Learning Style and Program Design in Interactive Multimedia

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This study was conducted to investigate the effects of variations in the design and delivery of interactive multimedia (IMM) on the learning and attitudes of elementary education majors. A multivariate analysis of variance was conducted with three independent variables—small group or individualized format, inductive or deductive design of instruction, and match of learner style to instruction—and four dependent variables—content scores, observation skill scores, overall satisfaction, and attitude toward learner control of instruction. Scores on the observation skills evaluation were significantly higher when the student's learning style was matched with the design of instruction. Satisfaction and attitude outcomes were significantly different for format: students in the small group were more satisfied, while those using the individual learning station were more strongly agreed that they controlled the pace and sequence of their own instruction. Content scores were not significantly different. In the future, the use of interactive multimedia with various formats and designs may serve to meet the needs of students with differing learning styles and at different developmental levels.

☐ Each new wave of educational technology advancement has raised hopes for the promotion of higher levels of achievement in student learning. In 1940, Johnson wrote about the exemplary effect moving pictures would have in history instruction. Later, programmed learning and computer-assisted instruction promised individualized instruction for students. Today, interactive multimedia (IMM), which combines videodisc with its moving sequences and still visuals with two audio tracks and a computer, is proposed as the solution to many learning problems.

Attempting to evaluate the effectiveness of various technologies presents difficulties that are not easily solved. On the one hand, small variations in isolated parts of a system can be manipulated in carefully controlled laboratories, with small numbers of individual learners, and in conformance with guidelines for scientific rigor. However, these studies often have limited applicability to the larger world. On the other hand, entire instructional systems may be evaluated in real-life educational settings. Here, some scientific rigor is sacrificed for wider applicability and overall external applicability (Ross & Morrison, 1989). Most studies of the effectiveness of various configurations of IMM focus on training for specific skills (Abrams, 1986; Basion, 1985; Bosco, 1989; Henderson & Landesman, 1989; Peterson, Hofmeister, & Lubke, 1989). More work is needed in studying the effects of broader instructional systems in the realistic environment of the university.

To expand the research related to IMM, it is necessary to consider factors that might influence learning, such as the design of instruction, the format for learning, and the match of learning style to instruction.

DESIGN OF INSTRUCTION

Instruction can be designed to involve the learner in an inquiry process in which facts are gathered from data sources, similarities and differences among facts are noted, and concepts are developed. In this process, the instructional program serves as a facilitator of learning for students who are working to develop their own answers to questions (Borich, 1988; Ellis, 1991).

On the other hand, instructional programs can present concepts with clear definitions followed by clear examples. An advance organizer—the conceptual overview of material—is presented ahead of a learning task. This advance organizer is at a higher level of abstraction and inclusiveness than the learning task itself and is designed to make learning meaningful and efficient (Ausubel, 1977).

FORMATS FOR LEARNING

Individualized and cooperative group learning have been identified as possible structures for organizing learning. Both provide ways to provide goal structures that determine the interactions between the instructional program and the student, and between students.

In an individualistic pattern, there is no relationship between one person's goal or learning outcome and another's. Each learner is rewarded for his or her individual achievement, with evaluation being based on set standards. This has often been a pattern for computer-assisted programs designed to teach specific skills (Glasser, 1986; Johnson & Johnson, 1985).

In a cooperative small group environment, there is positive interdependence among group members as all work toward a common goal. There is a balance between task functions, such as managing the group and developing summaries, and maintenance functions, such as making sure all members participate and offer encouragement to each other (Bossert, 1988; Johnson & Johnson, 1985; Slavin, 1988).

MATCH OF LEARNER STYLE AND INSTRUCTIONAL PROGRAM

At the college level, understanding learning styles including developmental levels has been considered a viable way to encourage decision making about instruction. The developmental research as well as research related to learning styles have begun to influence methods used in instruction.

Adult learners move in developmental stages from directive, right/wrong orientations to more relativistic positions based on evidence. Finally, they are able to make commitments to various positions while recognizing relativism (King, Kitchener, Davison, Parker, & Wood, 1983; Moore, 1983; Perry, 1970). Further, adult learners may think in abstract conceptual, concrete experiential, reflective observational, or active experimental ways (Knefelkamp & Cornfeld, 1983; Kolb, 1976, 1981). Instructional models that meet the needs of adult students at different developmental levels and with different approaches to learning tasks have begun to be implemented (Herbster, 1987; Jones & Van Valkenburgh, 1987; VanCleaf, 1988).

