Values of Our Decade" in the center of the paper and then as a small group generated factors affecting those values, provided additional details on the factors, and then drew arrows to indicate the relationships among the informational units. Their work was analyzed for the number of factors (first level), the number of second-level details, the number of third-level details, and the number of relationships they identified among the informational units. Pre-treatment responses were compared to post-treatment responses.

Procedures

During the first week, the 13 students attended three Macintosh-HyperCard sessions and seven Humanities sessions. During the second week, they attended four Macintosh-HyperCard sessions and four Humanities sessions. During the third week, they attended two Macintosh-HyperCard sessions and two Humanities sessions. And, during the fourth week, they attended eight Macintosh-HyperCard sessions and no Humanities sessions. Pre-treatment data were collected in the afternoon session of the first day of the academy; post-treatment data were collected in the morning session of the last day of the academy.

Analysis of the Data

Paired t-tests were performed to determine pre-treatment to post-treatment differences in (a) the influence of the art, music, science, history, technology, and literature on their assigned decade and (b) the cumulative influence of each single factor on the other factors to determine the interrelatedness of the factors. If the procedure used to determine the cumulative influence produced significant differences, then t-tests were also conducted to determine the influence of each single factor on the other factors, in order to determine the dominating factors.

RESULTS AND DISCUSSION

Influence of Single Factors

There was a significant increase in their perceptions of how certain factors singly influenced their assigned decade: $t(12) = -2.86$, $p = .014$. The pre-treatment mean was 11.85; the post-treatment mean was 13.39. The range was 0 to 18.

Influence of Single Factors on Each Other

There was a significant increase in their cumulative perceptions of how each factor affected other factors: $t(12) = -2.79$, $p = .02$. Due to the significant cumulative perceptions, t-tests were run on each factor and its interrelatedness to the other five factors. There were significant pre-treatment to post-treatment differences in their perceptions for the following factors: (a) history ($t[12] = -2.24$, $p = .045$); (b) science ($t[12] = -2.2$, $p = .049$); and (c) technology ($t[12] = -2.2$, $p = .049$). (See Table 1 for means.) There were no significant pre-treatment to post-treatment differences for the following factors: (a) art ($t[12] = .75$, $p = .47$); (b) music ($t[12] = -.52$, $p = .61$); and (c) literature ($t[12] = .61$, $p = .55$). The range for each factor was 0 to 15.

The programming of decade-related factors apparently promoted the students' perception of how these factors were interrelated—for example, technology, especially in the Space Age, allowed certain historical events to occur, events such as the landing on the moon. Based on these findings, the three significant factors—history, science, and technology—influenced each other as well as the other factors. Conversely, the programming did not result in their seeing an increased interrelatedness of literature, art, and music: art—6.69 to 6.0; music—7.31 to 7.92; and literature—7.77 to 7.39. Although these means indicate a certain degree of influence of these factors on other factors, not only is the influence lower than the history, science, and technology means, but there is also a nonsignificant shift from pre-treatment to post-treatment. In fact, the means for literature and art decreased. The significant pre-treatment to post-treatment shifts, however, seem to support the notion that the combined HyperCard-humanities research treatment significantly increased their perception of the interrelatedness among history, science, and technology. The students, when responding to the art, literature, and music items, may have believed that these factors reflected society rather than influenced society.

Table 1. Pre- and Post-Treatment Means of Significant Interrelatedness Scores

	Cumulative	*History*	*Science*	*Technology*
PRE	*45.92*	*8.31*	*7.85*	*8.08*
POST	*52.92*	*10.85*	*9.62*	*10.15*

Increased Knowledge

There were significant increases in the number of values ($t[12] = -3.69$, $p = .003$), the number of events ($t[12] = -4.38$, $p = .0009$), and the number of social reforms ($t[12] = -2.33$, $p = .04$), from pre-treatment to post-treatment. This measure was taken to verify that the students did acquire additional information as a result of the humanities-research component of the treatment.

Descriptive Analysis of Mapping

There were pre-treatment-to-post-treatment increases in the number of factors they listed (25 versus 31), in the second-level details they provided (45 versus 51), in the third-level details they provided (4 versus 16), and in the number of relationships among the informational units (2 versus 17). The critical concerns for this measure were (a) did the students provide more detail? and (b) did they identify relationships among informational units? Although there were fairly minor shifts in the pre-treatment to post-treatment number of factors and second-level details, there were dramatic shifts in the third-level details and the relationships. The increased third-level shifts may have been due to the linking of stacks in order to provide more detailed information for the intended user. The same may have been true for the increased number of relationships; for example, by including stacks that would allow the intended user to access information on a novel that reflected a historical event—accessing stacks on *The Grapes of Wrath* while browsing through stacks on the Great Depression—may have promoted this type of change.

SUMMARY

These results of this study, for the most part, indicate that students engaging in the development of HyperCard-based programs featuring the various factors affecting the values of certain decades promotes an increased awareness of the interrelatedness of these factors. Because their perceptions of some factors were significant from pre-treatment to post-treatment and others were not, it can be assumed that these changes in perceptions were due to the linking nature of the HyperCard authoring language. This study is unique from the majority of studies on hypermedia in that the emphasis of interrelatedness centered on students as ***creators*** of such programs, rather than ***users*** of them.

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