IMM AND FACTORS AFFECTING LEARNING

Little research has been completed on IMM and the above-mentioned factors that may affect learning in teacher education. Of the research that has been done, instructional design that considers individual and small group instruction has been related to behaviorist, cognitivist, and constructivist paradigms (Seels, 1989). Concerns remain, however, about the effects of IMM, particularly its ability to accommodate different learning styles (Kerka, 1989).

Thus, the study reported here is a necessary step in the effort to understand the effects of IMM and the role that it might play in teacher education. The study includes consideration of (1) the design of instruction, (2) formats for learning, and (3) match of learning style to instruction. Further, the effects on learners' (1) concept learning, (2) observational skill learning, (3) overall satisfaction, and (4) attitudes toward aspects of instruction are related to the above variables.

METHOD

Subjects

Fifty-three students (subjects) in a third field experience course of an elementary teacher education program were involved in the study. Eleven percent of the subjects were male and 89% were female, a proportion that is not atypical in elementary education. All subjects were under 30 years of age.

Subjects had completed their liberal education requirements and two previous field experience courses in which they spent up to ten hours a week in classrooms and had three hours of class on campus. The students had learned and practiced basic concepts in planning, management, professional behavior, and ethics in these classes. During the third field experience class in which this study took place, students learned about and practiced principles of small group and individualized learning and integrated unit planning.

Procedures

Subjects first took a learner survey to determine their learning style. This survey included 25 statements with a Likert scale. A factor analysis of the responses yielded two groups: those students who wished to be told what to do with clear directions—deductive learner style—and those students who wished to create their own concepts after considering many examples—inductive learner style. Style scores were based the numerical totals from the Likert scale responses for the deductive and inductive clusters of questions. (See Carlson & Falk, 1986, for further explanation of the learner survey.)

Next, all subjects engaged in eight one-hour instructional sessions over a two-week period. Two clusters of subjects used the small group format, with a peer manager who kept the small group on task, helped the group members summarize information, and then entered group responses into the computer program that controlled the videodisc. Two clusters of subjects used the individualized format, with a peer manager who kept individuals on task and assisted with any hardware problems.

Within both the small group and the individualized formats, the design of instruction for one cluster of subjects was inductive and the design of instruction for the other cluster of subjects was deductive. In the inductive design, the subjects first saw examples and then developed concepts. In the deductive design, the subjects first learned concepts and definitions and then saw specific examples. The above variables were incorporated into a completed crossed design with random assignment of subjects to instructional systems.

Two weeks after the conclusion of instruction, a content test, an observation skills evaluation, and an attitude inventory were administered. Subjects were asked to rate their overall satisfaction with the quality of instruction. Subjects were also asked to describe, in narrative form, what were the most effective and least effective characteristics of the instruction.

Materials

The videodisc contained samples of group behavior which had been recorded on videotape and mastered onto videodisc. A college class group offered examples for learning basic concepts about group behavior and formed the instruction section of the instructional program. Group interactions on the videodisc also included those in an elementary cooperative group, a parent education group, and a senior citizens' group. These examples offered subjects an opportunity to review the basic concepts and to practice their observational skills. When the learner "became" a member of a search committee for an educational organization through a videodisc simulation and was forced to make decisions which affected the committee's functioning, an opportunity was offered for applying the concepts learned. A computer program was developed to accompany the videodisc. All of the instruction in this study taught the same content and used the same videodisc examples.

Two constellations of hardware were used. For the small group instruction, the videodisc was used with a MacView Projector, a Hypercard program, a monitor, a videodisc player, and a Macintosh computer. Used in the individual instructional format was a Digital Equipment Company videodisc learning station with touch-screen monitor, computer, videodisc player, and earphones. Learners worked through the program provided with computer text and graphics on the monitor.

Criterion Measures

Concept and Observation Skills Evaluation

The concept test and observation skills evaluation tools were based on the instructional objectives. This paper-and-pencil concept test included 25 multiple-choice and matching items related to task functions (8 items); maintenance functions (8 items); and group goal structures (9 items). In the observation skills evaluation, a videotape segment of a real elementary learning group (not seen prior to the evaluation) was viewed by the subjects, and the subjects were asked to tally and label the task and maintenance behaviors used by the elementary pupils and describe the goal structure used. Numbers of correct responses were totaled for each subject, with a maximum score of 18 possible.

Construct validity and content validity for these tools were determined in the following way. Basic concepts, selected from the theories of experts such as Johnson and Johnson (1982, 1985), Schmuck and Schmuck (1971), and Slavin (1988) formed the structure for the construction of test items. Questions were systematically written to represent each aspect of small group learning theory. These were reviewed by a professor skilled in group dynamics.

Reliability of the evaluation tools was determined by using the Kuder-Richardson formula. For the concept test, the reliability coefficient was .82. For the observation skills evaluation tool, the reliability coefficient was .71.

Attitude and Overall Satisfaction

Included in the attitude survey were 16 statements related to the quality of the instructional design. Subjects rated each item on a Likert scale from 1 (strongly agree) to 5 (strongly disagree). For example, a subject would be asked to respond to an item such as "I had control over the pace and sequence of instruction." Subjects were also asked to rate their overall satisfaction with the instruction from 1 (high) to 7 (low). Items in this tool were adapted from college-developed attitude surveys for computer-assisted instruction (Carlson & Falk, 1989).

Open-Ended Questions

Subjects were asked to respond to two open-ended questions: "What was most effective about the instruction?" and "What was least effective about the instruction?"

Data Analysis

The means and standard deviations for content, observation skills, attitude (pace and control over instruction), and satisfaction with format (individualized and small group); for design of instruction (inductive and deductive); and for match of instruction to style (matched and unmatched) were calculated using the SPSS Frequency program. Open-ended responses were summarized and tallied by a student assistant who did not know the identity of the subjects.

Prior to using SPSS Multivariate Analysis of Variance (MANOVA), evaluation of the following was satisfactorily completed: multivariate normality, multivariate outliers, homogeneity of variance-covariance matrices, linearity, and multicollinearity. The multivariate analysis of variance included the use of the Wilks' criterion to determine how combined dependent variables were affected by the independent variables and their interactions. To investigate the effects of each main effect and interaction on the individual dependent variables, a stepdown analysis was performed on the basis of an *a priori* ordering of the importance of the dependent variables. Each dependent variable was analyzed in turn, with higher-priority dependent variables as covariates. Dependent variables were tested using univariate analysis of variance. Homogeneity of regression was achieved for all components of the stepdown analysis. η^2 was calculated to show the strength of association between the independent variable and the dependent variable for which it showed a significant relationship.

A between-subjects multivariate analysis of variance was performed on the four dependent variables: observation, attitude toward control over pace and sequence of instruction, overall satisfaction, and content. Independent variables were format (individualized and small group); design for instruction (inductive and deductive); and match of learning style and design of instruction (matched and unmatched). The order of entry for the independent variables was match, format, and design. No multivariate outliers were identified. Four of the 53 cases were dropped due to missing values.

RESULTS

The means and standard deviations for the two levels of each independent variable are shown in Table 1 for all four criterion variables. The MANOVA revealed that the combined dependent variables were affected significantly by match of learner style to instruction and by group/individual format, but not by inductive/deductive design of instruction.

Significant differences for match were obtained on the observation measure, stepdown $F(1,41) = 3.94, p < .01, \eta^2 = .13$. On the observation measure, the mean score of 13.87 for subjects whose style was matched to the design of instruction was significantly higher than the score of 11.55 for subjects whose style was not matched.

Significant differences for format were obtained for attitude, stepdown $F(1,40) = 11.42$, $p < .01, \eta^2 = .18$, and for satisfaction, stepdown $F(1,39) = 16.43, p < .01, \eta^2 = .13$. Subjects in the individual program ($\bar{x} = 1.94$) agreed more strongly that they had control over the pace and sequence of instruction than did those in the small group ($\bar{x} = 2.93$). Nevertheless, subjects in the small group ($\bar{x} = 2.50$) were significantly more satisfied than those using the individual program (3.25).

No other significant differences were found among variables.

Results from Questions about Effective and Least Effective Aspects of Instruction

Responses of subjects to the open-ended questions indicated some important differences.

TABLE 1 ☐ Mean Scores and Standard Deviations on Criterion Measures (standard deviations in parentheses)

		CRITERION MEASURES			
Variable	*Level*	*Concepts*	*Observation*	*Attitudes*	*Satisfaction*
Match	Matched	17.48 (4.03)	13.87 (3.35)	2.39 (.96)	2.84 (.93)
	Unmatched	17.59 (2.82)	11.55 (2.89)	2.48 (.81)	2.91 (1.11)
Design	Inductive	17.59 (2.87)	12.42 (2.89)	2.59 (1.01)	2.86 (.83)
	Deductive	17.50 (2.87)	13.00 (3.83)	2.26 (.69)	2.88 (1.19)
Format	Small Group	17.93 (3.20)	13.27 (3.20)	1.94 (.87)	2.50 (.80)
	Individual	17.15 (2.75)	12.16 (3.33)	2.93 (.73)	3.25 (.87)

Some reactions were true whether subjects' learning styles were matched or unmatched with design of instruction. For example, subjects across all groups reported that instruction was effective because they learned the difference between task and maintenance functions (10 subjects); that they enjoyed interactions with new technologies (25 subjects); that they benefited from working with peers (7 subjects); and that they enjoyed the realistic examples of behavior (10 subjects). Subjects in both groups reported that instruction was ineffective when there were technical problems with the equipment (5 subjects) and when they lacked control and pacing over the instruction (5 subjects).

Differences between matched and unmatched groups arose primarily in reaction to the design and format. Inductive learners in inductive groups found instruction effective when they created their own labels and then heard expert response (6 subjects). Deductive learners in deductive groups valued the definitions given in glossaries and on video and the specificity of the steps of instruction (5 subjects). In contrast, deductive learners in inductive design groups, in commenting about what was least effective about the instruction, found that the objectives were not clearly stated (4 subjects), that the instructional programs needed clarification (7 subjects), and that they had difficulty in creating their own labels for behaviors (8 subjects). On the other hand, inductive learners in deductive groups stated that the instructional program was repetitious and lacked flexibility (4 subjects) and that they had difficulty in keeping motivated (7 subjects).

DISCUSSION

This study indicates that IMM provides one way to learn basic concepts. In this study, in which all subjects had systematic (either inductive or deductive design) instruction using the realistic, visually appealing examples portrayed on videodisc, there were no significant differences in scores on content tests, and the mean content scores were comparable to the highest mean content scores in previous studies using IMM (Carlson & Falk, 1989, 1990–91).

What is of great interest in this study is the finding related to observation scores. Here, significantly higher observation scores were attained by learners whose style was matched to design of instruction. It is important to consider what is involved in observation, at least as evaluated in this study. Subjects needed to be able to clearly describe types of behavior and then recognize those behaviors when they appeared in the context of real group interaction. Interpretation of the observation results was also required. It appears from student comments that an inductive learner in deductive instruction did not have sufficient opportunity to intellectually engage in and digest the information and derive meaningful personal categorizations. A deductive learner in inductive instruction was likely to become frustrated and lose attention when the instruction seemed unclear, with consequent loss in opportunities for instruction. It seems that visually engaging examples of IMM are not sufficient to overcome the barriers that arise when learning styles are not matched with design of instruction, at least in the area of developing observation skills.

Subjects in the small group were significantly more satisfied with instruction than were those who worked individually. Although these small-group subjects reported in response to the open-ended questions that they felt a lack of control over the pace and sequence of their instruction, and indicated this in the attitude survey as well, they also described the positive nature of the interactions with other learners. Perhaps the need for human interaction and reaction is of greater importance than learner control of instruction through sophisticated computer programs. The combination of interpersonal interaction with IMM seems to be most acceptable, at least in this study.

This study is a small step in the investigation of the effectiveness of new IMM in teacher education. Based on what has been learned here, the use of small groups with IMM has positive effects in terms of satisfaction with instruction. Matching learning style with the design of instruction is of importance with regard to both achievement and attitudes.

Many questions remain that must be studied in the future. Replications of studies such as the present one could support or refute the conclusions drawn here. The use of more sophisticated surveys of learning style and more minute evaluations of observation skills acquisition could lead to a deeper exploration of how various IMM configurations affect different types of learners. Purposefully using instruction unmatched to style and guiding learners to analyze their interactions could be beneficial. The relationship of this instruction to in-class group learning experiences could be explored. Ratings of learners' actual facilitation of small group learning in elementary classrooms also need to be explored. Learners could create open-ended, personalized visual essays using IMM, and comparative evaluations of outcomes from these experiences and those stemming from small group learning could be conducted. These are but a few of the many possibilities for future study.

At present, the use of IMM could be considered as a force in teacher education. Basic concepts can be learned. Observation skills can be developed through designs that involve peer discussion about video examples and through matching learning style with the design of instruction. Satisfaction can be achieved through combining the videodisc technology with small groups who use peer managers. Thus, the questions become more subtle. What types of IMM instruction need to be developed for which outcomes needed in teacher education? What variations need to be made for students with differing learning styles and at different developmental levels? What provisions need to be made to allow students to explore instructional designs unmatched to their style? The effort to develop instructional programs to answer these questions and to evaluate their effectiveness will continue far into the future. □

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